# EFFECT OF WEANING AGE AND FEEDING SYSTEM ON GROWTH PERFORMANCE AND SERUM BIOCHEMICAL PROFILE OF NELLORE (JODIPI) MALE LAMBS

*By*
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*Thesis submitted to the*
**SRI VENKATESWARA VETERINARY UNIVERSITY**
*in partial fulfillment of the requirements*
*for the award of the degree of*

## MASTER OF VETERINARY SCIENCE

*In the faculty of veterinary science*

**DEPARTMENT OF LIVESTOCK PRODUCTION AND MANAGEMENT**
**COLLEGE OF VETERINARY SCIENCE**
**SRI VENKATESWARA VETERINARY UNIVERSITY**
**TIRUPATI – 517 502**

**SEPTEMBER, 2014**

# CERTIFICATE

**M.JAYASREE** *has satisfactorily prosecuted the course of research and that the thesis entitled* **"EFFECT OF WEANING AGE AND FEEDING SYSTEM ON GROWTH PERFORMANCE AND SERUM BIOCHEMICAL PROFILE OF NELLORE (JODIPI) MALE LAMBS"** *submitted is the result of original research work and is of sufficiently high standard to warrant its presentation to the examination. I also certify that the thesis or part thereof has not been previously submitted by her for a degree of any university.*

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Place : Tirupati

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# CERTIFICATE

*This is to certify that the thesis entitled* **"EFFECT OF WEANING AGE AND FEEDING SYSTEM ON GROWTH PERFORMANCE AND SERUM BIOCHEMICAL PROFILE OF NELLORE (JODIPI) MALE LAMBS"** submitted *in partial fulfillment of the requirements for the degree of* ***MASTER OF VETERINARY SCIENCE*** *of the Sri Venkateswara Veterinary University, Tirupati, is a record of the bonafide research work carried out by* **M.JAYASREE** *under my guidance and supervision. The subject of the thesis has been approved by the Student's Advisory Committee.*

*No part of the thesis has been submitted by the student for any other degree or diploma. The published part has been fully acknowledged. All assistance and help received during the course of the investigation have been duly acknowledged by the author of the thesis.*

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# DECLARATION

I, ***M.JAYASREE,*** hereby declare that the thesis entitled **"EFFECT OF WEANING AGE AND FEEDING SYSTEM ON GROWTH PERFORMANCE AND SERUM BIOCHEMICAL PROFILE OF NELLORE (JODIPI) MALE LAMBS"** submitted to Sri Venkateswara Veterinary University, Tirupati for the degree of ***MASTER OF VETERINARY SCIENCE*** is the result of original research work done by me. I also declare that the materials contained in this thesis have not been published earlier.

**Date:** **(M.JAYASREE)**

# ACKNOWLEDGEMENTS

*I earnestly revere the almighty for his boundless blessings, which accompanied me in all endeavours.*

*I place my profound etiquette and heartfelt thanks to my Chairman of Advisory Committee* ***Dr.G.Gangaraju,*** *Associate Professor, Department of Instructional Livestock Farm Complex, C.V.Sc, Tirupati for his continuous help, valuable guidance, constructive suggestions and endless encouragement given generously during the course of investigation and in the completion of my thesis.*

*I am pleased to place my profound etiquette and heartfelt thanks to* ***Dr. K. Sarjan Rao*** *,Professor and University Head, Department of Livestock Production and Management, College of Veterinary Science, Rajendra Nagar member of Advisory committee, for his kind advise, timely guidance and deliberate counsel during the period of investigation.*

*I am extremely thankful to* ***Dr. B. Ekambaram,*** *Principal Scientist, Livestock Research Station, Palamaner member of Advisory committee for his meticulous guidance, constant encouragement, keen interest, transcendent suggestions and kind treatment during every phase of my experimental work and in the compilation of this thesis.*

*I wish to express my deep sense of gratitude and profound thanks to* ***Dr. J. Suresh,*** *Professor and head, Department of LPM, C.V.Sc, Tirupati for his valuable and inspiring guidance, untiring help and sparing time in preparation of the thesis are invaluable.*

*I wish to express my abysmal thanks to* ***Dr.A.Ravi*** *Associate professor, department of Animal Nutirition, C.V.Sc, Tirupati for his noble ideas, meticulous guidance, constant encouragement, constructive criticism, keen interest, transcendent suggestions and kind treatment during the course of investigation. It was indeed a rare privilege for me to work under his unending inspiration.*

*I wish to convey my sincere thanks to* ***Dr.B.Rangamma,*** *Assistant professor, C.V.Sc, Tirupati for her continuous encouragement and cooperation during the period of my Post Graduation.*

*I am highly thankful to* ***Dr. D. Srinivasa Rao,*** *Professor and University Head (Animal Nutrition), Dept. of ILFC and* ***Dr. M. Rajesh,*** *Assistant Professor, A.H.P. Palamaner, for their valuable suggestions and guidance during my study period.*

*I owe my effusive thanks to* ***Teju, Shanmukhi, Bhargavi, Mohana, Hema, Dhyana, Pavani, Nimmi, Radhika, Rama devi, Mounika, Sireesha, Jyothsna, Vijay, Vamsi, Kartik, Vikram, Harin and many more*** *for their encouragement and friendly guidance.*

*I affectionately acknowledge the help rendered by my senior* ***Lavanya*** *and Juniors* ***Abilash & Swathi.***

*It is time to surface out my genuflect love and affectionate gratitude to my beloved parents* ***Rajeswari*** *and* ***Sankaraiah*** *whose boundless love, unparalleled affection, moral support is a constant source of motivation for me in shaping up my career. Here, I wish to express my deep sense of propinquity for my brother* ***Vishnu Prasad*** *and sister* ***Vishnu Priya*** *for their affection, encouragement and cooperation which cannot be described in words.*

*I reserve a special bouquet of thanks for* ***Sreenivasulu*** *my father's elder brother who constantly educated, guided and moulded me into present position and for his untiring support, help, care and constant encouragement without which this endeavor could not be accomplished.*

*I affectionately and heart fully acknowledge the help, support and love rendered by my family members* ***Jagadeesh, Monish, Durga, Ravi Shankar, Ravi, Nagrathna, Shankar, Madhu babu.***

*The cooperation of* ***Hari Krishna, Amrutha*** *and* ***Divya*** *Veterinary Assistants and* ***Bala Krishna*** *worker in Livestock Research Station is indeed acknowledged.*

*My thanks to A.H.Polytechnic students especially Ramesh, Jyothi, Harshini, Kaveri and shepherds who helped me during my experiment.*

*I am thankful to* ***Vijaya Bhaskar Reddy*** *for his cooperation in laboratory analysis.*

*I express my heartfelt thanks to* ***Venkatamma, Muneedra and Mahesh*** *for their good co-operation during my study period.*

***(M.JAYASREE)***

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## LIST OF ABBREVIATIONS

| | | |
|---|---|---|
| FAO | - | Food and Agriculture Organization |
| % | - | Percentage |
| g | - | gram |
| dl | - | deciliter |
| NRC | - | National Research Council |
| AOAC | - | Association of Analytical Chemists |
| kg | - | kilogram |
| DM | - | Dry matter |
| OM | - | Organic matter |
| CP | - | Crude protein |
| CF | - | Crude fibre |
| EE | - | Ether extract |
| NFE | - | Nitrogen free extract |
| ADG | - | Average Daily Gain |

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**Title of the thesis** : EFFECT OF WEANING AGE AND FEEDING SYSTEM ON GROWTH PERFORMANCE AND SERUM BIOCHEMICAL PROFILE OF NELLORE (JODIPI) MALE LAMBS

**Degree to which it is submitted** : MASTER OF VETERINARY SCIENCE

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**Year** : 2014

## ABSTRACT

A study on the effect of weaning age and feeding system on growth performance and serum biochemical profile of lambs was carried out in Nellore male lambs. In addition the body weight changes of ewes and resumption of ovarian cyclicity in ewes was also studied. The experiment was carried out in ICAR Network Programme on Sheep Improvement at Livestock Research Station, Palamaner, Chittoor district, A.P.

Forty eight Nellore lambs with an average body weight of 3.24 ± 0.04 kg were selected and were randomly distributed into four treatments of twelve animals each in four systems of rearing. The four treatments may be described as follows:

T-1, lambs fed milk plus concentrate creep and weaned early at 2 months of age

T-2, lambs fed milk plus concentrate creep and weaned at 3 months of age

T-3, lambs fed milk plus concentrate creep and weaned lately at 4 months of age

T-4, lambs fed milk only and weaned at 3 months of age (control).

The study revealed that there was a significant difference ($P<0.01$) among the treatments with regard to body weights recorded from weaning to 24th week. Further lambs in treatments T-2 and T-3 have recorded higher body weights at different weeks starting from weaning to 24 weeks.

The mean total weight gain of lambs was 14.67 ± 0.49, 19.25 ± 0.59, 17.99 ± 1.27 and 13.14 ± 0.93 kg, respectively for T-1, T-2, T-3 and T-4 treatments. The pre weaning weight gain and total weight gain of lambs were significantly ($P < 0.01$) higher for T-2 and T-3 than T-1 and T-4 (control) treatments. The post weaning weight gain of lambs was significantly ($P<0.01$) higher in T-1 (6.00 ± 0.42) and T-2 (6.71 ± 0.25) than T-3 (3.78 ± 0.34) and T-4 (3.56 ± 0.68) treatments. The overall average daily gain for T-1, T-2, T-3 and T-4 treatments were 81.52 ± 2.71, 106.95 ± 3.28, 99.95 ± 7.05 and 73.10 ± 5.17 g, respectively and significant ($P < 0.01$) difference was observed among the treatments.

The mean body length of male lambs at birth were 30.17 ± 0.58, 30.08 ± 0.40, 29.58 ± 0.42 and 29.33 ± 0.58 cm for T-1, T-2, T-3 and T-4 treatments, respectively. There was a significant ($P < 0.01$) difference between the treatments with regard to body length of lambs at all ages except at birth. Significant ($P < 0.01$) difference was also noticed at weaning and 6 months between the treatments with regard to height of lambs. There was a significant ($P<0.01$ at weaning and 6 months) difference between the treatments with regard to chest girth of lambs at all ages except at birth and at 2 months which did not differ significantly. The paunch girth of lambs differed significantly ($P < 0.01$) at weaning and at 6 months age.

The mean serum glucose levels (mg/dl) were 50.36 ±1.58, 36.45 ± 2.24, 36.21 ± 1.41, 49.18 ± 1.71, 56.53 ± 1.30, 60.66 ±1.49 and 62.29A ±1.75 for zero to six days post weaning, respectively. The mean serum protein (mg/dl) content of ram lambs among treatments was also not significant and values were 6.63 ± 0.12, 6.72 ±

0.12, 6.63 ± 0.10 and 6.53 ± 0.11 in T-1, T-2, T-3 and T-4, respectively. Post weaning serum urea levels (mg/dl) on zero to six days was not significantly different.

The percent of ewes returned to oestrus was found to be 88.89%, 87.50%, 90.91% and 90.91% for the treatments T-1, T-2, T-3 and T-4, respectively. Resumption of ovarian cyclicity after parturition was significantly ($P<0.01$) lower in T-1 than other treatments which were comparable.

The weights of the ewes at fifth month were significantly ($P< 0.01$) higher in T-1 than other treatments which do not differ significantly among themselves. The weights of the ewes at sixth month were significantly ($P< 0.05$) higher in T-1 than other treatments which were comparable.

The length of ewes at lambing were significantly ($P < 0.01$) higher in T-2 compared to other treatments. The length of ewes at 2 months and at weaning were significantly ($P < 0.05$) higher in T-2 compared to other treatments. The mean height of ewes differ significantly ($P < 0.01$) among treatments at various ages. The mean chest girth of ewes at 6 months differ significantly ($P < 0.05$) and it was lower in T-3 than other treatments. The paunch girth of ewes differ significantly ($P < 0.01$) among treatments at weaning and at 6 months age.

An attempt was made to estimate cost of production of lambs from birth to six months of age. Cost per animal was found to be Rs.1791.82/-, Rs.1693.20/-, Rs.1595.82/- and Rs.1576.18/-, respectively for the treatments T-1, T-2, T-3 and T-4. T-2 and T-3 recorded lower costs per kg weight gain of Rs. 87.96/- and Rs. 88.71/- while T-1 and T-4 recorded Rs. 122.14/- and Rs.119.95/-, respectively.

There was 8.33 % pre weaning mortality in treatment T-4 where as T-1, T-2 and T-3 recorded zero percent mortality. T-4 recorded 18.18% post weaning mortality whereas in treatments T-1 and T-2 the mortality was 8.33 %. There was zero percent mortality in T-3.

# CHAPTER I
# INTRODUCTION

Livestock and rural economy in India have been intricately woven into each other since time immemorial. Down through the centuries, rearing of sheep and goats has remained a subsidiary occupation of a vast segment of the rural population in India. A comparative study of ovine rearing and that of bovine in ecologically fragile zones indicate that within the desired grazing pressure, ovines are more economical and less harmful than the large ruminants. It is no wonder that sheep and goat constitute an inseparable part of the agricultural ecosystem in India.

The sheep and goats in India are mostly reared by the landless labourers and marginal farmers who are considered as the socially and economically disadvantaged sections in the rural society. About five million families are estimated to be engaged in various activities related to rearing of sheep and goats utilising their products. It provides gainful employment and income to the weaker sections especially to the rural poor. Many surveys had shown that on an average a small ruminant gives a return of Rs.120-200 per animal. Sheep with its multi facet utility (for wool, meat, milk, skins and manure) is an important rural economy in India. The annual contribution of sheep and goat was estimated to be Rs.10,087.45 crores to the Indian economy constituting about 5.40 per cent GNP of agriculture sector (FAO, 2004).

In spite of enormous technological advancement efforts made for livestock improvement, the status of sheep rearing still remains in its primitive form when compared with the progress in dairy and poultry sectors. Majority of people involved in rearing of sheep practice age-old traditional systems of rearing without the knowledge of scientific methods.

India's vast genetic resources in sheep are reflected by the availability of 42 breeds of sheep with 65 million sheep which is 12.71 % of total livestock population (19th Livestock Census, 2012). Singh (2007) reported that sheep in India contributed 2.92 per cent of the meat, 2.39 per cent of the wool and 3.24 percent of the skin produced in the world.

The sheep population in Andhra Pradesh state is 263.95 lakhs (19th Livestock Census, 2012) which accounts for 40.57 per cent of country's total sheep population. This accounts for 47.05 per cent of total livestock and 74.42 per cent of total small ruminants of the state. More than 7.06 lakh farmers in Andhra Pradesh are depending on sheep rearing activity. Nellore breed is a popular mutton type breed in Andhra Pradesh that has been least represented and no systematic studies have been conducted to assess the factors that favour optimal growth in young lambs.

The present investigation aims at studying the weaning stress in lambs since it is considered responsible for low productivity in addition to other environmental stresses. The weaning may be stressful period in lamb's life and is often characterized by slowing, stoppage of growth or loss of weight gain. The magnitude of stress at weaning depends on age and weight of lambs at weaning as well as on diet and feeding modalities before weaning. Intake of solid feed before weaning also affects the weaning shock. Male lambs are more susceptible to weaning shock than female lambs. Creep feeding to lambs is a very common practice in scientific rearing of sheep which improves weaning weights by 10-20%. Additionally, it allows for a smoother transition on to different types of feeds during the post-weaning period. Thus the lamb can support early weaning as it can adopt for new feeding system as early as possible. The poly oestrus behaviour of ewes in tropical area can be utilized efficiently by separating their lambs from their dams to remove the adverse effect of

suckling on dam, for early return to post partum oestrus. Hence, the present study is conducted to assess and compare the influence of weaning age and feeding system on the efficiency of production from early, natural and late weaned Nellore lambs reared under intensive system of management.

The present study was taken up with the following objectives to study the effect of weaning age and feeding system on

1. Growth performance of lambs
2. Serum biochemical profile of lambs
3. Ewes body weight and postpartum oestrus
4. Economics of lamb production

# CHAPTER II
# REVIEW OF LITERATURE

## 2.1 LAMB MANAGEMENT

Olthoff and Boylan (1991) in a study on Finn sheep to determine their potential in commercial sheep production and found that the lambs reared by ewes generally grew faster than nursery-reared lambs.

Padmanabhan (1994) in a study conducted in Salem and Dharmapuri districts of Tamilnadu to analyse economics of sheep farming reported that in Mecheri block of Salem district lambs are taken care for 2 months period and were kept at home and afterwards they were released into the flocks. Some of the farmers fed the lambs with eggs, green leaves of neem and other trees and grasses.

Napolitano *et al* (1995) evaluated the influence of artificial rearing at different ages in Comisana lambs and reported that early separation from the ewe affects humoral immune response and post-separation performance of lambs as a possible consequence of reduced ability of young animals to cope with emotional and nutritional stresses.

Mears and Brown (1997) in a study to evaluate the potential use of hormones to measure stress responses concluded that lambs separated from their mothers vocalize to show their displeasure.

Orgeur *et al* (1999) performed a study on Ile-de-France ewes and their lambs to measure the behavioural consequences of two types of sudden weaning: total separation (TS) and partial separation (PS) which revealed that regardless of the separation procedure, lambs vocalized significantly more than mothers on the day of weaning.

Napolitano *et al* (2003) in an experiment to assess the effects of 4 maternal deprivation or prevented suckling on lambs found that, lambs reared with

their mothers become accustomed to solid feed more rapidly than artificially reared lambs.

Sevi *et al* (2003) in their study to compare the weight gains of artificially reared lambs which were gradually separated or abruptly separated from their mothers found that lambs subjected to a gradual separation exhibited a more rapid approach to and a higher intake of solid feed than did the lambs that were abruptly removed. They suggested that a gradual separation from the mothers adversely affected behavioural, immune and endocrine responses of artificially reared lambs.

Gauly *et al* (2004) conducted a study to assess the effect of four different production systems on daily weight gain reported that the process of separation at weaning can induce some stress for lambs.

Sahana *et al* (2004) in an experiment to study the characteristics of Jalauni sheep under field conditions reported that lambs were kept in farmers' house for about 15 days from birth and later allowed with flock for grazing.

Dixit *et al* (2005) observed that lambs suckled their mother upto 2 months of age and then were sent to graze along with the mother in Rampur Bushair sheep flocks of Jammu And Kashmir State.

Rajapandi (2005) in a study on management practices of Coimbatore sheep observed that lambs were kept in during day time up to 20 days and nourished only by suckling and later the lambs were sent for grazing along with the flock.

Thiruvenkadan *et al* (2007) after studying the management practices followed by shepherds in Tamilnadu reported that 50% of farmers sent the lambs for grazing immediately after 1 day of lambing.

Schichowski *et al* (2008) in a study conducted to the evaluate the effects of age at weaning reported that 16 wk old lambs are more accustomed to a separation

from the mother than younger lambs and progressive natural weaning has very little apparent negative consequences on social groups of ewes and lambs.

Chandran *et al* (2009) conducted a survey on management practices of Vembur sheep in Tamil Nadu and reported that the lambs were maintained on ewe's milk up to 1 month and there after they were fed with cooked grains. They further reported that the lambs were maintained on *Cyprus rotundus* grass for 1-3 months before they were allowed for grazing

## 2.2 BODY WEIGHTS

Mejia *et al* (1991) in a study on performance of African hair sheep in intensive production system reported that, the mean birth weight of lambs was 2.32 ± 0.52 kg and weaning weight was 14.9 ± 2.62 kg. Further the pre-weaning growth rate of lambs was recorded as 106±34 g/day (n=84) for a weaning age of 129±46 days and mortality was recorded at the rate of 10.4% from birth to weaning.

Based on the data collected from the breeding tract of Nellore sheep reported Prasad *et al* (1991) that the overall mean weight of lambs at 3 and 6 months were 11.12±0.10 and 14.92±0.11 kg, respectively.

Martins and Peters (1992) in a study to assess the overall productivity of Karakul sheep reported that the body weight of ewes in the first month post-partum was 40.8 kg while lamb weight at 150 days was 27.4 kg.

Schoeman and Burger (1992) after studying the productive performance of Dorper sheep reported that average birth, weaning (at approx. 52.8 d of age) and 100-days weights were 4.2, 18.2 and 27.9 kg, respectively.

Panneerselvam (1993) in a study on Nilgiri sheep in an organised farm reported that the body weight of lambs at 3 and 6 months were 10.16±0.09 and 14.56±0.13 kg, respectively.

Haribhaskar (1994) studied the body weights of Madras Red sheep under field conditions and reported the means for body weights of lambs for 0 to 3 and 3 to 6 months as 8.21±0.15 and 12.79±0.11 kg, respectively.

Metha *et al* (1995) conducted a survey in Rajasthan to study management practices in the native tract and reported that the body weights of Sonadi lambs at 3 and 6 months were 13.60±0.50 and 16.10±0.49 kg, respectively.

Sinha and Singh (1997) in their study on Muzaffarnagri sheep to estimate genetic and phenotypic parameters found that least squares means were 3.48 ± 0.07, 16.82 ± 0.37 and 25.16 ± 0.41 kg, for weight at birth, 3 and 6 months respectively.

Chandran (1998) in a study on characteristics and management of Vembur sheep reported that the mean body weights of lambs at 3 and 6 months were 11.89±0.24 and 16.09±0.22 kg, respectively.

Bose *et al* (1999) after studying the characteristics of Garole sheep reported that the average body weights of adult ewes was 11.31±0.33 kg .

Kushwaha *et al* (1999) conducted a survey to assess the status of Chokla sheep in farmers' flock and reported that the average body weight of males and females around 3–4 months of age were 18.70 and 17.32 kg and 6–8 months of age were 23.82 and 21.42 kg, respectively.

Dixit *et al* (2001) in a study to evaluate genetic and non-genetic influences on the body weights of Bharat Merino lambs observed that the average lamb weights were 3.1±0.03 kg at birth, 15.0±0.2 kg at 3 months, 21.6±0.2 kg at 6 months, and 29.1±0.3 kg at 12 months of age and the average daily gains were 133±1.6 and 52±0.9 g at pre- and post-weaning periods, respectively.

Rastogi (2001) conducted a study to determine the influence of lambing season, sex and type of birth on body weights of lambs and reported that the flock averages for body weights of lambs at birth, at 56 days and 6 months of age,

preweaning daily gain and mortality were 2.75, 10.8, and 19.2, 0.152 kg, and 18.3 per cent, respectively.

Boujenane (2002) investigated the body weights and survival of lambs and reported that the mean body weights at birth, 30 days and at 90 days were 2.86, 7.21, 16.4 and kg, respectively and survivability of lambs up to 90 days was 83 percent.

Pattanayak *et al* (2003) conducted a survey on breed characteristics, management practices, reproductive and growth performance of Ganjam sheep in Orissa and observed that average pooled weight at birth, 3 and 6 months of age were 2.08, 8.61 and 12.92 kg, respectively**.**

Raman *et al* (2003) surveyed the habitat and distribution of Madras Red sheep in Tamil Nadu and reported that the pooled mean body weights of lambs at birth, 3 and 6 months of age were 2.60±0.02, 11.50±0.12 and 15.82±0.18 kg, respectively. In adults, the body weights of males and females were 35.20±0.32, 23.12±0.14 kg, respectively.

Saravana kumar (2003) in a study on the performance of Nellore sheep observed that the average body weight of adult female was 30.00 ± 0.27 kg.

Sushil Kumar *et al* (2003 a) in a study to determine the production potential of Malpura sheep at an organized farm in Rajasthan observed that the overall least square means were 2.88, 11.57, 18.50, 21.74 and 25.61 kg for birth, 3, 6, 9 and 12 months, respectively.

Sushil Kumar *et al* (2003 b) recorded data on growth production traits of Malpura sheep and Kheri sheep maintained under farmers' flocks and observed that the overall least square means for birth, 3 and 6 months in Malpura sheep were 3.16, 9.86 and 15.58 kg where as the corresponding figures were 3.12, 10.81 and 15.97 kg, respectively for Kheri sheep,

Sahana *et al* (2004) conducted a study to establish the morphological characteristics and performance parameters of Jalauni sheep and reported that average adult body weights of males and females were 35.50±2.10 and 27.20±0.70 kg, respectively.

Aganga (2005) after studying the reproductive performance and growth rates of lambs reported that the average birth weight of Tswana male lamb was 2.5 and 2.09 Kg for female lambs and average body weight of lambs after 3 months was 7.15 Kg for males and 6.35 Kg for females.

Dixit *et al* (2005) in a study to characterize the Rampur Bushair sheep in north temperate region of India reported that average adult body weights of males and females were 34.70 and 26.00 kg, respectively.

Karunanithi *et al* (2005) studied the characteristics of Mecheri sheep and observed that the body weight of the animals at birth, 3, 6 and 9 months of age were 2.82±0.01, 10.9±0.1, 15.6±0.1 and 17.6±0.2 kg, respectively.

Musa *et al* (2005) in their study conducted on West African sheep at University of Nyala Farm reported that overall birth weight of males was 3.18±0.49 kg and they were weaned at approximately 3 months of age with an average body weight of 11.55±2.19kg.

Dangi and Poonia (2006) conducted a study to determine the factors affecting weaning and six months weight in crossbred sheep and found that the means of weaning and six month weight were 10.36±0.21 and 13.41±0.27 kg, respectively.

Patro *et al* (2006) in a study to determine the production potential of indigenous meat type sheep observed that the mean value for body weights at birth, 3 and 6 month of age were 1.89 ± 0.01, 6.68 ± 0.03and 10.79 ± 0.03kg, respectively.

Ajoy Mandal *et al* (2007) in a study to evaluate voluntary nutrient intake and growth performance of Muzaffarnagari lambs under intensive feeding system reported that the overall least-square means of weight at 3, 6 months and average daily weight gain (ADG) were 13.83 kg, 23.29 kg and 105.11 g, respectively.

Arora *et al* (2007) observed that average weight of adult rams was 43.28 ± 0.30 kg and that of ewes 32.05 ± 0.16 kg. and the least squares means of body weight at weaning and hogget's stage were 14.89±0.11 and 22.91±0.18 kg, respectively in a study on Jaisalmeri sheep in farmers' flocks.

Gopal Dass (2007) conducted a survey to study the performance and husbandry practices of Pugal sheep in its home tract and observed that overall least square means of body weight at birth, 3, 6, 12 months and adult weights were 2.62±0.01, 17.70±0.05, 23.67±0.09, 29.62±0.26 and 39.04±0.26 kg, respectively.

Arunkumar *et al* (2008) in a study to determine the production potential of Malpura breed reported that the average adult body weight was 40 kg in males and 30 kg in females.

Mishra *et al* (2008) in a study to evaluate the performance of Garole×Malpura (GM) half-breds observed that the overall least square means of body weights at birth, weaning, 6 and 12 months of age were 1.94±0.04, 9.84±0.26, 14.48±0.39 and 20.42±0.79 kg, respectively.

Prince *et al* (2008) studied growth performance of Chokla lambs maintained under semi-arid condition and reported that overall least square means of body weights at birth, weaning, six months of age and average daily gains during pre-weaning and post-weaning (3-6 month) were 2.74, 10.94, 17.80 kg, 91 g and 75 g, respectively.

Chandran *et al* (2009) conducted a survey on management practices of Vembur sheep in Tamil Nadu and reported that the average body weight of Vembur

lambs at 3, 6, 9, and 12 months were 11.9±0.2, 16.1±0.2, 18.7±0.3 and 22.4 ±0.5 kg, respectively and the adult body weights were 29.9±0.2 kg for females and 43.1±0.9 kg for males.

Devendran *et al* (2009) studied the characteristics of Coimbatore sheep and reported that average body weights in adults were 35.5 ± 0.5 kg in males, 24.5 ±0.4 in females and average body weight at 3 months age was 12.4 ± 0.4kg.

Mohammadi *et al* (2009) in a study to estimate body weight at different ages in Afshari sheep reported that the averages of birth weight, weaning weight and body weight at 6 months of the age were 3.26 ± 0.07, 22.02 ±0.41 and 31.94±0.62 kg, respectively.

Muhittin Ozder (2009) conducted a study to estimate genetic parameters and observed that averages for birth weight, 3 months weight, 6 months weight, 12 months weight, pre-weaning daily gain and post-weaning daily gain were 4.31±0.02, 32.4±0.36 45.1±0.43, 53.4±0.55 kg, 315±4 g and 76±2 g, respectively in Turkish Merino Lambs.

Vecihi Aksakal *et al* (2009) in a study to estimate the effect of various ages of weaning on growth performance reported that live weights at 45 days for the lambs weaned at 45, 60 and 75 days were 12.20, 11.58 and 12.47 kg, respectively and at 60 days were 14.38, 14.79 and 15.40 kg, respectively and 75 days were 15.30, 16.06 and 17.28 kg, respectively in Morkaraman lambs.

Arora *et al* (2010) conducted a study to characterize the Ganjam breed phenotypically and reported that the average body weight in males was 27.0±0.96 kg and that of females was 23.9±0.63 kg respectively.

Ashish Chopra *et al* (2010) in a study to assess the effect of non-genetic factors on growth traits of Bharat Merino sheep reported that least square means for

birth weight, 3 month weight and 6 month weight were 3.31±0.01, 15.67±0.07 and 22.39±0.10 kg, respectively.

Rathod Suresh and Sreedhar (2010) investigated effect of sex, season on performance of Nellore breed under semi intensive system and observed that overall mean body weight of lambs at birth, weaning and six months of age was 2.71±0.04, 14.51±0.09, 17.60±0.11 kg, respectively.

Mohammadi *et al* (2010) carried out a study to investigate the effects of environmental factors on pre-weaning growth traits in Zandi sheep observed that average weights were 4.23±0.012, 21.17±0.060 and 0.174±0.04 kg for Birth Weight (BW), Weaning Weight (WW) and Average Daily Gain from birth to weaning (ADG), respectively.

Balasubramanyam and Kumarasamy (2011) in a study on overall performance of Madras Red sheep reared under field conditions observed that the overall birth weight, 3-month and 6-month body weights were 2.82 ± 0.004, 10.96 ± 0.023 and 15.24 ± 0.022 kg, respectively.

Gbangboche *et al* (2011) in a study to evaluate the genetic parameters of monthly weights of West African Dwarf sheep from birth to 180 days reported that the average weights at birth, 30 days, 60 days, 90 days, 120 days, 150 days and 180 days weight were 1.93±0.02, 4.25±0.06, 7.60±0.12, 10.97±0.12, 13.58±0.15, 14.85±0.20 and 17.30±0.21 kg, respectively.

Balasubramanyam *et al* (2012) carried out a study to estimate the genetic and phenotypic parameters and trends for different body weight traits of Madras Red sheep and reported that the overall average body weights at birth, 3 and 6 months of age were 2.76, 9.90 and 14.53 kg respectively.

Ganesan *et al* (2013) in a study to evaluate growth performance of Madras Red sheep reported that the overall mean body weights at birth, 3rd, 6th, 9th and

12th month were found to be 2.687, 10.548, 14.943, 17.902 and 20.369 kg, respectively.

Nagaraja Ramakrishnappa *et al* (2013) in a study to determine the influence of weaning age on post-weaning growth performance in Mandya lambs reported that the least square means of live weight at weaning and at $24^{th}$ week in Gr-I, Gr-II, Gr-III were (weaned at age of 8, 10 and 12 week) 7.94, 8.86 and 9.85 and 13.15, 13.25 and 12.82 kg respectively.

Polat Ipek and Fikret Esen (2013) conducted a study to investigate the effects of various ages of weaning on growth rate of Awassi lambs reported that average weights of lambs weaned on 30, 60 and 90th days of ages at birth were 4.59, 4.37 and 4.42 kg; at 30th day were 10.93, 10.35 and 9.82 kg ($p<0.05$); at 60th day were 17.82, 14.35 and 17.40 kg ($p<0.01$); at 90th day were 25.97, 22.17 and 23.59 kg, respectively.

Rosov and Gootwine (2013) evaluated the contribution of the American Suffolk to growth traits of lambs born to Afec-Assaf ewes and found that average (mean ± SD) birth weight of lambs, weaning age, weaning weight, final weight and final age were 4.5 ± 1.2 kg, 35 ± 6 days, 14.7 ± 3.3 kg, 54.7 ± 8.2 kg and 153 ± 12 days, respectively.

Singh *et al* (2013) conducted study to examine the effect of genetic and non-genetic factors on pre-weaning growth in Marwari sheep and observed that the least-squares means for birth weight, weaning weight and average daily gain of Marwari lambs from birth to weaning were 3.14±0.02, 15.13±0.14 kg and 133.59±1.43 g/day, respectively .

## 2.3 AVERAGE DAILY GAIN

Nivasarkar and Acharya (1981) after studying the performance of Malpura and Sonadi breeds of sheep observed an ADG of 91 and 100 g in Malpura and Sonadi lambs given concentrates and hay ad-lib from 91$^{st}$ to 180$^{th}$ day of age in feed lot experiment.

Mejia *et al* (1991) in a study on performance of African hair sheep under intensive production reported that pre-weaning growth rate was 106±34 g/day (n=84) for a weaning age of 129±46 days and mortality was 10.4% from birth to weaning.

Prasad *et al* (1991) reported an ADG of 91.33 g and weight gain of 8.22 kg in a 90 days growth trial in Nellore weaner under intensive system of feeding and management.

Schoeman and Burger (1992) after studying the productive performance of Dorper sheep reported that average pre-weaning daily gain was 264 g/d and that of post-weaning daily gain up to 100 days of age was 205 g/d.

Shinde and Singh (1995) reported that sheep grazed on pastures are able to attain 27.3 kg finisher body weight at 6 months of age under free grazing and concentrate supplementation at the rate of 15 g/kg of body weight.

Karim and Rawat (1996) in a study on growth performance of native and cross bred lambs reported that crossbreds were able to achieve 35kg finishing weight at 6 months of age under intensive feeding on 50:50 roughage and concentrate based complete diet.

Sinha and Singh (1997) in a study to estimate genetic and phenotypic parameters of Muzzafarnagari sheep observed that the mean values for average daily

gain (ADG) for the periods 0–3 (ADG1), 3–6 (ADG2) and 0–6 (ADG3) months of age were 148.2 ± 3.9, 92.5 ± 3.2 and 120.5 ± 2.3 g, respectively.

Cloete *et al* (2000) in a study on productive performance of Dorper sheep recorded that post-weaning gains in excess of 0.18-0.20 kg per day when weaned early at 2-3 months of age.

Karim *et al* (2001) studied the impact of preweaning plane of nutrition (high, G1: Medium, G2: low, G3) on post weaning growth performance and reported that weaning weights were 14.3, 13.0 and 14.8 kg in G1, G2 and G3, respectively while the finishing weight was higher ($P<0.01$) in the G3 (24.8 kg) maintained on low plane of nutrition in preweaning phase, than G1 (21.9 kg) or G2 (21.0 kg).

Joshi *et al* (2003) observed that gain in body weight and growth efficiency during 0–3 and 3–6 months of age were 9.95±0.061 and 4.28±0.054 kg, respectively in a study on Marwari sheep under field condition.

Singh *et al* (2003) reported that lambs maintained under intensive and semi intensive system for a period of 90 days achieved 22.3 and 22.7 kg weight at 5 and 6 months of age, respectively. The total post weaning gains were 10.0 and 10.2 kg with 111g and 113 g of ADG in the two systems.

Gauly *et al* (2004) performed a study to assess the effect of four different production systems on daily weight gain noted that the lower average daily gain in lambs weaned at age of 40 days compared to unweaned lambs and concluded that it might be due to weaning stress.

Karim *et al* (2004) in a study undertaken on Bharat Merino weaners to assess their growth performance reported that post weaning ADG, post weaning total gain and six months weight of 98 ± 3.1 g, 8.9 ± 0.28 kg and 26.3 ± 0.36 kg, respectively under intensive system of management.

Aganga (2005) after studying the reproductive performance and growth rates of lambs reported that the average daily body weight gain (g/day) in the first 3 months after birth was 51.44±0.40 for males and 47.39±0.37 for female Tswana lambs raised under extensive management system.

Musa *et al* (2005) after studying the reproductive performance and growth rates of lambs observed that the average pre-weaning growth rate was 90 gram per day in lambs of West African sheep.

Rafiqul Islam *et al* (2005) studied the Dam- Lamb relationship on productive performance revealed that the unweaned lambs up to 6 months of age are more profitable in respect of body weight gain when compared to lambs weaned at 3 months of age.

Tripathi *et al* (2007) conducted a study on growth performance of weaner lambs and reported that adlibitum concentrate supplemented lambs had significantly ($P < 0.01$) higher daily gains (151 g) than 15 and 25 g / kg body weight concentrate supplemented lambs (77 and 98 g, respectively). Feed efficiency was similar for 15 and 25 g / kg b.wt concentrate supplemented lambs but significantly ($P < 0.01$) lower than the adlibitum concentrate supplemented lambs.

Abou Ward *et al* (2008) in a study to know the effect of weaning age on lamb performance observed that early weaned lambs (weaned at 8 weeks age) had higher daily gain (232 g/h/day *vs* 189 g/h/day) in comparison with the natural weaned group lambs (weaned at12 weeks age).

Selaive-Villaroel *et al* (2008) in a study to know the effect of weaning age on lambs performance reported that lambs weaned at 60, 75 and 90 days of age showed similar post-weaning growth rates.

Aksakal *et al* (2009) in a study to know the effect of weaning at various ages on performance of Morkaraman lambs reported that except for the final body

weight, lambs weaned at different ages viz., 45$^{th}$ day, 60$^{th}$ day and 75$^{th}$ day showed similar growing pattern.

Devendran *et al* (2009) analysed the absolute growth rate (Average Daily Gain) of Madras Red sheep at different stages of growth from birth to 12 months and found that the mean absolute growth rate for birth to 3 months and 3–6 months were 73.74±0.14 and 60.17±0.27 g, respectively. The average pre-weaning growth rate was high and got reduced progressively in post-weaning.

Mohammadi *et al* (2009) estimated that the Average Daily Gain from birth to weaning (ADG1) and weaning to 6$^{th}$ month of the ages (ADG2) were 184.04±5.02 and 156.84±11.81 g, respectively in a study on Growth Traits in Iranian Afshari sheep.

Abbas *et al* (2010) observed that weaning system had a significant effect on average daily gain (ADG) and on body weight at 3 and 4 months, in a study on the growth performance of Rahmani and Chios lambs.

Ashish Chopra *et al* (2010) reported that least square means for ADG from birth to 3 months and ADG from 3 to 6 months were 138±01 g and 77±01 g, respectively in a study on growth profile of Bharat Merino sheep in semi-arid region of Rajasthan.

Balasubramanyam *et al* (2010) after studying the performance of Madras Red sheep under farmer's flocks reported that average daily weight gain during 0–3 months and 3–6 months was 69.99±0.23 g and 44.56±0.23 g, respectively

Balasubramanyam and Kumarasamy (2011) observed that the average daily gains during 0-3 months and 3-6 months were 90.38 ± 0.249 and 47.68 ± 0.212 g respectively in Madras Red sheep reared under field conditions in Kancheepuram.

Gbangboche *et al* (2011) reported that the pre and post weaning average daily gains were 100.41±1.30 g $day^{-1}$ and 71.08±1.70 g $day^{-1}$, respectively in West African Dwarf Sheep.

Thiruvenkadan *et al* (2011) analysed the pre weaning and post weaning traits and reported that the pre and post-weaning average daily weight gains were 63.84±0.75 and 29.52±0.43 g respectively in Mecheri sheep.

Ekiz *et al* (2012) investigated the effects of suckling length and rearing type on average daily gains (ADG) of lambs at different periods of growth. A significant ($P<0.05$) decrease in ADG was observed in lambs weaned at 45 days and at 75 days. These results indicate that weaning might cause a decrease in ADG of lambs. With respect to ADG from birth to slaughter, lambs suckled until slaughter age (120 days) had higher ADG than those weaned at either 45 days or 75 days ($P<0.001$).

Abdel-Fattah (2013b) in a study to determine the effect of weaning age on growth performance of Bakri lambs found that early weaned lambs tended to have greater ($P<0.01$) ADG than late-weaned lambs and reported that late weaned lambs which had longer suckling period (4 months) did not show better post-weaning performance than those weaned earlier (2 months of age).

Ganesan *et al* (2013) in a study to estimate growth traits in Madras Red sheep reported that the overall average daily weight gains during 0-3, 3-6, 6-9 and 9-12 months were 87.357, 47.894, 31.717 and 25.615 g, respectively. Growth during pre-weaning period is rapid compared to other periods.

Hashem *et al* (2013) in a study to determine the effect of weaning age on growth performance of Bakri lambs found that early weaned lambs (weaned at 60 days of age) had a highly ($P<0.01$) significant effect on live body weight and had

higher values of ADG and growth rate with late weaned lambs (weaned at 120 days of age).

Rosov and Gootwine (2013) found that preweaning, post weaning and overall ADG was: 294 ± 66, 343 ± 62 and 330 ± 53 g/day, respectively in lambs belonging to the Afec-Assaf strain and its crosses with the American Suffolk.

## 2.4 BODY MEASUREMENTS

Vij *et al* (1997) conducted a survey in Sikkim to record characteristics of Bonpala sheep and information was recorded on morphological characteristics, management practices and body measurements and reported that length, height, heart girth and paunch girth averaged 63.33±1.08, 69.67±2.23, 82.44±1.87 and 90.33±1.45 cm, respectively in ewes.

Kushwaha *et al* (1999) conducted a study to assess the status of Chokla sheep in farmers' flock reported that heart girth, paunch girth, height at withers and body length in weaners were 66, 68, 60 and 63 cm, while in adult male and females (2 teeth) they were 78, 81, 71 and 74 cm and 75, 86, 67 and 71 cm, respectively.

Varade and Ali (1999) after studying body measurements of sheep in field conditions observed that the average body measurements were: chest girth 76.48±0.38 cm, body length 101.96±0.57 cm and body weight 30.39±0.40 kg in local ewes.

Saravana kumar (2003) in a study on the performance of Nellore sheep observed that the average body length, height at withers and chest girth of adult ewes were 67.05±0.22, 72.75±0.24 and 72.78±0.23 cm, respectively.

Dixit *et al* (2005) in a study to characterize the Rampur Bushair sheep in north temperate region of India observed that average body length, height at withers

and chest girth in females of Rampur Bushair were 50.34±0.71, 53.93±0.45, 75.99±0.38cm, respectively and body weight in females was 25.98±0.49 kg.

Karunanithi *et al* (2005) performed a study to determine the breed characteristics of Mecheri sheep reported that the pooled means for height at withers, chest girth and body length at about 24 months of age were 67±0.4, 74±0.4 and 66±0.4 cm, respectively.

Gopal Dass (2007) in a study on production performance of Pugal sheep observed that the overall least square means of body measurements of adults, viz. body length, height, chest girth, ear length and tail length were 61.59±.31, 61.76±0.17, 71.83±0.20, 9.48±.0.11 and 17.70±0.22 cm, respectively.

Arun kumar *et al* (2008) in a study to determine the production potential of Malpura breed reported that averages for body measurements such as body length, height at withers and chest girth in adult females were 63.91±0.14, 64.04±0.22 and 70.11±0.21 cm, respectively.

Chandran *et al* (2009) conducted a survey on management practices of Vembur sheep in Tamil Nadu and found that average body length, height at withers, chest girth, ear length and tail length at 3 months age were 48.9 ± 0.5 , 57.2 ± 0.4, 55.7 ±0.4, 13.9 ± 0.1, and 9.2 ± 0.1 ( in cm) respectively. He also reported average body length, height at withers, and chest girth in adult ewes as 67.0 ±0.1, 75.1±0.1 cm and 78.1±0.2 cm, respectively.

Devendran *et al* (2009) conducted a survey on the biometric parameters of Coimbatore sheep and found the average body length, height at withers, chest girth in adults as 62.4 ± 0.4, 60.9 ± 0.3 and 69.8 ±0.4 cm respectively. Average body length, height at withers, chest girth at 3 months age was reported as 49.6 ±0.7, 51.1 ±0.6, and 54.5 ±0.8 cm respectively. They further reported that chest girth was

higher than body length and height at withers at all age groups except at birth where height at withers was highest.

Dinesh Kumar Yadav *et al* (2009) carried out a survey on farmers' sheep flocks to study the morphometric characteristics and production characteristics of the Marwari sheep and found that the average adult body weights in males and females were 40.7±1.13 and 30.1±0.0.28 kg, respectively. Chest girth (cm) of rams was 81.71±0.81 and that of the ewes was 74.25±0.27.

Arora *et al* (2010) conducted a study to characterize the Ganjam breed phenotypically and reported that average body length, height at withers, chest girth in Ganjam sheep ewes were 58.7±0.36 cm, 64.9±0.45 cm, 64.9±0.45 cm, respectively and body weight in females was 23.9±0.63 kg.

Mengistie *et al* (2010) conducted a study to describe the production systems and management practices and investigated the physical linear body measurements of Washera sheep in the traditional farming systems reported that the overall least square mean of body weight, wither height, body length, heart girth, pelvic width and ear length obtained were 26.7±0.45 kg, 69.0±0.36 cm, 57.7±0.33 cm, 74.4±0.49 cm, 14.3±0.12 cm and 9.73±0.08 cm, respectively.

Tailor and Yadav (2011) in a study on growth performance of pre- and post-weaning Sonadi lambs reported that the overall least-square mean for body length, height and girth at birth were 32.86±0.84, 37.50±0.65 and 35.87±0.85 cm and at 6 months of age were 55.50±0.54, 56.93±0.52 and 58.72±0.57 cm respectively.

Raja *et al* (2012) in a study to know the phenotypic characterization of Ramnad White sheep found that the overall means for body weight, body length and height at withers, chest girth and paunch girth of females were 31.5±0.26kg, 65.5±0.30 cm, 74.4±0.20 cm, 75.8±0.31 cm and 74.0±0.38 cm, respectively.

Ravimurugan *et al* (2013) carried out a study on Kilakarsal sheep to estimate the body weight from body measurements and reported that the overall means for body weight, body length and height at withers, chest girth and paunch girth pooled over sexes were 23.39 ± 0.33 kg, 56.92 ± 0.31 cm, 69.74 ± 0.33 cm, 71.92 ± 0.44 cm and 69.44 ± 0.49 cm, respectively.

## 2.5 BIOCHEMICAL TESTS

Poe *et al* (1969) reported that total protein levels remained relatively stable throughout the experiment period while there was drop in urea and glucose levels.

Leat (1974) in a study to determine variation in the concentration of plasma glucose in sheep reported that normal plasma glucose concentration ranged between 55 and 72 mg/dl.

Jelinek *et al* (1984) studied the biochemical values of blood in rams during their growth period and found that there is a negative correlation between age and glucose level.

Halcombe *et al* (1992) studied the growth performance, serum hormones and metabolite responses before and after weaning the lambs at 42 days of age and they had observed that during the first 2 weeks of post weaning, diet had little effect on serum constituents in lambs although a significant change in growth response was observed.

Ramprabhu and Dhanapalan (1997) in a study on metabolic profile in Nilgiri sheep reported a total protein value of 6.88 g/dl.

Karim and Verma (2000) assessed blood biochemical and mineral profile periodically in Malpura weaner lambs maintained under intensive feeding (G1) as well as grazing with concentrate supplementation (G2) and reported a glucose concentration of 50.2 mg/dl and total protein value of 9.0-10.08 g% and were similar

in the two groups. Blood urea N was lower (P<0.01) in G2 (21.5 mg %) than G1 (28.2 mg %) receiving 1% urea in their composite feed lot ration.

Ramesh Kumar *et al* (2003) in a study to determine the blood biochemical profile of Mecheri sheep reported that the glucose values ranged between 37.5 and 50.8 mg/dl in males. The total protein value ranged between 4.30 and 7.26 g/dl and the total protein concentration increased linearly with the age of the Mecheri lambs.

Porwal *et al* (2005) in a study to determine blood biochemical profile of growing lambs reported a blood glucose concentration of 52.8 mg/dl and blood urea nitrogen (BUN) value of 13.58 mg% under intensive system of management and inferred that lambs under intensive feeding receiving concentrate supplementation had higher blood glucose and lower blood urea nitrogen values indicating their relatively better metabolic profile than lambs under extensive system of management.

More *et al* (2008) in a study to investigate the influence of age on blood biochemical constituents in Osmanabadi goats reported that serum glucose and total cholesterol increases as the age advanced.

Devendran *et al* (2009) in a study conducted to assess the haematological and blood-biochemical status of six and nine months old Coimbatore sheep found that the mean blood glucose (mg/dl) and protein (g/dl) levels were 70.39 ± 6.13 and 7.28 ± 0.35, respectively.

Abdel-Fattah *et al* (2013b) studied the effect of weaning age on some plasma biochemical parameters of Bakri lambs and observed that in both early weaned and late weaned groups, on the first month after weaning age there was decrease in Total Protein and Plasma Urea Nitrogen values of all lambs.

## 2.6 POST PARTUM OESTRUS

Fletcher (1973) conducted an experiment to study effects of lactation, suckling on post-partum ovulation and oestrus in ewes reported that ewes with restricted suckling activity or with lambs removed on the day after birth showed their first post-partum ovulation and oestrus at about the same times as ewes which reared their lambs normally.

Hoefler and Hallford (1987) in a study on influence of suckling on serum hormone profiles and return to estrus in spring-lambing ewes reported that interval from parturition to estrus (mean ± SE) was similar ($P > 0.15$) in ewes nursing their offspring (117 ± 6 d) and those that had their lambs removed (124 ± 6 d).

Mukasa-Mugerwa and Lahlou-Kassi (1995) in a study on reproductive performance and productivity of Menz sheep reported that Postpartum anoestrus was 76 days.

## 2.7 COST ECONOMICS

Nagpal *et al* (1995) reported that weaning kids at 3-4 months age and feeding intensively was most expensive (Rs. 28.92 to Rs. 32.84 /kg gain) compared to weaning at 2 months of age and rearing under a semi intensive system (Rs. 6.29 to Rs 7.25 /kg gain).

Porwal *et al* (2006) in a study to determine the relative economics of sheep rearing under different systems reported that in intensive system the cost of complete feed, labour charge and health coverage during the study period of 92 days was Rs.264, 20 and 5 per animal, respectively.

Abou ward *et al* (2008) reported that feed cost (pt.) per kg weight gain did not differ statistically between early and natural weaned groups.

Venkateswarlu and Ramana Reddy (2013) in a study on native ram lambs by supplementing the concentrate mixture at 1.0 per cent body weight to assess the

growth and carcass characteristics reported that the cost per kg gains are less in supplemented animals.

## 2.8 LAMB MORTALITY

Reddy and choudhuri (2000) in their study on lamb mortality revealed that lamb mortality was higher (58.48%) in the post weaning period than the pre-weaning period (41.52%).

Raman *et al* (2003) recorded a lamb mortality of 11 per cent in 0 to 3 months age group, 3 per cent in 3 to 6 months age group lambs of Madras Red sheep.

Thiruvenkadan *et al* (2003) in a study on mortality of Mecheri sheep reported that under field conditions the mean mortality rate among lambs was 7.52 and generally there was higher mortality in rams.

Ajoy Mandal *et al* (2005) in a study on factors affecting the mortality in Muzzafarnagari sheep reported that overall pre and post-weaning mortality averaged 6 .6 and 6.0 per cent respectively.

Kandasamy *et al* (2006) observed an annual mean mortality rate of 20.80 per cent for lambs in Coimbatore sheep.

Polat Ipek and Fikret Esen (2013) in their study on survival ability of Awassi lambs reported that survivability rates of $90^{th}$ day were 100, 90 and 86.67 per cent in first, second and third groups, which were weaned on 30, 60 and $90^{th}$ days of ages, respectively.

# CHAPTER III
# MATERIALS AND METHODS

A study on the effect of weaning age and feeding system on growth performance and serum biochemical profile of lambs and body weight changes of ewes and resumption of ovarian cyclicity in ewes was carried out in Nellore male lambs and their dams. The experiment was carried out at Livestock Research Station, Palamaner, Chittoor district, A.P. The laboratory analysis was carried out at Department of Livestock Production Management and Department of Animal Nutrition, College of Veterinary Science, Tirupati. The experiments conducted are dealt with under the following topics.

1. Growth studies
2. Biochemical studies
3. Cost economics
4. Post partum oestrus studies

## 3.1 SELECTION OF ANIMALS

Forty eight Nellore ram lambs with an average birth weight of 3.24 ± 0.04 kg were selected from Livestock Research Station, Palamaner and were randomly distributed into four treatments of twelve animals each covering four systems of rearing. The group averages of body weights in all four groups in all the systems were as uniform as possible. The group averages of body weights in T-1, T-2, T-3 and T-4 were recorded as 3.22 ± 0.69, 3.27 ± 0.12, 3.29 ± 0.78 and 3.16 ± 0.79 kg, respectively.

The four treatments with regard to feeding practice may be described as follows:

T-1, lambs fed milk plus concentrate creep and weaned early at 2 months of age

T-2, lambs fed milk plus concentrate creep and weaned at 3 months of age

T-3, lambs fed milk plus concentrate creep and weaned lately at 4 months of age

T-4 lambs fed milk only and weaned at 3 months of age are considered as control since majority of shepherds practice the same.

### 3.1.1 Feeding and watering of experimental animals

All the experimental lambs were offered mother's milk and creep ration as per the treatment norms mentioned earlier and thereafter fed with concentrate feed. The diets (NRC, 1985) were offered at the same time (08:30 hrs) to all groups. Measured quantity of chaffed Hybrid Napier fodder was offered to four treatment groups. The residues, if any, were weighed on the next day morning. Thus, the exact quantity of feed and fodder consumed by each experimental animal group was recorded throughout the experimental period. Clean, fresh and wholesome drinking water was made available throughout the experimental period. Ewes were sent to grazing and fed with concentrate mixture when they returned from grazing.

### 3.1.2 Housing and management of experimental animals

All the Nellore lambs were kept under hygienic conditions in well ventilated pens with adequate space requirements. Standard practice of deworming was carried out to all animals regularly. Healthy surroundings and proper cleanliness were maintained in the experimental sheds.

### 3.1.3 Body weight recording

Growth trial in lambs was conducted for 180 days and the body weights were recorded at weekly intervals during the trial period by using a digital balance before offering feed and water in the morning.

Body weights of dams were recorded at monthly intervals with the help of 50 kg circular hanging scale. This was performed in the morning before the animals were let out for grazing.

### 3.1.4 Average Daily Gain

The average daily gain (ADG) was calculated by using the following formulae.

$$\text{Average Daily Gain (ADG)} = \frac{\text{Final weight (kg)} - \text{Initial Weight (kg)}}{\text{No.of days of growth trial}}$$

## 3.2 BLOOD COLLECTION FOR METABOLITES

The whole blood sample (10 ml) was collected into a clean, dry, sterilized test tube without adding anti coagulant and serum was separated by centrifugation and then transferred into a sterilized plastic vial, labelled and stored at -20 $^{0}$C till use for 72 hrs after collection of blood. Clean and sterile glassware and analytical grade chemicals were used in the study.

### 3.2.1 Biochemical studies

Blood serum metabolites like Glucose, total protein and urea were analyzed to find out the changes if any due to effect of weaning age. The following biochemical constituents were estimated by using standard kits.

| S.No | Biochemical Constituent | Method of estimation | Kits used |
|---|---|---|---|
| 1. | Glucose | GOD- POD method | Span diagnostic kit |
| 2. | Total protein | Biuret method | Span diagnostic kit |
| 3. | Urea | Berthelot method | Excel diagnostic kit |

### 3.3 Sampling of feeds and fodders

Representative samples of feed and green fodder and hay were collected daily during the collection period before offering to animals and kept for dry matter estimation. The dried samples were pooled for 7 days and ground in a laboratory Willey mill and ground material was preserved in airtight polythene bags for subsequent analysis.

#### 3.3.1 Ingredients composition:

The ingredient composition of creep and concentrate is presented in Table 1.

**Table 1: Ingredient composition (%) of experimental diets**

| Nutrient | | Creep feed | Concentrate |
|---|---|---|---|
| 1. | Maize | 40 | 40 |
| 2. | Ground nut cake | 30 | 22 |
| 3. | Rice bran | 10 | 10 |
| 4. | De-oiled rice bran | 13 | 20 |
| 5. | Molasses | 5.0 | 5.0 |
| 6. | Mineral mixture | 2.0 | 2.0 |
| 7. | Salt | 1.0 | 1.0 |

The creep feed is fortified with vitamins A, $B_2$ and $D_3$ and antibiotic feed supplements

#### 3.3.2 Chemical analysis

Feed and fodder samples were analysed for proximate composition using AOAC (2005) Procedures and fibre fractions by methods of Goering and Vansoest (1970).

## 3.4 BODY MEASUREMENTS

The biometric parameters of lambs and dams viz. body length, height at withers, chest girth and paunch girth were recorded (cm) with a flexible tape as described by Ravimurugan *et al* (2007).

**Body length (BL):** distance from point of shoulder to tuber ischii

**Height at Withers (HW):** distance from base of hoof to the highest point of withers

**Chest girth (CG):** body circumference around the chest just behind the elbow joint

**Paunch girth (PG):** body circumference around the paunch

## 3.5 COST OF PRODUCTION OF LAMBS

An attempt was made to estimate the cost of production of lambs from birth to six months of age covering four treatments reared under different weaning ages and feeding management practices. For this purpose the total cost of production of lambs and corresponding weight gains during the period were recorded. Further the cost of production per kg weight gain was calculated for all the treatments.

To arrive at the total cost of production total feed component, labour, medicines and other miscellaneous expenses were considered. Cost of feeding included cost of creep feed, cost of concentrate feed, notional value of green fodder and hay fodder were considered.

With regard to weight gain during experimental period, initial body weight and weight at end of experiment i.e. six months were recorded and thus total weight gain was arrived. Further, cost per kg weight gain was calculated by dividing total cost per animal by weight gain per animal.

The labour cost was arrived on actual basis for the experiment period of six months. One labour was employed for six months at the rate of Rs. 5,000/- per

month. When shared among the four treatments the labour cost comes to Rs. 7,500/- per treatment.

A uniform amount of Rs. 5,00/- was incurred for each treatment for the experimental period concerned to the cost of medicines and other miscellaneous expenses. All the costs and cost per kg weight gain were arrived after considering the mortality of experimental lambs.

## 3.6 MORTALITY

### 3.6.1 Pre weaning mortality

The number of lambs died during the period from birth to weaning to the number of lambs born alive (as percentage).

$$\text{Pre weaning mortality (\%)} = \frac{\text{No. of lambs at birth} - \text{No. of lambs at weaning}}{\text{No. of lambs at birth}} \times 100$$

### 3.6.2 Post weaning mortality

The number of lambs died during the period from weaning to six months to the number of lambs born alive (as percentage).

$$\text{Post weaning mortality(\%)} = \frac{\text{No. of lambs at weaning} - \text{No. of lambs at six months}}{\text{No. of lambs at weaning}} \times 100$$

## 3.7 POST PARTUM OESTRUS

The oestrus behaviour was checked every following the day of weaning using an intact teaser ram of proven sexual vigour. Observation was done between 8:00 -10:00 am and 4:00 - 6:00 pm for one hour on each occasion. Oestrus was noted if the female stood willingly for the male to mount her.

## 3.8 STATISTICAL ANALYSIS

Data collected were tabulated and analysed as per standard statistical procedures (Snedecor & Cochran, 1994) using SPSS (version 15.0.1), software.

# CHAPTER IV
# RESULTS

Data recorded on experimental lambs and their dams from Livestock Research Station, Palamaner and samples were analyzed in the Department of Livestock Production Management, College of Veterinary Science, Tirupati. The data was statistically analyzed and tabulated and the results are presented in this chapter.

## 4.1 BODY WEIGHTS OF LAMBS

The body weights of lambs were measured and analysed and the results are presented in Table 2. The mean values for body weights of lambs at birth, weaning, $17^{th}$ week, $18^{th}$ week, $19^{th}$ week, $20^{th}$ week, $21^{st}$ week, $22^{nd}$ week, $23^{rd}$ week and $24^{th}$ week in T-1 were 3.22 ± 0.69, 11.67 ± 0.47, 16.03 ± 0.61, 16.33 ± 0.65, 16.66 ± 0.65, 16.04 ± 0.59, 16.79 ± 0.64, 17.14 ± 0.59,17.45 ± 0.56 and 17.86 ± 0.52 kg, respectively, while in T-2 the corresponding values were 3.27 ± 0.12, 15.67 ± 0.54, 17.52 ± 0.57, 18.29 ± 0.63, 18.88 ± 0.68, 19.91 ± 0.41, 20.24 ± 0.41, 20.79 ± 0.44, 21.26 ± 0.50 and 22.50 ± 0.63 kg, respectively. The respective values in T-3 were 3.29 ± 0.78, 17.50 ± 1.07, 17.88 ± 1.16, 18.42 ± 1.17, 18.90 ± 1.19, 19.38 ± 1.25, 19.63 ± 1.23, 20.10 ± 1.32, 20.45 ± 1.24 and 21.16 ± 1.32 kg; and those of T-4 were 3.16 ± 0.79, 12.68 ± 0.53, 13.68 ± 0.72, 13.71 ± 0.71, 13.83 ± 0.70, 14.04 ± 0.70, 14.53 ± 0.74, 15.08 ± 0.85, 15.61 ± 0.87 and 16.32 ± 0.96 kg, respectively. The body weight at birth did not differ significantly among treatments. There was a significant difference ($P < 0.01$) among the treatments with regard to body weights recorded from weaning to $24^{th}$ week.

**Table 2. Least square means (± SE) of live body weights (Kg) of Nellore lambs weaned at different ages**

| S. No | Age | T-1 | T-2 | T-3 | T-4 |
|---|---|---|---|---|---|
| 1. | Birth $^{NS}$ | 03.22 ± 0.69 | 03.27 ± 0.12 | 03.29 ± 0.78 | 03.16 ± 0.79 |
| 2. | Weaning $^{**}$ | $11.67^{b}$ ± 0.47 | $15.67^{a}$ ± 0.54 | $17.50^{a}$ ± 1.07 | $12.68^{b}$ ± 0.53 |
| 3. | Week -17$^{**}$ | $16.03^{ab}$ ± 0.61 | $17.52^{a}$ ± 0.57 | $17.88^{a}$ ± 1.16 | $13.68^{b}$ ± 0.72 |
| 4. | Week -18$^{**}$ | $16.33^{ab}$ ± 0.65 | $18.29^{a}$ ± 0.63 | $18.42^{a}$ ± 1.17 | $13.71^{b}$ ± 0.71 |
| 5. | Week -19$^{**}$ | $16.66^{ab}$ ± 0.65 | $18.88^{a}$ ± 0.68 | $18.90^{a}$ ± 1.19 | $13.83^{b}$ ± 0.70 |
| 6. | Week -20$^{**}$ | $16.04^{b}$ ± 0.59 | $19.91^{a}$ ± 0.41 | $19.38^{a}$ ± 1.25 | $14.04^{b}$ ± 0.70 |
| 7. | Week -21$^{**}$ | $16.79^{bc}$ ± 0.64 | $20.24^{a}$ ± 0.41 | $19.63^{ab}$ ± 1.23 | $14.53^{c}$ ± 0.74 |
| 8. | Week -22$^{**}$ | $17.14^{ab}$ ± 0.59 | $20.79^{a}$ ± 0.44 | $20.10^{a}$ ± 1.32 | $15.08^{b}$ ± 0.85 |
| 9. | Week -23$^{**}$ | $17.45^{ab}$ ± 0.56 | $21.26^{a}$ ± 0.50 | $20.45^{a}$ ± 1.24 | $15.61^{b}$ ± 0.87 |
| 10. | Week -24$^{**}$ | $17.86^{ab}$ ± 0.52 | $22.50^{a}$ ± 0.63 | $21.16^{a}$ ± 1.32 | $16.32^{b}$ ± 0.96 |

$^{NS}$ values in a row do not differ significantly.
$^{abc}$values in a row not sharing common superscripts differ significantly $^{**}$ ($P < 0.01$).

## 4.2 GROWTH PERFORMANCE OF LAMBS

### 4.2.1 Body weight gain

The body weights (kg) at birth, weaning and 6 months of experimental lambs are shown in Table 3. The mean birth, weaning and 6 month body weights of different treatment groups were 3.22 ± 0.69, 11.67 ± 0.47 and 17.86 ± 5.16 kg, respectively (T-1); 3.27 ± 0.12,15.67 ± 0.54 and 22.50 ± 0.63 kg, respectively (T-2); 3.29 ± 0.78, 17.50 ± 1.07 and 21.28 ± 1.30 kg, respectively (T-3) and 3.16 ± 0.79, 12.68 ± 0.53 and 16.32 ± 0.96 kg, respectively (T-4). The mean pre weaning weight gain was 8.45 ± 0.45, 12.40 ± 0.50, 14.21 ± 1.04 and 9.52 ± 0.52 kg, respectively for T-1, T-2, T-3 and T-4 treatments respectively. The mean total weight gain was 14.67 ± 0.49, 19.25 ± 0.59, 17.99 ± 1.27 and 13.14 ± 0.93 kg, respectively for T-1, T-2, T-3 and T-4 treatments respectively. The pre weaning weight gain and total weight gain were significantly ($P < 0.01$) higher for T-2 and T-3 than T-1 and T-4 (control) treatments. The post weaning weight gain was significantly ($P < 0.01$) higher in T-1 (6.00 ± 0.42) and T-2 (6.71 ± 0.25) than T-3 (3.78 ± 0.34) and T-4 (3.56 ± 0.68) treatments.

### 4.2.2 Average daily gain (g)

The data on effect of weaning age and feeding system on growth performance characteristics of lambs during 6 months growth trail is presented in Table 4.

The pre weaning average daily gains (g) were comparable among T-1 (140.83 ± 7.45), T-2 (137.78 ± 5.50) and T-3(118.4 ± 8.65) and were significantly ($P < 0.01$) higher than that of control group T-4 (105.76 ± 5.76).

**Table 3. Weight gain (Kg) in Nellore lambs weaned at different ages**

| S. No | Treatment | Birth weight $^{NS}$ | Weaning weight$^{**}$ | Pre weaning weight gain$^{**}$ | 6 months weight$^{**}$ | Post weaning weight gain$^{**}$ | Total weight gain $^{**}$ |
|---|---|---|---|---|---|---|---|
| 1 | T-1 | 3.22 ± 0.69 | $11.67^{b}$ ± 0.47 | $8.45^{b}$ ± 0.45 | $17.86^{b}$ ± 5.16 | $6.00^{a}$ ± 0.42 | $14.67^{b}$ ± 0.49 |
| 2 | T-2 | 3.27 ± 0.12 | $15.67^{a}$ ± 0.54 | $12.40^{a}$ ± 0.50 | $22.50^{a}$ ± 0.63 | $6.71^{a}$ ± 0.25 | $19.25^{a}$ ± 0.59 |
| 3 | T-3 | 3.29 ± 0.78 | $17.50^{a}$ ± 1.07 | $14.21^{a}$ ± 1.04 | $21.28^{a}$ ± 1.30 | $3.78^{b}$ ± 0.34 | $17.99^{a}$ ± 1.27 |
| 4 | T-4 | 3.16 ± 0.79 | $12.68^{b}$ ± 0.53 | $9.52^{b}$ ± 0.52 | $16.32^{b}$ ± 0.96 | $3.56^{b}$ ± 0.68 | $13.14^{b}$ ± 0.93 |

$^{NS}$ values in a column do not differ significantly

$^{ab}$values in a column not sharing common superscripts differ significantly $^{**}$ ($P < 0.01$).

**Table 4. Average daily gain (g) in Nellore lambs weaned at different ages**

| S.N | Average daily gain | T-1 | T-2 | T-3 | T-4 |
|---|---|---|---|---|---|
| 1 | Pre weaning ADG (g)$^{**}$ | $140.83^{a}$ ± 7.45 | $137.78^{ab}$ ± 5.50 | $118.4^{bc}$ ± 8.65 | $105.76^{c}$ ± 5.76 |
| 2 | Post weaning ADG (g)$^{**}$ | $50.00^{bc}$ ± 3.52 | $74.53^{a}$ ± 2.78 | $63.00^{ab}$ ± 5.72 | $39.50^{c}$ ± 7.57 |
| 3 | Overall ADG (g)$^{**}$ | $81.52^{b}$ ± 2.71 | $106.95^{a}$ ± 3.28 | $99.95^{a}$ ± 7.05 | $73.10^{b}$ ± 5.17 |

$^{abc}$values in a row not sharing common superscripts differ significantly $^{**}$ ($P < 0.01$).

The post weaning ADG (g) was significantly (P < 0.01) higher in T-2 (74.53 ± 2.78) than T-1(50.00 ± 3.52), T-3 (63.00 ± 5.72) and T-4(39.50 ± 7.57) which were comparable.

The overall average daily gain for T-1, T-2, T-3 and T-4 treatments were 81.52 ± 2.71, 106.95 ± 3.28, 99.95 ± 7.05 and 73.10 ± 5.17 g, respectively and significant (P < 0.01) difference was observed among the treatments.

## 4.3 Body measurements of experimental lambs

The body measurements of the lambs are shown in Tables 5, 6, 7 and 8. The parameters are presented as means along with their standard errors.

### 4.3.1 Body length of lambs:

The lengths of lambs in different treatments are presented in Table 5. The mean body length of male lambs at birth were 30.17 ± 0.58, 30.08 ± 0.40, 29.58±0.42 and 29.33 ± 0.58 cm for T-1, T-2, T-3 and T-4 treatments respectively. The corresponding values at two months of age were 47.50 ± 0.97, 44.00 ± 1.06, 48.42 ± 0.89 and 44.73 ± 1.02 cm respectively and those at weaning age were 47.50 ± 0.97, 50.64 ± 1.02, 54.08 ± 1.14 and 48.36 ± 0.85 cm respectively. The corresponding values for six months age were 52.45 ± 0.78, 57.67 ± 1.53, 56.00 ± 0.61 and 52.22 ±1.43 cm respectively. There was a significant (P < 0.01) difference between the treatments with regard to body length of lambs at all ages except at birth.

### 4.3.2 Height at withers of lambs

The height of lambs in different treatments was presented in Table 6. The height of lambs at birth were 40.92 ± 0.57, 40.17 ± 0.58, 40.50±0.63 and

**Table 5. Mean (±SE) for body length (cm) of lambs weaned at different ages**

| S. | Treatment | At birth $^{NS}$ | 2 months $^{**}$ | Weaning $^{**}$ | 6 months $^{**}$ |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| | T 1 | 30.17 ± 0.58 | 47.50$^{ab}$ ±0.97 | 47.50 $^{b}$ ± 0.97 | 52.45 $^{b}$ ± 0.78 |
| | T 2 | 30.08 ± 0.40 | 44.00$^{c}$ ± 1.06 | 50.64 $^{ab}$ ± 1.02 | 57.67 $^{a}$ ± 1.53 |
| | T 3 | 29.58 ± 0.42 | 48.42$^{a}$ ± 0.89 | 54.08 $^{a}$ ± 1.14 | 56.00$^{ab}$ ± 0.61 |
| 4 | T 4 | 29.33 ± 0.58 | 44.73$^{bc}$ ± 1.02 | 48.36 $^{b}$ ± 0.85 | 52.22$^{b}$ ± 1.43 |

**Table 6. Mean (±SE) for height at withers (cm) of lambs weaned at different ages**

| S. | Treatment | At birth $^{NS}$ | 2 months $^{NS}$ | Weaning $^{**}$ | 6 months $^{**}$ |
|---|---|---|---|---|---|
| | T 1 | 40.92 ± 0.57 | 56.83 ± 1.41 | 56.83 $^{b}$ ± 1.41 | 65.18 $^{b}$ ± 1.19 |
| | T 2 | 40.17 ± 0.58 | 53.50 ± 1.34 | 58.64 $^{b}$ ± 1.59 | 70.90 $^{a}$ ± 1.52 |
| | T 3 | 40.50 ± 0.63 | 55.83 ± 1.13 | 63.67 $^{a}$ ± 1.34 | 67.83$^{ab}$ ± 1.67 |
| 4 | T 4 | 39.58 ± 0.54 | 53.64 ± 0.78 | 56.64 $^{b}$ ± 0.74 | 58.67 $^{c}$ ± 0.93 |

**Table 7. Mean (±SE) for chest girth (cm) of lambs weaned at different ages**

| S. | Treatment | At birth$^{NS}$ | 2 months $^{NS}$ | Weaning $^{**}$ | 6 months $^{**}$ |
|---|---|---|---|---|---|
| | T 1 | 35.83 ± 0.41 | 55.58 ± 0.83 | 55.58 $^{c}$ ± 0.83 | 67.82 $^{b}$ ± 0.57 |
| | T 2 | 35.08 ± 0.40 | 56.00 ± 1.41 | 62.09 $^{b}$ ± 1.64 | 72.60 $^{a}$ ± 1.36 |
| | T 3 | 36.50 ± 0.51 | 57.42 ± 1.42 | 67.00 $^{a}$ ± 1.45 | 70.67 $^{ab}$ ± 1.86 |
| 4 | T 4 | 34.83 ± 0.37 | 55.18 ± 1.10 | 55.09 $^{c}$ ± 1.01 | 59.00 $^{c}$ ± 0.55 |

**Table 8. Mean (±SE) for paunch girth (cm) of lambs weaned at different ages**

| S. | Treatment | At birth $^{NS}$ | 2 months $^{NS}$ | Weaning $^{**}$ | 6 months $^{**}$ |
|---|---|---|---|---|---|
| | T 1 | 34.08 ± 0.34 | 53.92 ± 1.01 | 53.92 $^{b}$ ± 1.01 | 67.18 $^{a}$ ± 2.73 |
| | T 2 | 34.17 ± 0.55 | 55.92 ± 1.60 | 61.00 $^{a}$ ± 1.92 | 70.00 $^{a}$ ± 1.09 |
| | T 3 | 35.08 ± 0.53 | 55.25 ± 1.34 | 65.42 $^{a}$ ± 1.49 | 69.50 $^{a}$ ± 1.29 |
| 4 | T 4 | 33.83 ± 0.61 | 53.82 ± 1.37 | 54.09 $^{b}$ ± 0.95 | 59.44 $^{b}$ ± 0.84 |

$^{abc}$ values in a column not sharing common superscripts differ significantly $^{**}$ ($P < 0.01$).

$^{NS}$ values in a column do not differ significantly.

39.58 ± 0.54 cm for T-1, T-2, T-3 and T-4 treatments, respectively and there was no significant difference among the treatments.

The mean height of lambs at two months of age were 56.83 ± 1.41, 53.50 ± 1.34, 55.83 ± 1.13 and 53.64 ± 0.78 cm, respectively for T-1, T-2, T-3 and T-4 treatments. Whereas the corresponding values at weaning were 56.83±1.41, 58.64±1.59, 63.67±1.34 and 56.64 ± 0.74 cm and those of six months age were 65.18 ± 1.19, 70.90 ± 1.52, 67.83 ± 1.67 and 58.67 ± 0.93 cm, respectively. At two months of age height at withers did not differ significantly among the treatments. There was significant ($P < 0.01$) difference at weaning and at six months between the treatments with regard to height of lambs.

### 4.3.3 Chest girth of lambs

The chest girth measurements of lambs were analysed and are presented in Table 7. The mean girths of lambs at birth were 35.83 ± 0.41, 35.08 ± 0.40, 36.50 ± 0.51 and 34.83 ± 0.37 cm for T-1, T-2, T-3 and T-4 treatments respectively. The corresponding values at two months of age were 55.58 ± 0.83, 56.00 ± 1.41, 57.42 ± 1.42 and 55.18±1.10 cm respectively and those at weaning age were 55.58 ± 0.83, 62.09 ± 1.64, 67.00 ± 1.45 and 55.09 ± 1.01 cm respectively. The corresponding values for six months age were 67.82 ± 0.57, 72.60 ± 1.36, 70.67 ± 1.86 and 59.00 ± 0.55 cm respectively. There was no significant difference at birth and two months of age between the treatments. There was significant ($P < 0.01$) difference at weaning and six months between the treatments with regard to chest girth of lambs.

### 4.3.4 Paunch girth of lambs

The paunch girth measurements of lambs are presented in Table 8. The mean girths of lambs at birth were 34.08 ± 0.34, 34.17 ± 0.55, 35.08 ± 0.53 and 33.83 ± 0.61 cm for T-1, T-2, T-3 and T-4 treatments, respectively. The corresponding values at two months of age were 53.92 ± 1.01, 55.92 ± 1.60, 55.25 ± 1.34 and 53.82 ± 1.37 cm, respectively and those at weaning age were 53.92 ± 1.01, 61.00 ± 1.92, 65.42 ± 1.49 and 54.09 ± 0.95 cm, respectively. The corresponding values for six months age were 67.18 ±2.73, 70.00±1.09, 69.50 ± 1.29 and 59.44±0.84 cm, respectively. The paunch girths of lambs did not differ significantly between the treatments at birth and at two months of age. The paunch girth of lambs differ significantly ($P < 0.01$) at weaning and at six months age.

## 4.4 BIOCHEMICAL STUDIES

### 4.4.1 Biochemical studies in ram lambs up to one week after weaning

The serum glucose, total protein and urea of ram lambs were estimated for seven consecutive days after weaning to study the effect of weaning stress.

#### 4.4.1.1 Glucose:

Serum glucose levels estimated for seven consecutive days after weaning are presented in Table 9.

Serum glucose level was significantly lower ($P < 0.01$) on first and second day after weaning and gradually started to increase from third day onwards.

**Table 9. Post weaning serum glucose (mg/dl) of ram lambs weaned at different ages**

| S. No. | Treatment | 0 Day | 1st Day | 2nd Day | 3rd Day | 4th Day | 5th Day | 6th Day | Mean** |
|---|---|---|---|---|---|---|---|---|---|
| 1 | T 1** | 55.88$^{AB}$±2.51 | 36.29$^{C}$ ±3.94 | 46.67$^{BC}$±2.43 | 55.88$^{AB}$±2.51 | 60.81$^{A}$ ± 1.67 | 63.09$^{A}$ ±2.64 | 64.50$^{A}$ ±4.00 | 54.73$^{a}$± 1.63 |
| 2 | T 2** | 49.80$^{C}$ ±2.83 | 37.53$^{D}$ ±1.68 | 34.50$^{D}$ ± 0.83 | 54.38$^{BC}$ ±3.29 | 60.41$^{AB}$±1.90 | 64.84$^{A}$ ±3.20 | 66.62$^{A}$ ±1.97 | 52.58$^{a}$ ± 1.80 |
| 3 | T 3** | 45.33$^{BC}$ ±4.11 | 36.10$^{CD}$±7.40 | 32.36$^{D}$ ± 1.47 | 45.89$^{BC}$ ±1.67 | 53.61$^{AB}$ ±1.02 | 60.72$^{A}$ ±2.51 | 63.18$^{A}$ ±3.83 | 48.17$^{b}$ ± 1.98 |
| 4 | T 4** | 50.42$^{AB}$ ±2.20 | 35.86$^{C}$ ± 3.91 | 31.31$^{C}$ ± 2.19 | 40.58$^{BC}$ ±3.12 | 51.30$^{A}$ ± 3.55 | 54.01$^{B}$ ±2.47 | 54.85$^{B}$ ±2.90 | 45.47$^{b}$ ± 1.59 |
| | Mean** | 50.36$^{C}$ ±1.58 | 36.4 5$^{D}$ ± 2.24 | 36.21$^{D}$ ± 1.41 | 49.18$^{C}$ ± 1.71 | 56.53$^{B}$ ± 1.30 | 60.66$^{A}$ ±1.49 | 62.29$^{A}$ ±1.75 | |

$^{ABCD}$ values in a row not sharing common superscripts differ significantly $^{**}$ ($P < 0.01$).
$^{ab}$ values in a column not sharing common superscripts differ significantly $^{**}$ ($P < 0.01$).

The mean serum glucose levels (mg/dl) were 50.36 ±1.58, 36.45 ± 2.24, 36.21 ± 1.41, 49.18 ± 1.71, 56.53 ± 1.30, 60.66 ±1.49 and 62.29 ± 1.75 for zero to six days post weaning, respectively.

The mean serum glucose levels (mg/dl) of ram lambs in T-1 and T-2 were significantly higher ($P < 0.01$) than those in T-3 and T-4 and the values were 54.73 ± 1.63, 52.58 ± 1.80, 48.17 ± 1.98 and 45.47 ± 1.59 for treatments T-1, T-2, T-3 and T-4, respectively.

#### 4.4.1.2 Total protein:

Serum total protein levels estimated for seven consecutive days after weaning are presented in Table 10.

Post weaning serum protein levels (g %) on zero to six days was not significantly different.

The mean serum protein (g %) values were 6.43 ± 0.14, 6.50 ± 0.15, 6.39 ± 0.13, 6.65 ± 0.15, 6.72 ± 0.16, 6.79 ± 0.15 and 6.89 ± 0.14 in ram lambs during zero to six days post weaning, respectively.

The mean serum protein (g %) content of ram lambs among treatments was also not significant and values were 6.63 ± 0.12, 6.72 ± 0.12, 6.63 ± 0.10 and 6.53 ± 0.11 in T-1, T-2, T-3 and T-4, respectively.

#### 4.4.1.3 Urea:

Serum urea levels estimated for seven consecutive days after weaning are shown in Table 11.

**Table 10. Post weaning serum protein (mg/dl) of ram lambs weaned at different ages** [NS]

| S.No. | Treatment | 0 Day | 1st Day | 2nd Day | 3rd Day | 4th Day | 5th Day | 6th Day | Mean |
|---|---|---|---|---|---|---|---|---|---|
| 1 | T 1 | 6.74 ± 0.35 | 6.67 ± 0.33 | 6.40 ± 0.06 | 6.42 ± 0.29 | 6.48 ± 0.51 | 6.82 ± 0.08 | 6.86 ± 0.40 | 6.63 ± 0.12 |
| 2 | T 2 | 6.49 ± 0.21 | 6.40 ± 0.39 | 6.57 ± 0.47 | 7.03 ± 0.15 | 6.65 ± 0.27 | 6.81 ± 0.39 | 7.08 ± 0.14 | 6.72 ± 0.12 |
| 3 | T 3 | 6.29 ± 0.32 | 6.75 ± 0.18 | 6.33 ± 0.18 | 6.96 ± 0.18 | 6.76 ± 0.22 | 6.64 ± 0.43 | 6.67 ± 0.30 | 6.63 ± 0.10 |
| 4 | T 4 | 6.23 ± 0.24 | 6.21 ± 0.30 | 6.24 ± 0.23 | 6.19 ± 0.41 | 6.98 ± 0.21 | 6.91 ± 0.17 | 6.92 ± 0.22 | 6.53 ± 0.11 |
| | Mean | 6.43 ± 0.14 | 6.50 ± 0.15 | 6.39 ± 0.13 | 6.65 ± 0.15 | 6.72 ± 0.16 | 6.79 ± 0.15 | 6.89 ± 0.14 | |

NS: values in a row or column do not differ significantly.

**Table 11. Post weaning serum urea (mg/dl) of ram lambs weaned at different ages** [NS]

| S.No. | Treatment | 0 Day | 1st Day | 2nd Day | 3rd Day | 4th Day | 5th Day | 6th Day | Mean |
|---|---|---|---|---|---|---|---|---|---|
| 1 | T 1 | 15.03 ± 1.00 | 12.04 ± 1.43 | 12.13 ± 1.25 | 14.71 ± 0.90 | 14.76 ± 0.58 | 13.23 ± 0.96 | 14.03 ± 1.13 | 13.70 ± 0.41 |
| 2 | T 2 | 14.60 ± 0.70 | 11.98 ± 0.73 | 14.15 ± 1.60 | 12.21 ± 1.31 | 12.31 ± 1.03 | 11.58 ± 1.05 | 14.06 ± 0.95 | 12.98 ± 0.42 |
| 3 | T 3 | 15.00 ± 0.28 | 14.11 ± 0.36 | 12.64 ± 2.36 | 11.40 ± 0.73 | 12.56 ± 0.55 | 12.57 ± 0.54 | 12.85 ± 0.44 | 13.02 ± 0.39 |
| 4 | T 4 | 12.49 ± 1.01 | 10.59 ± 0.51 | 10.38 ± 1.92 | 13.57 ± 0.88 | 12.14 ± 0.42 | 12.40 ± 0.54 | 12.70 ± 0.47 | 12.04 ± 0.37 |
| | Mean | 14.28 ± 0.43 | 12.18 ± 0.47 | 12.32 ± 0.90 | 12.97 ± 0.52 | 12.94 ± 0.38 | 12.45 ± 0.40 | 13.41 ± 0.40 | |

NS: values in a row or column do not differ significantly.

Post weaning serum urea levels (mg/dl) on zero to six days was not significantly different.

The mean serum urea (mg/dl) values were 14.28 ± 0.43, 12.18 ± 0.47, 12.32 ± 0.90, 12.97 ± 0.52, 12.94 ± 0.38, 12.45 ± 0.40 and 13.41 ± 0.40 in ram lambs during zero to six days post weaning, respectively.

The mean serum urea (mg/dl) content of ram lambs among treatments was also not significant and values were 13.70 ± 0.41, 12.98 ± 0.42, 13.02 ± 0.39 and 12.04 ± 0.37 in T-1, T-2, T-3 and T-4, respectively.

### 4.4.2 Biochemical studies in ram lambs at monthly intervals post weaning

The serum glucose, total protein and urea of ram lambs were estimated at monthly intervals after weaning to study the effect of weaning stress.

#### 4.4.2.1 Glucose

Serum glucose levels estimated at monthly intervals after weaning are presented in Table 12.

Serum glucose (mg/dl) content of ram lambs in T-1, T-2 and T-3 were not significantly different during the study period. However in T-4 it was significantly higher ($P < 0.01$) during the fifth and sixth months than during third and fourth month. It was also higher during the fourth month when compared to third month glucose level.

The mean serum glucose level (mg/dl) was significantly higher ($P < 0.01$) during the fifth (59.28 ± 2.43) and sixth (62.79 ± 2.60) months than the levels observed during second (55.10 ± 1.76), third (56.80 ± 3.64) and fourth months (56.58 ± 2.31).

**Table 12. Effect of weaning at different ages on serum glucose (mg/dl) level of ram lambs**

| S.No. | Treatment | 2nd month | 3rd month | 4th month | 5th month | 6th month | Mean** |
|---|---|---|---|---|---|---|---|
| 1 | T 1NS | 55.10 ± 1.76 | 45.83 ± 5.53 | 47.02 ± 1.28 | 48.16 ± 1.28 | 51.53 ± 3.14 | 49.49 b ± 1.40 |
| 2 | T 2NS | - | 78.45 ± 4.16 | 77.88 ± 2.90 | 73.92 ± 3.93 | 79.93 ± 2.57 | 77.60 a ± 1.72 |
| 3 | T 3NS | - | - | 46.57 ± 2.51 | 50.28 ± 4.11 | 48.60 ± 1.65 | 48.48 b ± 1.67 |
| 4 | T 4** | - | 45.13 C ± 2.82 | 54.27 B ± 2.96 | 69.87 A ± 4.13 | 76.43 A ± 3.96 | 60.57 a ± 2.65 |
| | Mean** | 55.10 B ± 1.76 | 56.80 B ± 3.64 | 56.58 B ± 2.31 | 59.28 A ± 2.43 | 62.79 A ± 2.60 | |

NS: values in a row do not differ significantly.
ABC values in a row not sharing common superscripts differ significantly ** (P < 0.01).
ab values in a column not sharing common superscripts differ significantly ** (P < 0.01).


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Similarly the mean serum glucose level (mg/dl) of ram lambs in T-2 (77.60 ± 1.72) and T-4 (60.57 ± 2.65) was significantly higher ($P < 0.01$) than in the ram lams maintained on T-1 (49.49 ± 1.40) or T-3(48.48 ± 1.67).

#### 4.4.2.2 Total Protein

Serum total protein levels estimated at monthly intervals after weaning are presented in Table 13.

Serum protein level (g %) of ram lambs in T-1 or T-2 was not significantly different during the study period. However it was significantly lower ($P < 0.01$) during the fourth month in T-3 and during third and fourth month in T-4 when compared with the serum protein levels during fifth and sixth months.

The mean serum protein level (g %) was significantly higher ($P < 0.01$) during the second (6.47 ± 0.33), fifth (6.76 ± 0.19) and sixth (7.26 ± 0.13) months than during third (5.61 ± 0.21) and fourth months (6.02 ± 0.20).

The mean serum protein level (g %) of ram lambs maintained on T-4 (5.78 ± 0.29) was significantly lower ($P < 0.01$) than those maintained on T-1 (6.68 ± 0.11), T-2 (6.70 ± 0.13) or T-3(6.43 ± 0.26).

#### 4.4.2.3 Urea

Serum urea levels estimated at monthly intervals after weaning are presented in Table 14.

Serum urea level (mg/dl) of ram lambs in T-1 or T-3 was not significantly different during the study period. However it was significantly lower ($P < 0.05$) during the fourth month in T-2 and T-4 when compared with the serum urea levels during third, fifth and sixth months.

**Table 13. Effect of weaning at different ages on serum protein (mg/dl) level of ram lambs**

| S.No. | Treatment | 2nd month | 3rd month | 4th month | 5th month | 6th month | Mean** |
|---|---|---|---|---|---|---|---|
| 1 | T 1NS | 6.47 ± 0.33 | 6.29 ± 0.28 | 6.86 ± 0.17 | 6.96 ± 0.20 | 6.84 ± 0.19 | 6.68 a ± 0.11 |
| 2 | T 2NS | - | 6.22 ± 0.22 | 6.79 ± 0.22 | 6.95 ± 0.36 | 6.92 ± 0.20 | 6.70 a ± 0.13 |
| 3 | T 3** | - | - | 5.30 C ± 0.41 | 6.18 B ± 0.35 | 7.81 A ± 0.25 | 6.43 a ± 0.26 |
| 4 | T 4** | - | 4.20 B ± 0.19 | 4.80 B ± 0.32 | 7.06 A ± 0.60 | 7.40 A ± 0.26 | 5.78 b ± 0.29 |
| | Mean** | 6.47 B ± 0.33 | 5.61 C ± 0.21 | 6.02 C ± 0.20 | 6.76 B ± 0.19 | 7.26 A ± 0.13 | |

NS: values in a row do not differ significantly.

ABC values in a row not sharing common superscripts differ significantly ** (P < 0.01).

abvalues in a column not sharing common superscripts differ significantly ** (P < 0.01)

**Table 14. Effect of weaning at different ages on serum urea (mg/dl) level of ram lambs**

| S.No. | Treatment | 2nd month | 3rd month | 4th month | 5th month | 6th month | Mean* |
|---|---|---|---|---|---|---|---|
| 1 | T 1NS | 14.43±1.34 | 11.58±1.34 | 11.58±1.34 | 11.99±1.34 | 11.45±1.40 | 12.21 b ±0.60 |
| 2 | T 2* | - | 14.08 AB ±1.34 | 11.43 B ±1.34 | 13.12 AB ±1.47 | 14.80 A ±1.47 | 13.36 ab ±0.70 |
| 3 | T 3NS | - | - | 15.78±1.34 | 13.88±1.34 | 14.05±1.34 | 14.59 a ±0.77 |
| 4 | T 4* | - | 12.73 AB ±1.40 | 11.19 B ±1.55 | 13.90 A ±1.55 | 13.86 A ±1.55 | 12.92 b ±0.75 |
| 5 | MeanNS | ` | 12.80±0.78 | 12.49±0.69 | 13.23±0.71 | 13.56±0.72 | |

NS: values in a row do not differ significantly.

AB values in a row not sharing common superscripts differ significantly * ($P < 0.05$).

ab values in a column not sharing common superscripts differ significantly * ($P < 0.05$)

The mean serum urea level (mg/dl) of ram lambs was not significantly different among treatments and the values were 12.80±0.78, 12.49±0.69, 13.23±0.71 and 13.56±0.72 for third, fourth fifth and sixth months, respectively.

The mean serum urea level (mg/dl) of ram lambs maintained on T-1 (12.21 ± 0.60) and T-4 (12.92 ±0.75) were significantly lower ($P < 0.05$) than those maintained on T-3(14.59 ± 0.77) while in T-2 (13.36 ±0.70) it was comparable with other treatments.

**4.5 Body weights of ewes**

The mean body weights of ewes are presented in Table 15. The means of body weight of ewes in T-1 were 38.08 ± 1.17, 35.00 ± 0.90, 33.67 ± 0.78, 32.38 ± 0.61, 32.29 ± 0.69, 34.54 ± 0.84, 31.50 ± 1.24 and 33.67 ± 0.78 kg, respectively for weight at lambing, 1st month, 2nd month, 3rd month, 4th month, 5th month, 6th month and at weaning, whereas the corresponding values in T-2 were 36.79 ± 1.28, 32.75 ± 1.30, 32.29 ± 0.96, 31.64 ± 0.93, 31.00 ± 0.95, 30.82 ± 0.82, 30.31 ± 0.71 and 31.64 ± 0.93 kg, respectively and those of T-3 were 36.25 ± 1.51, 35.92 ± 1.26, 31.75 ± 1.13, 31.54 ± 1.04, 31.50 ± 1.04, 30.91 ± 1.00, 27.73 ± 1.08 and 31.50 ± 1.04 kg, respectively and for the same in T-4, the values were 36.83 ± 1.51, 35.17 ± 1.29, 33.63 ± 1.18, 31.92 ± 1.12, 29.67 ± 1.08, 29.45 ± 1.00, 28.86 ± 0.84 and 31.92 ± 1.12 kg, respectively. The weights of the ewes at 5th month were significantly ($P < 0.01$) higher in T-1 than other treatments which do not differ significantly among themselves. The weights of the ewes at 6th month were significantly ($P < 0.05$) higher in T-1 than other treatments which were comparable.

**Table 15. Least square means (±SE) of live body weights (kg) of Nellore dams at monthly intervals**

| SNatment | | At lambing $^{NS}$ | 1 month $^{NS}$ | 2 month $^{NS}$ | 3 month $^{NS}$ | 4 month $^{NS}$ | 5 month$^{**}$ | 6 month$^{*}$ | At weaning $^{NS}$ |
|---|---|---|---|---|---|---|---|---|---|
| 1 | T -1 ( 2 m) | 38.08 ± 1.17 | 35.00 ± 0.90 | 33.67 ± 0.78 | 32.38 ± 0.61 | 32.29 ± 0.69 | 34.54 ± 0.84$^{a}$ | 31.50 ± 1.24$^{a}$ | 33.67 ± 0.78 |
| 2 | T- 2 ( 3 m) | 36.79 ± 1.28 | 32.75 ± 1.30 | 32.29 ± 0.96 | 31.64 ± 0.93 | 31.00 ± 0.95 | 30.82 ± 0.82$^{b}$ | 30.31 ± 0.71$^{ab}$ | 31.64 ± 0.93 |
| 3 | T- 3 ( 4 m) | 36.25 ± 1.51 | 35.92 ± 1.26 | 31.75 ± 1.13 | 31.54 ± 1.04 | 31.50 ± 1.04 | 30.91 ± 1.00$^{b}$ | 27.73 ± 1.08$^{b}$ | 31.50 ± 1.04 |
| 4 | T -4 (3 m) | 36.83 ± 1.51 | 35.17 ± 1.29 | 33.63 ± 1.18 | 31.92 ± 1.12 | 29.67 ± 1.08 | 29.45 ± 1.00$^{b}$ | 28.86 ± 0.84$^{ab}$ | 31.92 ± 1.12 |

$^{NS}$ values in a column do not differ significantly.

$^{ab}$values in a column not sharing common superscripts differ significantly ($P < 0.01$).

$^{ab}$values in a column not sharing common superscripts differ significantly ($P < 0.05$)

## 4.6 Body measurements of experimental ewes

The body measurements of the ewes were presented in Tables 16, 17 18 and 19. The parameters are presented as means along with their standard errors.

### 4.6.1 Body length of ewes

The lengths of ewes in different treatments are presented in Table 16. The mean body length in female sheep at lambing were 60.92 ± 0.92, 65.08 ± 0.76, 61.42 ± 0.51 and 62.25 ± 0.79 cm for T-1, T-2, T-3 and T-4 treatments respectively whereas the corresponding values at two months were 65.17 ± 1.34, 67.67 ± 0.87, 63.33 ± 0.66 and 63.75 ± 0.96 cm respectively and those at weaning were 65.17 ± 1.34, 68.00 ± 0.89, 64.08 ± 0.74 and 64.33 ± 1.10 cm, respectively. The corresponding values for six months age were 66.67 ± 0.96, 68.75 ± 0.92, 65.60 ± 1.01 and 67.09 ± 0.67 cm respectively. The length of ewes at lambing were significantly ($P < 0.01$) higher in T-2 compared to other treatments T-1, T-3 and T-4 (control) which did not differ significantly among themselves. The length of ewes at two months and at weaning were significantly ($P < 0.05$) higher in T-2 compared to other treatments T-1, T-3 and T-4 (control) which did not differ significantly among themselves. There was no significant difference between the treatments with regard to body length at six months age.

### 4.6.2 Height at withers of ewes

The heights of ewes in different treatments are presented in Table 17. The height of ewes at lambing were 74.67 ± 0.78, 73.50 ± 1.16, 69.75 ± 1.16 and 72.00 ± 0.75 cm for T-1, T-2, T-3 and T-4 treatments, respectively whereas the corresponding values at two months were 77.83 ± 0.80, 75.25 ± 1.33,70.83 ± 1.15

**Table 16. Mean (± SE) for body length (cm) of ewes weaned at different ages**

| S.No | Treatment | At lambing ** | 2 months * | At weaning * | 6 months NS |
|---|---|---|---|---|---|
| 1 | T 1 | $60.92^{b} \pm 0.92$ | $65.17^{ab} \pm 1.34$ | $65.17^{ab} \pm 1.34$ | $66.67 \pm 0.96$ |
| 2 | T2 | $65.08^{a} \pm 0.76$ | $67.67^{a} \pm 0.87$ | $68.00^{a} \pm 0.89$ | $68.75 \pm 0.92$ |
| 3 | T 3 | $61.42^{b} \pm 0.51$ | $63.33^{b} \pm 0.66$ | $64.08^{b} \pm 0.74$ | $65.60 \pm 1.01$ |
| 4 | T 4 | $62.25^{b} \pm 0.79$ | $63.75^{b} \pm 0.96$ | $64.33^{ab} \pm 1.10$ | $67.09 \pm 0.67$ |

**Table 17. Mean (±SE) for height at withers (cm) of ewes weaned at different ages**

| S.No | Treatment | At lambing ** | 2 months ** | Weaning ** | 6 months ** |
|---|---|---|---|---|---|
| 1 | T 1 | $74.67^{a} \pm 0.78$ | $77.83^{a} \pm 0.80$ | $77.83^{a} \pm 0.80$ | $79.78^{a} \pm 1.00$ |
| 2 | T2 | $73.50^{a} \pm 1.16$ | $75.25^{ab} \pm 1.33$ | $76.64^{a} \pm 1.33$ | $77.13^{a} \pm 0.99$ |
| 3 | T 3 | $69.75^{b} \pm 1.16$ | $70.83^{c} \pm 1.15$ | $71.33^{b} \pm 1.33$ | $72.50^{b} \pm 1.38$ |
| 4 | T 4 | $72.00^{ab} \pm 0.75$ | $73.42^{bc} \pm 0.73$ | $74.58^{ab} \pm 0.82$ | $76.91^{a} \pm 0.88$ |

**Table18. Mean (±SE) for chest girth (cm) of ewes weaned at different ages**

| S.No | Treatment | At lambing NS | 2 months NS | Weaning ** | 6 months * |
|---|---|---|---|---|---|
| 1 | T 1 | $84.83 \pm 0.79$ | $79.67 \pm 0.48$ | $79.67^{a} \pm 0.48$ | $81.11^{a} \pm 1.18$ |
| 2 | T2 | $85.08 \pm 0.94$ | $79.67 \pm 0.48$ | $80.91^{a} \pm 1.24$ | $80.13^{ab} \pm 1.71$ |
| 3 | T 3 | $83.58 \pm 1.10$ | $78.50 \pm 0.92$ | $67.50^{b} \pm 1.36$ | $76.80^{b} \pm 1.01$ |
| 4 | T 4 | $83.58 \pm 0.90$ | $79.25 \pm 1.03$ | $77.75^{a} \pm 1.13$ | $77.09^{ab} \pm 0.95$ |

**Table 19. Mean (±SE) for paunch girth (cm) of ewes weaned at different ages**

| S.No | Treatment | At lambing NS | 2 months * | Weaning ** | 6 months * |
|---|---|---|---|---|---|
| 1 | T 1 | $86.00 \pm 1.18$ | $78.17^{ab} \pm 1.26$ | $78.17^{a} \pm 1.26$ | $78.89^{a} \pm 0.82$ |
| 2 | T2 | $85.33 \pm 1.14$ | $78.17^{ab} \pm 1.26$ | $75.82^{a} \pm 1.13$ | $74.75^{ab} \pm 1.37$ |
| 3 | T 3 | $83.25 \pm 1.63$ | $81.58^{a} \pm 1.59$ | $67.33^{b} \pm 1.57$ | $72.50^{b} \pm 1.80$ |
| 4 | T 4 | $84.17 \pm 1.06$ | $75.08^{b} \pm 1.25$ | $75.50^{a} \pm 0.91$ | $73.09^{b} \pm 1.40$ |

$^{abc}$ values in a column not sharing common superscripts differ significantly
$^{**}$ ($P < 0.01$).
$^{ab}$ values in a column not sharing common superscripts differ significantly
$^{*}$ ($P < 0.05$).
NS in a column not differed significantly

and 73.42 ± 0.73cm, respectively and those at weaning were 77.83 ± 0.80, 76.64 ± 1.33,71.33 ± 1.33 and 74.58 ± 0.82 cm, respectively and those at six months were 79.78 ± 1.00, 77.13 ± 0.99, 72.50 ± 1.38 and 76.91 ± 0.88cm, respectively. The mean height of ewes differ significantly ($P < 0.01$) among treatments at various ages.

### 4.6.3 Chest girth of ewes

The chest girth measurements of ewes are shown in Table 18.The mean girths of female sheep at lambing were 84.83 ± 0.79, 85.08 ± 0.94, 83.58 ± 1.10 and 83.58 ± 0.90 cm for T-1, T-2, T-3 and T-4 treatments, respectively whereas the corresponding values at 2 months were 79.67 ± 0.48, 79.67 ± 0.48, 78.50 ± 0.92 and 79.25 ± 1.03 cm and those at weaning were 79.67 ± 0.48, 80.91 ± 1.24, 67.50 ± 1.36 and 77.75 ± 1.13 cm, respectively. The corresponding values for 6 months age were 81.11 ± 1.18, 80.13 ± 1.71, 76.80 ± 1.01 and 77.09 ± 0.95 cm, respectively. There was no significant difference between the treatments with regard to chest girth of ewes at lambing and at two months. The mean chest girth of ewes at weaning was significantly ($P < 0.01$) lower in T-3 compared to other treatments which did not differ significantly among treatments. The mean chest girth of ewes at 6 months differ significantly ($P < 0.05$) and it was lower in T-3 than other treatments which were comparable.

### 4.6.4 Paunch girth of ewes

The paunch girth measurements of lambs are presented in Table 19. The mean paunch girths of female sheep at lambing were 84.83 ± 0.79, 85.08 ± 0.94, 83.58 ± 1.10 and 83.58 ± 0.90 cm for T-1, T-2, T-3 and T-4 treatments, respectively whereas the corresponding values at 2 months were 79.67 ± 0.48, 79.67 ± 0.48, 78.50 ± 0.92 and 79.25 ± 1.03 cm and those at weaning were 79.67 ± 0.48,

80.91 ± 1.24, 67.50 ± 1.36 and 77.75 ± 1.13 cm, respectively. The corresponding values for 6 months age were 81.11 ± 1.18, 80.13 ± 1.71, 76.80 ± 1.01 and 77.09 ± 0.95 cm, respectively. There was no significant difference between the treatments with regard to paunch girth of lambs at lambing. The paunch girth of ewes at 2 months was significantly ($P < 0.05$) lower in T-4 than other treatments which were comparable. The paunch girth of ewes differ significantly ($P < 0.01$) among treatments at weaning and at 6 months age.

## 4.7 POST PARTUM OESTRUS

The resumption of ovarian cyclicity after parturition and body weights and body measurements of ewes at resumption of post partum heat are presented in the Table 20 and 21.

### 4.7.1 Percent return to oestrus

The percent of ewes returned to oestrus was found to be 88.89%, 87.50%, 90.91% and 90.91% for the treatments T-1, T-2, T-3 and T-4, respectively.

### 4.7.2 Number of days taken to resumption of oestrus

The means for number of days to return to oestrus after parturition were 161.90±6.76, 184.50±10.09, 193.60±5.08 and 186.63±3.94 days, for the treatments T-1, T-2, T-3 and T-4, respectively. Resumption of ovarian cyclicity after parturition was significantly ($P <0.01$) lower in T-1 than other treatments which were comparable.

**Table 20. Post partum resumption of ovarian cyclicity in experimental ewes**

| S.No | Treatment | No. of days to return to estrus* | % of ewes returned to estrus |
|---|---|---|---|
| 1 | T-1 | 161.90 [b] ±6.76 | 88.89% |
| 2 | T-2 | 184.50 [ab] ±10.09 | 87.50% |
| 3 | T-3 | 193.60 [a] ±5.08 | 90.91% |
| 4 | T-4 | 186.63 [a] ±3.94 | 90.91% |

[ab]values in a column not sharing common superscripts differ significantly [*] ($P < 0.05$).

**Table 21: Body measurements and body weights of ewes at post partum resumption of ovarian cyclicity [NS]**

| S.No | Treatments | Body length (cm) | Height at withers (cm) | Chest girth (cm) | Paunch girth (cm) | Body weight (kg) |
|---|---|---|---|---|---|---|
| 1 | T-1 | 64.88±1.52 | 75.75±0.82 | 79.50±0.73 | 74.88±1.33 | 32.06±1.12 |
| 2 | T-2 | 63.00±2.38 | 76.00±2.35 | 77.25±1.31 | 72.50±1.32 | 29.25±1.30 |
| 3 | T-3 | 64.30±1.03 | 73.00±1.37 | 77.90±1.04 | 75.60±1.79 | 28.45±1.02 |
| 4 | T-4 | 61.90±1.59 | 73.00±1.03 | 77.30±1.02 | 72.90±1.54 | 28.90±0.90 |

[NS] values in a column do not differ significantly

### 4.7.3 Body weights and measurements of ewes at resumption of ovarian cyclicity

The means for body length (cm) of the ewes was 64.88±1.52, 63.00±2.38, 64.30±1.03, and 61.90±1.59, height at withers (cm) was 75.75±0.82, 76.00±2.35, 73.00±1.37 and 73.00±1.03, chest girth (cm) was 79.50±0.73, 77.25±1.31, 77.90±1.04 and 77.30±1.02 and paunch girth (cm) was 74.88±1.33, 72.50±1.32, 75.60±1.79 and 72.90±1.54, respectively for the treatments T-1, T-2, T-3 and T-4. The body weight of the ewes recorded at resumption of post partum heat was 32.06±1.12, 29.25±1.30, 28.45 ± 1.02 and 28.90±0.90 kg, for the treatments T-1, T-2, T-3 and T-4 respectively. The body length, height at withers, chest girth, and paunch girth and body weight were found non-significant among the treatments (Table 21).

## 4.8 COST OF PRODUCTION OF LAMBS

Economics of lamb production which includes cost of production, weight gain in lambs and consequently cost per animal as well as cost per kg weight gain are shown in tables 22 and 23.

Cost of feeding was found to be the major source of total cost of production for different treatments. Total feed costs for the treatments T-1, T-2, T-3 and T-4 were recorded as Rs. 11710.01, Rs. 10625.24, Rs. 11149.84 and Rs. 6185.65, respectively.

Same way the total cost of production for the respective groups was recorded as Rs. 19710.01, Rs. 18625.24, Rs. 19149.85 and Rs.14185.65.

**Table 22: Cost of feeding of experimental lambs**

| | Total creep feed intake (kg) | Total cost of creep feed @ Rs. 20/- per kg | Total concentrate intake (kg) | Total cost of concentrate @ Rs.19/-per kg | Total intake of green fodder (kg) | Total cost of green fodder @ Rs. 1/-per kg | Total intake of hay (kg) | Total cost of hay @ Rs. 2/-per kg | Total feed upto 6 months (kg) | Total feed cost (Rs.) |
|---|---|---|---|---|---|---|---|---|---|---|
| T-1 | 79.38 | 1587.6 | 466.29 | 8859.51 | 671.0125 | 671.0125 | 295.944 | 591.888 | 1512.6265 | 11710.011 |
| T-2 | 170.1 | 3402.0 | 316.17 | 6007.23 | 646.125 | 646.125 | 284.944 | 569.888 | 1417.339 | 10625.243 |
| T-3 | 260.82 | 5216.4 | 244.08 | 4637.52 | 688.200 | 688.200 | 303.864 | 607.728 | 1496.964 | 11149.848 |
| T-4 | 0 | 0 | 269.01 | 5111.19 | 570.662 | 570.662 | 251.900 | 503.800 | 1091.572 | 6185.652 |

**Table 23: Economics of lamb production**

| | Total cost of production (Rs.) | | | | | Weight gain (kg) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Feed cost | Labour | Medicines and other misc. expenses | Total cost | Cost per animal | Final weight | Initial weight | Weight gain | Cost per kg weight gain (Rs.) |
| **T-1** | 11710.01 | 7500 | 500 | 19710.01 | 1791.82 | 17.86 | 3.22 | 14.67 | 122.14 |
| **T-2** | 10625.24 | 7500 | 500 | 18625.24 | 1693.20 | 22.5 | 3.27 | 19.25 | 87.96 |
| **T-3** | 11149.85 | 7500 | 500 | 19149.85 | 1595.82 | 21.28 | 3.29 | 17.99 | 88.71 |
| **T-4** | 6185.65 | 7500 | 500 | 14185.65 | 1576.18 | 16.32 | 3.16 | 13.14 | 119.95 |

Cost per animal for the treatments T-1, T-2, T-3 and T-4 were recorded as Rs. 1791.82, Rs. 1693.20, Rs. 1595.82 and Rs. 1576.18 respectively.

Average weight gains in each treatment was recorded as 14.67 ± 0.49, 19.25 ± 0.59, 17.99 ± 1.27 and 13.14 ± 0.93 kg, respectively for the treatments T-1, T-2, T-3 and T-4.

When cost per kg weight gain was calculated T-2 recorded lowest of Rs. 87.96/- followed by T-3 of Rs. 88.71/- followed by T-4 of Rs.119.95/- and T-1 of Rs. 122.14/-.

### 4.9 Mortality

Both pre weaning and post weaning mortality of selected lambs under each treatment is presented in Table 24. Pre weaning mortality was recorded upto two months in T-1, three months for T-2 and T-4 and four months for T-3 treatments. Post weaning mortality of lambs was recorded from the day of weaning to the attainment of six months of age.

On perusal of Table 24, it was revealed that there was 8.33 per cent pre weaning mortality in treatment T-4 where as T-1, T-2 and T-3 recorded zero percent mortality.

As far as post weaning mortality is concerned T-4 recorded 18.18 per cent mortality which is highest among the treatments where as in T-1 and T-2 post weaning mortality was 8.33 per cent. There was zero percent mortality in T-3.

**Table 24. Mortality (%) of lambs weaned at different ages**

| S.No. | Treatment | No. of lambs at birth | No. of lambs at weaning | Pre weaning mortality (%) | No. of lambs at six months | Post weaning mortality |
|---|---|---|---|---|---|---|
| 1 | T-1 | 12 | 12 | 0 | 11 | 8.33 |
| 2 | T-2 | 12 | 12 | 0 | 11 | 8.33 |
| 3 | T-3 | 12 | 12 | 0 | 12 | 0 |
| 4 | T-4 | 12 | 11 | 8.33 | 9 | 18.18 |

## 4.10 CHEMICAL COMPOSITION OF EXPERIMENTAL FEEDS

The chemical composition of the feeds offered during experiment is presented in Table 25. The dry matter, crude protein, crude fibre, ether extract, nitrogen free extract and total ash content of Creep feed, Concentrate, Hybrid Napier, Lucerne and Horse gram were 90.6, 19.8, 19.5, 2.52, 51.76 and 6.42; 90.4, 16.2, 15.2, 2.52, 59.66 and 6.42; 28.2, 7.70, 27.81, 2.10, 52.87, and 9.52; 28.2, 7.70, 27.81, 2.10, 52.87 and 9.52; 89.2, 13.8, 26.2, 0.42, 51.44 and 8.14; 90.2, 9.48, 26.2, 0.52, 55.52 and 8.28 per cent, respectively.

**Table25. Chemical composition of experimental feeds (% dry matter basis)**

| Feed item | DM | CP | CF | EE | NFE | Ash |
|---|---|---|---|---|---|---|
| **I. Concentrate Diets offered to the lambs** | | | | | | |
| 1. Creep feed | 90.6 | 19.8 | 19.5 | 2.52 | 51.76 | 6.42 |
| 2. Concentrate | 90.4 | 16.2 | 15.2 | 2.52 | 59.66 | 6.42 |
| **II. Roughage diets offered to the lambs** | | | | | | |
| 1. Hybrid Napier ( green) | 28.2 | 7.70 | 27.81 | 2.10 | 52.87 | 9.52 |
| 2. Lucerne hay | 89.2 | 13.8 | 26.2 | 0.42 | 51.44 | 8.14 |
| 3. Horse gram hay | 90.2 | 9.48 | 26.2 | 0.52 | 55.52 | 8.28 |

DM= dry matter, CP=crude protein, CF= crude fibre, EE= ether extract, and NFE= nitrogen free extract.

# CHAPTER V
# DISCUSSION

The results presented in the previous chapter are discussed here thoroughly to have complete idea on effect of weaning age and feeding system on growth performance of lambs and post partum resumption of ovarian cyclicity in ewes.

## 5.1 BODY WEIGHTS OF LAMBS

Least square means of live body weights of Nellore ram lambs recorded from weaning to 24 weeks on weekly basis are presented in Table 2 which revealed that there was a significant difference ($P < 0.01$) among the treatments, showing that weaning of lambs at different ages and feeding practices related to offering of concentrate creep ration has got considerable influence on the weekly body weights.

Further lambs in treatments T-2 and T-3 have recorded higher body weights at different weeks starting from weaning to 24 weeks compared to lambs in T-4. The results were in concurrence with Abbas *et al* (2010) reported that normal and late weaned lambs were heavier significantly ($P < 0.01$) at third and fourth months of age than early weaned lambs. It indicated that average body weight recorded at three and four months of age increased with lengthening the suckling period and the growth of lambs is temporarily slowed down after weaning. The results regarding offering of creep feed to lambs were similar with Poe *et al* (1969) who reported that lambs on creep diets gained faster than lambs fed milk only. However Nagaraja Ramakrishnappa *et al* (2013) and Abbas *et al* (2010) reported that early and normal weaned lambs were heavier than late weaned lambs with no significant difference.

The present findings differ with Abou Ward *et al* (2008) who reported that early weaned lambs recorded higher body weights when compared to the na
weaned lambs.

## 5.2 GROWTH PERFORMANCE OF LAMBS

### 5.2.1 Body weight gain

Perusal of Table 3 revealed that lambs in T-3 fed milk plus creep feed and weaned at four months of age recorded highest pre weaning weight gain of 14.21 ± `1.01 kg compared to other treatments. The pre weaning weight gain and total weaning weight gain were significantly ($P < 0.01$) higher for T-2 and T-3 than in T-1 and T-4 treatments. The reason could be that lambs in T-3 took advantage of late weaning since they received mother's milk as well as creep in a better way compared to other groups.

Experimental lambs in T-2 group recorded highest post weaning as well as total weight gain of 6.71 ± 0.25 kg and 19.25 ± 0.59 kg, respectively. Further lambs in treatments T-1 and T-2 recorded significantly ($P < 0.01$) higher post weaning gain compared to T-3 and T-4 treatments. While the lambs in T-3 which received milk and creep feed and weaned at four months performed better, the lambs in T-4 which were denied creep feed and weaned at three months performed least among the four treatment groups proving the importance of recommended practice of offering creep feed for better body gains. However Selaive-Villaroel *et al* (2008) reported that lambs weaned at 60, 75 and 90 days of age showed similar post-weaning growth rates. Whereas Rafiqul Islam *et al* (2005) found that the unweaned lambs up to 6 months of age are more profitable in respect of body weight gain when compared to lambs weaned at 3 months of age.

### 5.2.2 Average Daily Gain

Perusal of Table 4 revealed that pre weaning ADG was significantly ($P < 0.01$) higher in treatments T-1, T-2 and T-3 than T-4 while lambs in T-1 recorded the highest pre weaning ADG of 140.83 ± 7.45 g; T-4 recorded least pre weaning

ADG of 105.76 ± 7.57 g. Post weaning ADG was significantly ($P < 0.01$) higher in T-2 than all other treatment groups. As per overall ADG is concerned significant difference was observed among treatments. Lambs in T-4 which was denied creep feed recorded least pre weaning, post weaning and overall ADG among all treatments confirming the importance of inclusion of creep feed in lamb rearing for better growth rates. Lambs in T-2 receiving milk and creep feed and weaned at 3 months showed better performance with regard to post weaning and overall ADG compared to other treatments. The pre weaning average daily gain results were in concurrence with Abdel-Fattah *et al* (2013a) who found that early weaned lambs tended to have greater ($P<0.01$) ADG than late-weaned lambs. Similar results were reported by Schichowski *et al* (2008) who found that lambs weaned at 8 weeks of age had significantly higher average daily gain compared with the lambs weaned at 16 weeks of age. However Nagaraja Ramakrishnappa *et al* (2013) reported that there is no significant difference ($P > 0.05$) in post weaning growth in terms of average daily gain between the groups. Ekiz *et al* (2012) reported that lambs suckled until slaughter age (120 days) had higher ADG than those weaned at either 45 days or 75 days ($P<0.001$). Gauly *et al* (2004) noticed that the lower average daily gain in lambs weaned at age of 40 days compared to unweaned lambs and concluded that it might be due to weaning stress.

## 5.3 BODY MEASUREMENTS OF EXPERIMENTAL LAMBS

The body measurements of the lambs in four treatments are presented in Tables 5, 6, 7 and 8. Body measurements as well as body weights are indirect indicators of growth performance in growth studies. Thus the body measurements correlate with body weights and body weight gains.

### 5.3 .1 Body length of lambs

The mean body length of lambs in different treatments was presented in Table 5. There was a significant ($P < 0.01$) difference between the treatments with regard to body length of lambs at all ages except at birth.

It is quiet natural that the significant differences of body length at two months, weaning and six months are due to corresponding increase in body weights of lambs at different ages.

### 5.3.2 Height at withers of lambs

Perusal of Table 6 indicated that there was significant ($P < 0.01$) difference at weaning and at six months between the treatments with regard to height of lambs. Whereas at birth and at two months of age height at withers did not differ significantly among the treatments.

### 5.3.3 Chest girth of lambs

The chest girth measurements of lambs pertaining to different treatments at birth, two months, weaning and six months are presented in Table 7 which indicated that there was significant ($P < 0.01$) difference at weaning and six months between the treatments with regard to chest girth of lambs. Whereas differences were non-significant at birth as well as at two months of age.

### 5.3.4 Paunch girth of lambs

The paunch girth measurements of lambs were presented in Table 8. Scrutiny of Table 8 indicates that the paunch girths of lambs did not differ significantly between the treatments at birth and at two months of age. However the paunch girth of lambs differ significantly ($P < 0.01$) at weaning and at six months age.

## 5.4 BIOCHEMICAL STUDIES

### 5.4.1 Biochemical studies in ram lambs up to one week after weaning

#### 5.4.1.1 Glucose

Scrutiny of Table 9 with regard to post weaning serum glucose levels of ram lambs weaned at different ages, it could be noticed that compared to zero day of weaning glucose levels show a sharp decline on first and second day after weaning And further the levels sharply got raised on third day and were maintained upto sixth day in all the treatments. This effect could be due to weaning stress during first and second days and due to acclimatization for the new environment. Poe *et al* (1969) also reported that glucose concentration dropped sharply immediately after weaning.

The mean serum glucose levels of experimental lambs in T-1 and T-2 were significantly ($P< 0.01$) higher than those in T-3 and T-4. It is further observed that lambs in T-4 recorded lowest mean glucose levels i.e. 45.47 ± 0.15 mg/dl which could be due to nutritional stress since creep feed was not offered for this particular treatment lambs. Blood glucose levels up to third day after weaning were lower than normal range of 50-80 mg/dl as reported by Dhanotia, 2004.

The lower values recorded in the present study might be due to transitional phase of pre ruminant stage of weaners used in the experiment.

#### 5.4.1.2 Total protein

Perusal of Table 10 indicates that post weaning serum protein levels (mg/dl) from zero to six days of weaning was not significantly different among all the treatments showing that there is a little effect of weaning stress on the levels of serum protein among the experimental lambs of all treatments. Poe *et al* (1969) also reported that protein levels remained relatively stable throughout the period. Porwal *et al* (2006) also reported no significant differences among different systems of rearing.

#### 5.4.1.3 Urea

Perusal of Table 11 indicates that post weaning serum urea levels (mg/dl) from zero to six days of weaning was not significantly different among all the treatments showing that there is a little effect of weaning stress on the levels of serum urea among the experimental lambs of all treatments. The values were in the lower range of normal values of 10-30 mg/dl. However Poe *et al* (1969) reported that urea levels dropped at weaning and slowly increased with ingestion of feed and development of rumen.

### 5.4.2 Biochemical studies in ram lambs at monthly intervals post weaning

#### 5.4.2.1 Glucose

Serum glucose levels were estimated in ram lambs at monthly intervals and the results were presented in Table 12 which revealed that serum glucose mg/dl content of ram lambs in T-1, T-2 and T-3 were not significantly different. The values were within the normal range of 50-80 mg/dl as reported by Dhanotia, 2004. The overall blood glucose concentration was the reflection of digestive efficiency and plane of nutrition meeting faster rate of gain which is associated with compensatory improvement in digestive efficiency resulting in better availability of substrate in the body pool. Leat (1974) reported blood glucose levels between 55

and 72 mg/dl in sheep and Karim and Verma (2000) reported 50.72 mg/dl in Malpura lambs.

There was a significantly higher level of serum glucose in T-4 especially during fifth and sixth months than in third and fourth months. Inclusion of concentrate feed in the ration after third month could be the reason for the said effect in T-4. The mean serum glucose level was significantly ($P<0.01$) higher during fifth and sixth months compared to second, third and fourth months. The serum glucose levels have improved with the establishment of rumen as the age advanced. Poe *et al* (1969), Porwal *et al* (2006) and More *et al* (2008) also indicated increase in the blood glucose levels as the age advances.

When treatment means of serum glucose levels of ram lambs were examined it was revealed that T-2 and T-4 recorded significantly ($P<0.01$) higher values than in ram lambs that come under T-1 or T-3. However Abdel-Fattah *et al* (2013b) reported that weaning age has no significant effect on plasma glucose concentration

**5.4.2.2 Total Protein**

The study on serum protein levels of ram lambs as depicted in Table 13 revealed that the values not pertaining to T-1 or T-2 were not significantly different during the study period. However the serum protein levels were significantly during the fourth month in T-3 and third and fourth month in T-4 when compared to the values during fifth and sixth months. The values were within the normal range of 5.0 7.9 mg/dl as reported by Dhanotia, 2004. Higher values were reported for lambs by Karim and Verma (2000).

The mean serum protein level with regard to monthly means was significantly ($P<0.01$) higher during second, fifth and sixth months compared to third and fourth months. Abdel Fattah et al (2013b) reported that protein levels will come down after one month after weaning. Further the mean serum protein levels of

lambs falling under T-4 were significantly lower than those maintained on T-1 or T-3. The total protein content in the serum is an indicative of feeding status of animals. Hence, it was reflected in their levels.

#### 5.4.2.3 Urea

The study on serum urea levels of ram lambs as depicted in Table 14 revealed that the values not pertaining to T-1 and T-3 were not significantly different during the study period. However the serum urea levels were lower in T-2 and T-4 when compared with the serum urea levels during third, fifth and sixth months.

The mean serum urea level with regard to monthly means was not significantly different among treatments.

The mean serum urea level of ram lambs maintained on T-1 and T-4 were significantly ($P<0.01$) lower than those maintained on T-3 while T-2 was comparable with other treatments.

Abdel Fattah *et al* (2013b) in their study with regard to early weaned and late weaned lambs reported that on the first month after weaning there was a decrease in the urea values in all both male and female lambs which is in concurrence with the present observations.

## 5.5 BODY WEIGHTS OF EWES

Least square means of body weights recorded at lambing, at weaning and afterwards up to 6 months were presented in Table 15 which revealed that there was no significant difference among the treatments at lambing, at weaning and also up to 4 months.

The weights of ewes at fifth month were significantly ($P < 0.01$) higher in T-1 than other treatments. The weight of ewes at sixth month were significantly

($P < 0.05$) higher in T-1 than T-3 and the values pertaining to T-2 and T-4 are comparable. T-1 recorded highest body weight at the time of weaning. The reason for higher body weights at fifth month and sixth month pertaining to T-1 may be primarily due to early weaning at the age of two months resulting in relief from lactation stress at the earliest compared to other treatments. Same way the lower body weights at sixth month for T-3 among other treatments showing the effect of suckling stress up to fourth month compared to other treatments. Martins and Peters (1992) observed that body weight of ewes in the first month post-partum was 40.8 kg in Karakul sheep. Kushwaha *et al* (1999) reported that the average adult body weight of Chokla sheep was 28.60 kg in females. Saravana kumar (2003) observed that the average body weight of adult female is 30.00±0.27 kg in Nellore sheep.

## 5.6 BODY MEASUREMENTS OF EXPERIMENTAL EWES

The body measurements of the lambs in four treatments are presented in Tables 16, 17, 18and 19.

### 5.6.1 Body length of ewes

The length of ewes in different treatments was presented in Table 16. perusal of which indicates that the length of ewes at lambing were significantly ($P < 0.01$) higher in T-2 compared to other treatments. The length of ewes at two months and at weaning were significantly ($P < 0.05$) higher in T-2 compared to other treatments T-1, T-3 and T-4. Further there was no significant difference between the treatments with regard to body length at six months age.

### 5.6.2 Height at withers of ewes

The height of ewes in different treatments was presented in Table17. Perusal of which indicates that the mean height of ewes differ significantly ($P < 0.01$) among treatments at lambing, two months, weaning and six months.

### 5.6.3 Chest girth of ewes

The chest girth measurements of ewes were shown in Table 18. Perusal of which indicates that the mean chest girth of ewes at weaning was significantly ($P < 0.01$) lower in T-3 compared to other treatments. The mean chest girth of ewes at 6 months differ significantly ($P < 0.05$) and it was lower in T-3 than other treatments. There was no significant difference between the treatments with regard to chest girth of ewes at lambing and at two months.

### 5.6.4 Paunch girth of ewes

The paunch girth measurements of lambs were presented in Table 19. Scrutiny of table indicates that the paunch girth of ewes at 2 months was significantly ($P < 0.05$) lower in T-4 than other treatments. The paunch girth of ewes differ significantly ($P < 0.01$) among treatments at weaning and at 6 months age.

Saravana kumar (2003) in a study on the performance of Nellore sheep observed that the average body length, height at withers and chest girth of adult ewes was 67.05±0.22, 72.75±0.24 and 72.78±0.23 cm, respectively.

## 5.7 POST PARTUM OESTRUS

Number of days taken to return to oestrus as well as percent of ewes returning to oestrus after lambing is an important parameter for the overall reproductive efficiency of the ewes as well as breeding management of the flock.

### 5.7.1 Percent return to oestrus

The same were recorded for ewes of four treatments and presented in Table 20. An important parameter to estimate the breeding efficiency of flock is percent of ewes returning to heat after parturition. From the same table it was revealed that the percent of ewes returned to oestrus ranged from 87.5 % to 90.91 % which was almost similar and comparable.

The higher percent of ewes returning to heat among all the treatments compared to farmer's flocks indicated better management and supervision and better identification of animals in heat by effective usage of teaser rams in an organized farm.

### 5.7.2 Number of days taken to resumption of oestrus

From the Table 20 it was revealed that resumption of ovarian cyclicity after parturition was significantly lower in T-1 than other treatments which were comparable. It was also revealed that ewes from T-1 treatment recorded 161.90 ± 6.76 days for post partum appearance of heat. These results are higher than the values reported by Hoefler and Hallford (1987) and Mukasa-Mugerwa and Lahlou-Kassi (1995). Hoefler and Hallford (1987) reported that interval from parturition to oestrus was similar ($P > 0.15$) in ewes nursing their offspring (117 ± 6 d) and those that had their lambs removed. Similar findings were reported by Fletcher (1973).

### 5.7.3 Body weights and measurements of ewes at resumption of ovarian cyclicity

Body condition in terms of body weights and body measurements throw some light on percent of ewes returned to oestrus and number of days taken to return to heat after parturition. In this direction an attempt was made to record the body measurements including body length, height at withers, chest girth and paunch girth

in addition to body weight at post partum first oestrus. However on perusal of Table 21 with regard to body weights and body measurements indicated that there was no significant difference among the treatments. However highest body weights were noticed among the ewes of T-1 where the lambs were weaned at an early age of two months indicating that early weaning is always beneficial for the ewes to have better body condition and return to heat at an early date as well as percent of ewes returning to heat.

## 5.8 COST OF PRODUCTION OF LAMBS

On perusal of Table 22 and 23 reveals that cost of feeding of lambs for treatment 4 were found to be lowest since they were not offered creep feed at al.

Cost per animal (after considering the mortality) was found to be1791.82, 1693.20, 1595.82 and 1576.18 rupees respectively for the treatments T-1, T-2, T-3 and T-4. Highest weight gains (kg) were recorded in T-2 (19.25 ± 0.59) followed by T-3 (17.99 ± 1.27), T-1 (14.67 ± 0.49) and T-4 (13.14 ± 0.93).

Cost per kg weight gain was lower in T-2 and T-3 compared to T-1 and T-4. The reason for higher cost per kg weight gain in T-4 may be attributed to the lower weight gains recorded in that treatment.

However Abou ward *et al* (2008) reported that feed cost (pt.) per kg weight gain did not differ statistically between early and natural weaned groups. Venkateswarlu and Ramana Reddy (2013) reported that cost per kg gains is less in supplemented animals.

## 5.9 MORTALITY

Perusal of Table 24 with regard to both pre and post weaning mortalities reflected that the mortalities were well within the acceptable limits except in the case of T-4 where the post weaning mortality was higher at 18.18%. The higher post

weaning mortality percent recorded in control group i.e T-4 is similar to farmer's practice where higher mortalities would be noticed. Reddy and choudhuri (2000) in their study on lamb mortality revealed that lamb mortality was higher (58.48 per cent) in the post weaning period than the pre-weaning period. Polat Ipek and Fikret Esen (2013) in their study on survival ability of Awassi lambs reported that survivability rates of 90th day were 100, 90 and 86.67% in first, second and third groups, which were weaned on 30, 60 and 90th days of ages, respectively reflecting higher mortalities in late weaned lambs.

# CHAPTER VI
# SUMMARY AND CONCLUSION

A study on the effect of weaning age and feeding system on growth performance and serum biochemical profile of lambs was carried out in Nellore male lambs. In addition the body weight changes of ewes and resumption of ovarian cyclicity in ewes was also studied. The experiment was carried out at Livestock Research Station, Palamaner, Chittoor district, A.P. Forty eight Nellore (Jodipi) lambs with an average body weight of 3.24 ± 0.04 kg were selected and were randomly distributed into four treatments of twelve animals each in four systems of rearing. The four treatments may be described as follows:

T-1, lambs fed milk plus concentrate creep and weaned early at 2 months of age

T-2, lambs fed milk plus concentrate creep and weaned at 3 months of age

T-3, lambs fed milk plus concentrate creep and weaned lately at 4 months of age

T-4, lambs fed milk only and weaned at 3 months of age (control).

Least square means of live body weights of Nellore ram lambs recorded from weaning to 24 weeks on weekly basis revealed that there was a significant difference ($P < 0.01$) among the treatments. A considerable influence on body weights of lambs was observed when the lambs were weaned at different ages and reared in different feeding practices. Lambs in T-4 (control) for which creep feed was not offered recorded lower body weights when compared to other treatments.

The pre weaning weight gain and total weaning weight gain were significantly ($P < 0.01$) higher for T-2 and T-3 than in T-1 and T-4 treatments. Lambs in T-3 took advantage of late weaning since they received mother's milk as well as creep in a better way compared to other groups.

Lambs in treatments T-1 and T-2 recorded significantly ($P<0.01$) higher 79 weaning gain compared to T-3 and T-4 treatments.

Pre weaning ADG of T-4 (105.76 ± 7.57g) was significantly lower than other treatments, while lambs in T-1 recorded the highest pre weaning ADG of 140.83 ± 7.45 g. Post weaning ADG was significantly ($P < 0.01$) higher in T-2 than all other treatment groups. The overall average daily gain for T-1, T-2, T-3 and T-4 treatments were 81.52 ± 2.71, 106.95 ± 3.28, 99.95 ± 7.05 and 73.10 ± 5.17 g, respectively and significant ($P<0.01$) difference was observed among the treatments.

Body length of lambs at six months age were 52.45 ± 0.78, 57.67 ± 1.53, 56.00 ± 0.61 and 52.22 ±1.43 cm for T1, T2, T3 and T4 treatments respectively. There was a significant ($P < 0.01$) difference between the treatments with regard to body length of lambs at all ages except at birth.

The mean height of lambs at weaning were 56.83 ± 1.41, 58.64 ± 1.59, 63.67 ± 1.34 and 56.64 ± 0.74 cm for T1, T2, T3 and T4 treatments and those of six months age were 65.18 ± 1.19, 70.90 ± 1.52, 67.83 ± 1.67 and 58.67 ± 0.93 cm, respectively. At two months age height at withers did not differ significantly. There was significant ($P<0.01$) difference at weaning and at six months between the treatments with regard to height of lambs.

There was significant ($P < 0.01$) difference between the treatments at weaning and 6 months. No significant difference was observed in chest girth of lambs at birth and 2 months age.

The paunch girths of lambs did not differ significantly between the treatments at birth and at two months age. The paunch girth of lambs differed significantly ($P<0.01$) at weaning and at six months age.

Serum glucose, total protein and urea were estimated for seven consecutive days after weaning. In all the treatments Serum glucose level was significantly lower ($P<0.01$) on first and second day after weaning and gradually started to increase from third day onwards.

The mean serum glucose levels (mg/dl) of ram lambs were in T-1 and T-2 significantly higher ($P < 0.01$) than those in T-3 and T-4 and the values were 54.73 ± 1.63, 52.58 ± 1.80, 48.17 ± 1.98 and 45.47 ± 1.59 for treatments T-1, T-2, T-3 and T-4, respectively.

Post weaning serum protein levels (mg/dl) on zero to six days was not significantly different. The mean serum protein (mg/dl) content of ram lambs among treatments was also not significant and values were 6.63 ± 0.12, 6.72 ± 0.12, 6.63 ± 0.10 and 6.53 ± 0.11 in T-1, T-2, T-3 and T-4, respectively. Post weaning serum urea levels (mg/dl) on zero to six days was not significantly different. The mean serum urea (mg/dl) content of ram lambs among treatments was also not significant and values were 13.70 ± 0.41, 12.98 ± 0.42, 13.02 ± 0.39 and 12.04 ± 0.37 in T-1, T-2, T-3 and T-4, respectively. Serum Protein and urea levels were not affected by weaning stress in all treatments.

Serum glucose, total protein and urea levels were estimated at monthly intervals after weaning.

The mean serum glucose level (mg/dl) was significantly higher ($P<0.01$) during the fifth (59.28 ± 2.43) and sixth (62.79 ± 2.60) months than the levels observed during second (55.10 ± 1.76), third (56.80 ± 3.64) and fourth months (56.58 ± 2.31) as glucose levels linearly increase with the age.

The mean serum glucose level (mg/dl) of ram lambs in T-2 (77.60 ± 1.72) and T-4 (60.57 ± 2.65) was significantly higher ($P < 0.01$) than in the ram lams maintained on T-1 (49.49 ± 1.40) or T-3(48.48 ± 1.67).

The mean serum protein level (mg/dl) was significantly higher ($P < 0.01$) during the second (6.47 ± 0.33), fifth (6.76 ± 0.19) and sixth (7.26 ± 0.13) months than during third (5.61 ± 0.21) and fourth months (6.02 ± 0.20).

The mean serum protein level (mg/dl) of ram lambs maintained on T-4 (5.78 ± 0.29) was significantly lower ($P < 0.01$) than those maintained on T-1 (6.68 ± 0.11), T-2 (6.70 ± 0.13) or T-3(6.43 ± 0.26).

The mean serum urea level (mg/dl) of ram lambs was not significantly different among treatments and the values were 12.80±0.78, 12.49±0.69, 13.23±0.71 and 13.56±0.72 for third, fourth fifth and sixth months, respectively.

The mean serum urea level (mg/dl) of ram lambs maintained on T-1 (12.21 ± 0.60) and T-4 (12.92 ±0.75) were significantly lower ($P < 0.05$) than those maintained on T-3 (14.59 ± 0.77) while in T-2 (13.36 ±0.70) it was comparable with other treatments.

The percent of ewes returned to oestrus was found to be 88.89%, 87.50%, 90.91% and 90.91% for the treatments T-1, T-2, T-3 and T-4 respectively. Resumption of ovarian cyclicity after parturition was significantly ($P <0.01$) lower in T-1 than other treatments which were comparable.

Body weights of ewes did not differ significantly among the treatments up to four months. The weights of ewes at fifth month were significantly ($P < 0.01$) higher in T-1 as there was relief from lactation stress at the earliest compared to other treatments. The weight of ewes at sixth month was significantly ($P < 0.05$) lower in T-3 which was due to increased suckling period i.e up to four months.

The mean body lengths of ewes at six months age were 66.67 ± 0.96, 68.75 ± 0.92, 65.60 ± 1.01 and 67.09 ± 0.67 cm respectively for T1, T2, T3 and T4 treatments and there was no significant difference between the treatments at six months age. The length of ewes at lambing were significantly ($P < 0.01$) higher in T2 compared to other treatments. The body length of ewes at 2 months and at

weaning were significantly ($P < 0.05$) higher in T2 compared to other treatments T1, T3 and T4 (control).

The mean height of ewes at weaning were 77.83 ± 0.80, 76.64 ± 1.33, 71.33 ± 1.33 and 74.58 ± 0.82 cm, respectively for T-1, T-2, T-3 and T-4 treatments and those at six months were 79.78 ± 1.00, 77.13 ± 0.99, 72.50 ± 1.38 and 76.91 ± 0.88cm, respectively. The mean height of ewes differ significantly ($P < 0.01$) among treatments at various ages.

The chest girth of ewes at weaning was significantly ($P < 0.01$) lower in T-3 compared to other treatments which did not differ significantly among treatments. The chest girth of ewes at six months differ significantly ($P < 0.05$) and it was lower in T-3 than other treatments which were comparable.

The paunch girth of ewes differ significantly ($P < 0.01$) among treatments at weaning and at six months age.

An attempt was made to estimate cost of production of lambs from birth to six months of age. Cost per animal was found to be Rs. 1791.82, Rs.1693.20, Rs.1595.82 and Rs.1576.18, respectively for the treatments T-1, T-2, T-3 and T-4. T-2 and T-3 recorded lower costs per kg weight gain of Rs. 87.96/- and Rs. 88.71/- while T-1 and T-4 recorded Rs. 122.14/- and Rs.119.95/- respectively.

There was 8.33 per cent pre weaning mortality in treatment T-4 where as T-1, T-2 and T-3 recorded zero percent mortality. T-4 recorded 18.18 per cent post weaning mortality whereas in treatments T-1 and T-2 the mortality was 8.33 per cent. There was zero percent mortality in T-3.

The following conclusions may be drawn from the present study

- The practice of weaning of lambs at an age of three months supplemented with creep feed introduced at the age of 20 days is found to be encouraging in terms of body weight gains of lambs.

- Since resumption of ovarian cyclicity after parturition is an important measure of breeding efficiency, early weaning at two months of age coupled with supplementation of creep introduced at 20 days of age is also an important option for the breeder.

- As for as cost per kg live weight gain of lambs is concerned the practice of weaning at three months of age supplemented with creep feed is found to be economical.

- As for as usual practice of rearing of lambs by the farmers as in the case of T-4 is found to be inferior and not encouraging in terms of body growth rates, cost of production of lambs, mortality and also post partum oestrus in dams. The reason being denial of creep feed to the lambs at pre weaning stage.

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**Fig. 1: Concentrate Feeding of Lambs**

**Fig. 2: Researcher Recording Body Weight** 32

**Fig. 3: Collection of Blood sample by Researcher**

**Fig. 4: Measuring of Height at withers by Researcher**