EFFECT OF NUTRIENT SUPPLEMENTATION ON LITTER SIZE OF MALABARI DOES AND GROWTH RATE OF KIDS

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KERALA, INDIA

2015

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THESIS

submitted in partial fulfillment of the requirement for the degree of

MASTER OF VETERINARY SCIENCE

(Animal Nutrition)

2015

Faculty of Veterinary and Animal Sciences

Kerala Veterinary and Animal Sciences University

Pookode, Wayanad

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DECLARATION

I hereby declare that this thesis entitled **"Effect of nutrient supplementation on litter size of Malabari does and growth rate of kids"** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, fellowship or other similar title, of any other University or Society.

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CERTIFICATE

Certified that this thesis, entitled **"Effect of nutrient supplementation on litter size of Malabari does and growth rate of kids"** is a record of research work done independently by **Jasitha Ja-afar (13-MVM-25)** under my guidance and supervision and it has not previously formed the basis for the award of any degree, diploma, fellowship or associate ship to her.

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We, the undersigned committee of the Advisory Committee of **Dr. Jasitha Ja-afar (13-MVM-25),** a candidate for the degree of **Master of Veterinary Science in Animal Nutrition**, agree that this thesis entitled **"Effect of nutrient supplementation on litter size of Malabari does and growth rate of kids"** may be submitted by **Dr. Jasitha Ja-afar (13-MVM-25)** in partial fulfillment of the requirement for the degree.

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EXTERNAL EXAMINER

Acknowledgements

ACKNOWLEDGEMENTS

I express my sincere and heartfelt gratitude to my respected teacher and the Chairperson of the Advisory Committee, ***Dr. Ally. K****. Professor, Department of Animal Nutrition, for her meticulous guidance, personal attention, persuasion and help rendered in all possible ways, which was the major factor that led me to accomplish the task. The constant guidance and encouragement, even in tight schedule of time were instrumental in the completion of this study. Words are inadequate to express my gratitude to my advisor.*

I owe my solemn indebtedness to ***Dr. P. Gangadevi****, Professor and Head, Department of Animal Nutrition for her inspiring professional guidance, genuine support and timely help rendered to me for the completion of my work. I reckon it a rare privilege to work under her counsel and indomitable spirit.*

My heartful thanks and gratitude to ***Dr. R. Thirupathy Venkatachalapathy****, Associate Professor and Head, University Goat and Sheep farm., Mannuthy as a member of Advisory committee for his constant guidance and suggestions during feeding trial and in the completion of this study. I thank him for all the help and co-operation rendered from time to time.*

I express my sincere gratitude to ***Dr. Biju Chacko,*** *Assistant Professor, Department of Animal Nutrition, member of my advisory committee, for his expert advice and creative suggestions during various stages of my research work.*

I hereby convey my profound thanks to ***Dr. K. Shyama****, Assistant professor(SS), Department of Animal Nutrition who spared no pains in extending her helping hand and providing facilities throughout the entire course of this work Professor, Department of Animal Nutrition, who spared no pains in extending her helping hand and providing facilities throughout the entire course of this work.*

*My grateful thanks are in due to **Dr. M. T. Dipu**, Assistant Professor, Department of Animal nutrition for his unstinted support, valuable help, expert advice, constructive criticism, suggestions and keen interest shown at every stage of this research work.*

*I admire the timely help and support of, **Dr. Surej Joseph Bunglavan ,** Assistant Professor and **Dr. Jasmine,** Assistant professor, Department of Animal Nutrition for their inspirational advices. I am grateful to them for the care and valuable guidance.*

*My sincere thanks are due to the **Hon'ble Vice Chancellor, Registrar, Director (Academics & Research) and Director (Entrepreneurship),** Kerala Veterinary and Animal Sciences University, Pookode and **Dean,** College of Veterinary and Animal Sciences, Mannuthy, for providing necessary facilities for successful conduct of the work.*

*I am short of words to in expressing my deep sense of obligation to colleagues **Dr.Axsa P Thomas, Dr.Jamsheera K,** for their moral support, untiring help and constant inspiration which instilled in me the confidence to tackle many a hurdles during the study.*

*I take this opportunity to say heartfelt thanks to **Dr. Hiron, Dr. Parvathy, Dr. Upasana and Dr. Sreenesh,** who willingly devoted so much time in giving support to me during different stages of my research work and I admire their distinguished helping nature.*

*I sincerely thank **Dr. Jini, Dr. Susmitha, Dr. Roshma** and **Dr. Desinguraja** my senior colleagues for the timely help and support rendered to me. I also extend my heartfelt thanks to my junior colleagues **Dr.Arathy, Dr.Chithrima Dr. Praveen Banakar, Dr Jayaprakash** and **Dr. Rajkumar** for the timely help and support rendered to me.*

I would also like to extend huge, warm thanks to all staff members and laborers of University Goat and Sheep farm., Mannuthy for their cooperation and assistance. I remember with gratitude the help rendered by ***Late Mr. Karthikeyan,*** *Former Farm Assistant,* ***Mr. Backer,*** *Farm Assistant,* ***Smt. Marykutty, Mr.Selvan . Smt. Bindhu, Smt. Ramani and Smt Lathika*** *who looked after my experimental goats and helped me during the collection of sample, weighing of animal and digestion trial.*

I am extremely grateful to ***Mr. Sojan*** *and* ***Smt. Reshmi, Smt Daisy Mr. Krishnankutty*** *for their cooperation and assistance in experimental feed preparation. I express my deep sense of gratitude to my departmental non teaching staff, for the timely help and support rendered to me.*

I am also grateful to the workers in University Poultry Feed mill for their cooperation and also for their help in the procurement of feed ingredients.

I gratefully acknowledge ***Dr. Gleeja,*** *Assistant Professor, Department of Statistics for the help rendered in the statistical analysis of the data and* ***Mr. P.T. Jijo,*** *Academic Consultant, Central Diagnostic Laboratory, who helped me a lot for analyzing the samples .*

I owe my deepest gratitude to ***Mr. Mohanlal,*** *the former Librarian,* ***Smt Meera,*** *Assistant Librarian and other staffs in library for their timely help in providing books and journals.*

Words are inadequate to express my profound gratitude to my beloved husband ***Mr. Saifudheen E.P.,*** *without his love, support and encouragement it would not have been possible to complete this study successfully.*

My deepest gratitude goes to my most lovable mother ***Mrs. Nabeesakutty N.S.*** *andmy most lovable and caring father* ***Mr. Ja-afar T.*** *without their help, love and patronage, my efforts would not have been met with success. I owe my gratitude to*

my beloved sister, in laws, and other family members for their prayers, timely help and sacrifice. I also treasure the generous help, concern, encouragement, suggestions and moral support by them.

Above all I bow my head before God the Almighty for his abundant grace, blessings, mercy and unfathomable love showered on me for completion of this study.

Mannuthy **JASITHA JA-AFAR.**

Dedicated to my parents, teachers and my husband …

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Introduction

INTRODUCTION

Goat rearing is gaining momentum among the small scale farmers in Kerala. The animal production systems in the state needs to be viewed separately from the rest of the country mainly because of the limited land availability and high population density. Rearing of large animals has become an unsuccessful enterprise. This is evident from the dwindling cattle population of the state. Goats are easy to manage and their small size makes them suitable for homestead farming of Kerala. Moreover the demand for goat milk and meat is increasing nowadays. In addition, they can effectively utilises the tree fodder and agro by products. All these leads to wide acceptance of goat farming. Presently, more people are attracted to goat farming that is evidenced by the increase in goat population during the last ten years (2007 census). The main income from goat farming is through the sale of kids. In Kerala, goats are mainly fed with tree leaves and concentrate feeding is rare. Nutrient supplementation especially protein and energy prior to breeding in last month of gestation is important for increased number of kids, their survivability and better birth weight. So any attempt to increase the number of kids, birth weight and growth rate of kids will substantially increase the returns to the farmers.

The nutrient requirements of a goat is determined by age, sex, breed, body size, climate and physiological stage. Feeding strategies needs to satisfy the energy, protein, mineral, and vitamin requirement depending on the condition of the goats. Reproduction is a crucial aspect from nutrient requirements point of view. Maternal nutrition is very important as far as the survivability and growth rate of kids are concerned. Deficient care during pregnancy will affect the kid's birth weight and further growth performance. Nutrient requirement for reproduction varies considerably from one phase of reproductive cycle to another. Flushing is the practice of feeding increased level of feed to breeding does, mostly in the form of energy, prior to breeding. Flushing can improve the ovulation rate, thus the number of kids.

Foetus mainly develop during the last month of gestation and thus the does nutritional requirements increase greatly during this time.

Nutrient supplementation especially protein and energy prior to breeding and during last month of gestation is important for increased number of kids, their survivability and better birth weight. Unscientific feeding practices during these periods may lead to huge economic loss resulting from either abortion, or early kid mortality. Malabari breed of goat is the most common breed found in Kerala and well adapted to the plain regions of Kerala. Moreover twinning in Malabari does is very common and works on the nutrient requirement of these does on gestation are scanty. Keeping all these facts, the present work is aimed to investigate the effect of nutrient supplementation prior to breeding and during late gestation in goats on kidding rate and growth performance of kids.

Review of literature

2. REVIEW OF LITERATURE

2.1. NUTRIENT REQUIREMENTS OF DOES FOR REPRODUCTION

Nutrition is recognized as a significant regulator of reproduction. The energy and protein requirements of goats had been worked out based on the information available from the experiments conducted world wide. Majumdar (1960) conducted balance studies and determined the requirement of goats per kilogram as 2.63 gram crude protein for maintenance. The calculated digestible crude protein requirement was 1·12 pound/100 pound body weight. The dry matter requirement calculated was 2.6lg/100lb body weight(W)$^{0.734.}$ Sengar (1980) studied the nutrient requirements of goats and from digestibility trials, he reported the protein requirements for growth and maintenance as 4.52 g and 5.55 g digestible crude protein/(kg body weight)$^{0.75}$, respectively for pregnancy and maintenance. In his study on the nutrient requirement of goats he also reported that the energy requirement of goats for maintenance, growth and maintenance and for pregnancy and maintenance as 125 to 163 kcal digestible energy (DE)/(kg body weight)$^{0.75}$, 232.83 kcal and 211.79 kcal respectively. The reported values of 221.8 kcal DE and 5.55 g digestible crude protein (DCP) /kg W$^{0.75}$ as reported by Sengar (1980) represent the total requirements (maintenance + pregnancy) of goats with a mean body weight of 30.38 kg and gaining 61.75 g/day at pregnancy during the last two months of gestation. Devendra (1983) studied the energy and protein requirement of Katjang goats and reported that the metabolizable energy (ME) and DCP requirement of Katjang goats for maintenance and pregnancy was 602.5kcal /W $^{0.75}$ and 3.6 g DCP/W $^{0.75}$kg/day, respectively. According to Economides (1991), the digestible crude protein requirement for maintenance ranges from 2.3 to 2.8 g /kg $^{0.75}$ for goats. The requirement increased by 80-100 per cent during last stages of pregnancy. The energy requirement during first 15 weeks of pregnancy increased by 15per cent which again increased by 80-100per cent compared to dry animals in last stages of pregnancy.

Voicu *et al*.(1993) studied the energy and protein metabolism in pregnant and lactating goats and reported that the energy and protein requirement for maintenance were found to be 0.450 MJ ME/kg$^{0.75}$ and 2.43g protein dietary intake (PDI)/kg $^{0.75}$ respectively. According to Voicu *et al*. (1993), in pregnant goats 21per cent of ME was used as net energy (NE) for pregnancy. According to Ranjhan (1998), the nutrient requirements for pregnant does were given for body weights ranging from 15 to 60 kg. The energy requirement of pregnant does was per kilogram metabolic weight. For an adult goat weighing on an average 30 kg body weight the dry matter (DM), total digestible nutrients (TDN), ME and DCP requirement were 1170 g, 645 g, 2.33 M Cal , 71 g respectively (Ranjhan,1998). NRC (1981) recommended a value of 0.8 Mcal of ME/day as a suggested increase during the last two months of pregnancy. Mandal *et al*. (2005) proposed a system based on regressions using data from 25 experiments conducted on 93 different dietary treatments and reported maintenance requirement of total digestible nutrient to be 30.1g/kg W$^{0.75}$ and for pregnancy to be 227 kcal digestible energy. As a general guide the recommended minimum nutrient requirements for goats for different productivity levels (NRC,2007) were suggested. For dry non-pregnant animals the maintenance requirements suggested were 0.42 MJME/kg W$^{0.75}$.In NRC (2007) the nutrient requirement of mature does of 132 lb at different productivity levels were stated and adult goats in late pregnancy with twins required TDN 65.1 per cent and protein 11 per cent. Hwangbo *et al*. (2009) reported that feeding high level of protein (20 per cent) would increase the body weight of Black Bengal goats. Sahu *et al*. (2013) in their study on Ganjam goats reported that the supplementation of 300 g concentrate (CP 22 per cent and TDN 72 per cent) 60 days prior to expected date of kidding improved both pre partum and post partum body condition of goat compared to those fed 200 g of concentrate mixture.

2.1.1. Role of energy in reproduction.

Energy stimulated oestrus activity, ovulation rate, fertilization and survival of ova and the maintenance of the resultant embryos to term as viable kids (Gunn, 1984; Hosseini, 2008). Inadequate nutrition, particularly energy, depressed the reproductive performance of Indian breeds of goats (Satchdeva, 1973). Hossain *et al.* (2003) observed an increase in conception rate (95 per cent) in does when fed with high energy (11.98 ME /kg DM) feed compared to those fed with 10.84 MJ of ME/kg DM energy diet that had a conception rate of 67 per cent. Hosseini *et al.* (2008) studied the effect of dietary energy levels on feed efficiency and growth rate of ewes and reported that energy to be responsible for the efficient utilization of nutrients thus improving production and body gain of animals. El-Shahat and Abo-El Maaty (2010) reported that supplementation of energy (fatty acids) to the basal diet during pre-partum period had caused significant improvement in the number and size of ovarian pre-ovulatory follicles, thus the ovulation rate of ewes and subsequently the litter size.

2.1.2. Role of protein in reproduction.

Sahlu *et al*. (2000) reported in their work that the low protein (8.8 per cent CP) diet was inadequate to meet the does protein requirement during late gestation, but there was no apparent advantage in feeding the high (14.3per cent) than medium (11per cent) protein diet. Sahluf *et al*.(1995) reported that kidding rate, litter weight, and gestation length were unaffected by protein or energy amounts. Herrara *et al.* (2008) reported an increased ovulation rate as well as increase in body weight in goats in good body condition, supplemented with 120g protein /day than the un supplemented group.

2.2 EFFECT OF SUPPLEMENTATION OF ENERGY ON REPRODUCTION IN DOES

Flushing is to provide ewes with extra energy supply (flushing) for 2-3 weeks prior to and during breeding, for the purpose of increasing the number of lambs produced (Chaturvedi *et al.,*2006). Flushing is a common practice in females of different species that to prepare them for breeding season (Camelo *et al.*,2008). Flushing positively affect the body condition, fertility and ovulation rate of dams with poor nutritional status especially just before or during mating. (Chowdhury *et al*., 2002;Karikari and Blasu,2009).

2.2.1. On conception rate

Kusina *et al*. (2001) conducted an experiment in Mashona goat does to study the effect of energy on oestrus synchronization with three different dietary energy levels 0.27, 0.53 and 1.06 MJ of ME/ $kgW^{0.75}$ and reported that conception rate was significantly lower with low energy treatment (57.82 per cent) than high and medium level (79.43 and 88.94 per cent respectively). Chaturvedi *et al.* (2006) reported high conception rate (79. 2 per cent) in ewes supplemented with 1.5 per cent of body weight of concentrate during breeding period than those without supplementation. Camelo *et al.* (2008) reported an increase in conception rate (82.6 per cent) in goats fed high energy (1.8 Mcal of ME/ DM)diet compared to those fed a diet with 0.9Mcal of ME prior to breeding. Koyuncu and Canbolat (2009) fed Kivircik sheep 21 days before mating with diets containing varying energy levels (10.3, 11.0, 11.6 and 12.2 MJ /Kg DM) and they observed that all the ewes fed diets of a higher energy content (12.2 MJ/kg DM) conceived compared to lower energy content (10.3 MJ/kg DM). Rodriguez *et al.* (2009) carried out an experiment to ascertain the effect of nutritional supplementation on ovulation and pregnancy rates in female goats and concluded that does that were grazed in natural vegetation and supplemented with 260g of rolled corn, 110g of soya bean and 900g of alfalfa hay per animal had higher conception

rate (2 ± 0.1) than does that were grazed in natural vegetation only (1.6 ± 0.1). Zabuli *et al*. (2010) opined that the short term supplementation with energy (11.5 MJ/kg DM) during breeding period stimulated total number of ovulatory follicles and ovulation rate in goats. Hafez *et al*.(2011) conducted an experiment in Zaraibi goats to study the effect of energy supplementation pre mating and during mating with diets having two dietary energy concentrations (4193 Kcal/kg and 4469 Kcal/kg) and noted that the pregnancy rate was significantly higher (83.33 per cent)for goats fed on high energy diet (4469 Kcal/kg) compared to low energy diet of 4193 Kcal/kg (66.67 per cent). Mahmoud *et al*. (2012) observed significantly higher ovulation rate (2.8) in ewes fed with high energy diet (10.87MJ of ME/kg diet; 130 per cent of maintenance) than that of ewes fed with 8.4 MJ of ME/kg diet (1.15). Morales *et al.* (2012) observed in his study on Nubian goats that the goats supplemented with 400g concentrate mixture /kg/day (14 per cent CP and 2.92 Mcal of DE /kg) for 30 days prior to mating had higher pregnancy rate (92.5per cent) compared to non supplemented group (76.3per cent). Kulkarni *et al*. (2014) reported an increase in kidding percentage (100 per cent) when Osmanabadi goats were supplemented with extra concentrate mixture at the rate of 250g/doe/day during breeding and fed with supplementary concentrate mixture of 14.76 per cent crude protein and 66.27per cent TDN in last two months gestation compared to goats that were only flushed (90 per cent) and also those maintained in the prevailing farmer's feeding practices (80 per cent).

De Santiago-Miramontes *et al.*(2011) reported a decrease in the conception rate of goats when they were flushed (40 per cent)as well as stimulated with oestrogen and only flushed (35 per cent) compared to control (67 per cent) and mere stimulated group (55 per cent). Kor and Demirel (2012) fed goats 20 days prior to mating and 20 days after mating with diets containing varying protein levels (61.98g, 77.47g and 92.97g CP/head/day) and energy levels (1.58, 1.97 and 2.37Mcal ME) and they observed that there was no statistically significant difference between

treatments in pregnancy rate (100,100 and 94.74per cent, respectively). Safari *et al.*(2012) could not observe difference in fertility or fecundity between East African does fed with 200g, 400g feed or without supplementation.

2.2.2. On litter size

Kusina*et al*. (2001) conducted an experiment in Mashona does to study the effect of energy on oestrus synchronization, evaluated three levels of energy (0.27, 0.53 and 1.06 MJ of ME/ $kgW^{0.75}$) in goats 60 days prior to oestrus and found that goats fed with high energy diet had improved ovulation rate and number of kids (2 vs 1.52). Chaturvedi *et al.* (2006) reported that ewes fed with concentrate pellets at the rate of 1.5 per cent of their body weight few weeks prior to mating along with grazing had better ovulation rate and litter size (2.7) compared to those maintained on pasture alone (2.0). Koyuncu and Canbolat (2009) conducted an experiment in Kivircik sheep and reported that ewes fed with diets having 10.3 MJ/kg DM (L1) and 11 MJ/kg DM (L2) had significantly lower litter sizes (1.47 and 1.63, respectively) compared to those fed with 11.6 and 12.2 MJ/Kg DM (litter size of 1.95 and 2.05, respectively). Hafez *et al*.(2011) conducted an experiment in Zaraibi goats with diets having two dietary energy concentrations (4193 Kcal/kg and 4469 Kcal/kg) prior to breeding and found that twinning rate (42.86 per cent) and litter size (2.7 Vs 2) were increased in goats fed diet with 4469 Kcal/kg compared to those fed 4193 Kcal/kg. Kulkarni *et al*. (2014) reported that the twinning percentage (58.33 per cent) increased for both group of Osmanabadi goats that have flushed with extra concentrate mixture at the rate of 250g/doe/day and fed with supplementary concentrate mixture of 14.76 per cent crude protein and 66.27per cent TDN in last two months gestation and those goats that were only flushed compared to those goats maintained in the prevailing farmer's feeding practices (45.83 per cent).

Camelo *et al.*(2008) could not find any difference in the number of kids born to ewes given either 600g or 300g of extra feed prior to breeding (1.6,1.3 kids per

goat respectively). Kor and Demirel (2012) fed goats 20 days prior to mating and 20 days after mating with diets containing varying energy levels (1.58, 1.97, 2.37 Mcal of ME per kg) and they observed no statistically significant difference between treatments in litter size (1.16, 1.16, 1.22 respectively). Safari *et al.* (2012) could not find any significant difference in litter size of does (1.34, 1.28 and 1.23, respectively) fed extra 400g, 200g feed than control without supplementation. Saha *et al*. (2012) could not find any significant effect on litter size (1.8, 1.4 and 1.2) when Black Bengal goats were fed, 6 weeks prior to mating, either with 100g Mashkalai and 100g wheat bran or 50g Mashkalai and 50g wheat bran along with grazing or grazing alone.

2.2.3. On birth weight of kids

Chaturvedi *et al.* (2006) reported an increase in the average birth weight (3.47 kg) of lambs born to ewes fed with concentrate pellets at the rate of 1.5 per cent of their body weight few weeks prior to mating along with grazing compared to those that were allowed to graze alone (2.95kg). Koyuncu and Canbolat (2009) observed that the birth weight of lambs of Kivircik sheep was increased (4 ± 0.69) when the dams were fed with high energy diet (12.2 MJ/kg DM) 20 days prior to mating compared to a birth weight of 3.2 ± 0.47 kg born to those given diet having 10.3 MJ of energy/kg DM . Idris *et al.* (2011) reported an increase in the birth weight of lambs (3.6 kg) born to ewes fed with ground nut cake and molasses compared to those fed with Roselle seeds and molasses (3 kg) prior to breeding. Hafez *et al*. (2011) conducted an experiment in Zaraibi goats to study the effect of energy supplementation prior to mating with diets having two dietary energy concentrations (4193 Kcal/kg and 4469 Kcal/kg) and found that the mean birth weight of kids was significantly higher for goats flushed with high energy (2.59kg) compared to low energy group (1.48 kg).

Safari *et al.* (2012) could not find any significant effect on the birth weight of kids of African goats given extra 400g and 200g of concentrate prior to mating. Saha *et al*. (2012) reported in their experiment on Black Bengal goats that there was no significant effect on birth weight of kids (0.97,1.18 and 1.37 kg respectively) when does were fed either with 100g Mashkalai and 100g wheat bran or 50g Mashkalai and 50g wheat bran along with grazing or grazing alone 6 weeks prior to mating. Camelo *et al.*(2008) reported that the birth weight of kids of goats that were supplemented with 1.8 Mcal of ME energy diet (2.49 kg) was significantly lower compared to those fed with low energy feed of 0.9 Mcal ME (3.29 kg)

2.2.4. On growth rate of kids.

Idris *et al.* (2011) reported a significant increase in the daily growth rate of lambs (229 g/day) before weaning when the ewes were supplemented with groundnut cake and molasses compared to those supplemented with Roselle seeds and molasses(217 g/day).

Camelo *et al.* (2008) could not observe any significant difference in the weekly weight gain of kids (860g and 727g respectively) born to dams fed with either 600g or 300g feed daily prior to breeding. Saha *et al.* (2012) reported in their study in Black Bengal goats that there was no significant effect on overall growth rate of kids (33.18 g/day vs 31.25 g/day) when the dams were fed either with 100g Mashkalai and 100g wheat bran or 50g Mashkalai and 50g wheat bran along with grazing or grazing alone 6 weeks prior to mating. Safari *et al.* (2012) could not find any significant effect on growth rate from birth to weaning or weight loss of does from kidding to weaning when the does were fed with 200g and 400g of concentrate as pregnancy allowance prior to mating.

2.2.5. On the live weight changes of does

Safari *et al.*(2012) observed that to maintain good reproductive performance as well as to improve growth performance and survival rate of kids it is essential to have good live weight of does. Camelo *et al.* (2008) reported an increase in the mean body weight (42.9 kg) of does fed high energy (1.8 Mcal ME) diet 21 to 42 days prior to breeding and gestation, respectively compared to a body weight of 40.8 kg in those supplemented with low energy feed (0.9 Mcal of ME). Koyuncu *et al.* (2009) in their experiment with Kivircik sheep reported an increase in the live weight of ewes by 10.9 per cent during gestation by supplementation with high energy feed (12.2 MJ/kg DM) compared to 2.3 per cent in those fed low energy diet (10.3MJ/kg DM).

Idris *et al.*(2011) reported that the body condition score of dams was improved during mating, (2.6 vs 2.5) mid pregnancy (2.6 vs 2.4)and at the time of lambing (2.3 vs 2.1) when the desert ewes of Kordofan State were flushed in comparison to non-flushed animals. Saha *et al*. (2012) observed 53 per cent increase in the average weight gain of does fed daily with 80g of protein prior to breeding compared to those fed with ration of 40 g protein. Safari *et al.*(2012) observed an increase in body weight of Small East African does by 5.8 per cent when they were supplemented with 400 g concentrate mixture daily 21 days prior to breeding while an increase of only one per cent in body weight was there in 200g supplemented group.

Karikari and Blasu (2009) could not find any significant difference in the live body weight, body condition score (1.75±0.09 to 2.22±0.09 units) and daily live weight gain (40.8±4.97g) in West African dwarf goats during gestation when the does were either flushed or non flushed with extra concentrate mixture of 250g prior to breeding.

2.3. EFFECT OF NUTRITIONAL SUPPLEMENTATION TO DOES IN LATE GESTATION

Rastogi *et al*. (2006) reported a significantly higher feed intake, growth rate and birth weight of kids when the dams were fed additional 20g concentrate mixture/ kg $W^{0.75}$ from 121 days post mating to term. Meyer *et al*. (2010) studied the effect of plane of nutrition during gestation in ewes and found that the body condition score of the ewe as well as the birth weight of lambs were increased when ewes were fed with diet containing 140 per cent of the NRC (1985) requirement compared to the control (as per NRC) and restricted diet (60 per cent of NRC) during last two months of gestation. Sahu *et al.* (2013) opined, in their study in Ganjam goats, that in economic animal production does should not be underfed between 61-120 days of pregnancy, even though it is not necessary to feed pregnant goats with a high concentration ration throughout the gestation period. Low plane of nutrition during late pregnancy resulted in decreased colostrum yield, the performance of kids and also increased the incidences of health disorders in dam and kids (Mani *et al*., 1992; Abecia *et al.,* 2006). Kerslake *et al*. (2010) observed that does offered concentrate supplement at the rate of 400g /ewe/day containing 141 g crude protein and metabolizable energy content of 12.3MJ/kg DM from day 102 to 145 day of pregnancy had higher body weights and lamb birth weights (4.2kg) compared to lambs born to ewes offered pasture only (3.9 kg). Mahboub *et al.* (2013) conducted an experiment in Egyptian goat and reported that the dams' body weight (33.09kg) was increased when they were fed with diet containing 135per cent of the NRC(1985) requirement compared to a body weight of 27.63 kg in the control group fed with diet as per NRC requirement. Thomas *et al*. (2015) studied the effect of *ad libitum* pasture feeding (ryegrass-white clover) in late pregnancy (day 128-142 of pregnancy) in comparison to restricted availability and found that the nutritional regimen had no effect on live weight of ewe and lamb birth weight.

2.3.1. Effect of energy on the performance of does in late gestation.

2.3.1.1. On growth

Hossain *et al*. (2003) fed goats with rations containing three levels of dietary energy (10.02, 11.06 and 11.98 MJ of ME /kg DM) and reported that average daily live weight gain (37.7, 44.4 and 52.9 g/d, respectively) increased linearly as the dietary energy level increased. Mahgoub *et al*. (2005) conducted an experiment in Omani goats with three levels of dietary energy (2.1, 2.38 and 2.68 Mcal /kg DM) and concluded that body weight and body weight gain was significantly higher with values 96,84 and 53 g/day in groups fed with high energy (2.68 Mcal /kg DM) diets than those fed with low energy diets (2.1 Mcal /kg DM). Abdullah *et al*. (2007) formulated experimental diets for Black goats with 15 per cent crude protein and various levels of metabolizable energy (10.44,11.6 and 12.9 MJ/kg DM) and reported that goats fed with high energy (12.9 MJ/kg DM) had higher average body weight (23.3kg) compared to a body weight of 19.26 kg in goats fed on low energy diet (10.44MJ/kg DM).Hosseini *et al*. (2008) reported an increase in the average daily gain of goats (218.25g/day) when they were fed with high energy diet (2.6 Mcal/kg DM) compared to medium energy (2.46 Mcal/kg DM) and low energy diet (2.34 Mcal/kg DM).

Sayed (2009) fed goats with diets containing varying levels of energy (2.9, 3.2, 3.5 Mcal/kg diet) and concluded that average weight gain of the animals fed on high-energy diet (3.5 Mcal/kg) was increased by 31.60 per cent , while those fed on low energy diet (2.9 Mcal/kg) was decreased by 19.87 per cent . Kids of goats that fed on ration containing high energy level (3.5 Mcal/kg) recorded significantly higher average daily gain (284.11±8.22g) than that of medium (3.2 Mcal/g) and low energy diets (2.9 Mcal/kg). Koyuncu and Canbolat (2009) reported an increase in the average weight gain of does by 10.9 per cent during gestation when the ewes were fed with high energy feed of 12.2 MJ of ME per kg DM compared to an increase by 2.3 per

cent in those fed with low energy diet of 10.3 MJ of ME per kg DM. Hafez *et al*. (2011) revealed in their study on Zairaibi goats that the mean live body weight (51.8 kg) of does fed with high energy (4469 Kcal of GE /kg DM) diet during last month of gestation significantly exceeded that (45.2 kg) of low energy (4193 Kcal of GE /kg) fed group during gestation period at day 140. Idris *et al.*(2011) reported that the body condition score of dams improved during mating (2.6 vs 2.5), mid pregnancy (2.6 vs 2.4) and at the time of lambing (2.3 vs 2.1) when they were fed with rations containing either of the supplements groundnut cake, groundnut cake and molasses and roselle seeds and molasses compared to control which was managed under traditional farming practices. Sahu *et al.* (2013) in their study on different level of concentrate supplementation (300g and 200g concentrate with 72 per cent TDN) on the peri parturient (60 days pre partum) growth performance of Ganjam goats observed that the body weights of pregnant does were highest in 300g supplemented group compared to 200g supplemented group or control on pasture. He *et al*. (2013) in their study on protein or energy restriction in pregnant goats during late gestation reported that at day 144 of gestation, goats fed low energy diet (5.75 MJ/kg) weighed 10.8 per cent less (24.8 kg vs 27.8 ± 1 kg) than control diet (9.34 MJ/kg). Kulkarni *et al*. (2014) reported that the mean body weight of does (30.84kg) was increased in Osmanabadi goats fed extra 250g of concentrate mixture (14.76 per cent crude protein and 66.27per cent TDN)/doe/day during last two months of gestation compared to those goats that were only flushed and goats maintained in the prevailing farmer's feeding practices.

Camelo *et al.*(2008) could not observe any effect on body weight and growth of goats that were given diets having either 1.8 Mcal ME or 0.9 Mcal ME

2.3.1.2. On feed consumption

Saikia *et al.* (1995) reported, in their study on Assamese X Beetal goats fed with three isonitrogenous diet (12 per cent CP) at three levels of energy (60,65 and 70

per cent TDN), that the feed intake was decreased as energy density increased. Hossain *et al.* (2003) reported that as the dietary energy levels increased (10.02, 11.06 and 11.98 MJ of ME/kg DM), dry matter intake expressed as per cent live weight (3.44, 3.13and 2.84 kg/d, respectively) and daily average dry matter intake (406.1 to 362.4 g/d) was significantly decreased. Hosseini *et al.*(2008) reported, in their study on the effect of different energy levels of diet on growth rate, that ewes that received the low energy diet (2.34 Mcal/kg DM) had a higher average daily feed intake (1.42 Vs 1.32 kg/day) than those received high energy diets (2.6 Mcal/kg DM). Yagoub *et al*.(2008) reported a decrease in the dry matter intake (1.52kg/d to 1.21kg/d) in goats as the dietary energy level decreased from 11.5 to 9.5 MJ. Sayed (2009) reported in his study on the effect of different dietary energy levels on the performance of goats, that the feed intake was higher (1.32 kg/d) for group fed on low energy diet (2.90 Mcal/kg diet) compared with other treatment groups that fed with medium energy of 3.20 Mcal/kg diet (1.14kg/d) and high energy diet of 3.50 Mcal/kg diet (1.01kg//d).

Mahgoub *et al.* (2005) in their work on performance of Omani goats fed diets containing various metabolizable energy densities evaluated three dietary ME concentrations of 2.1, 2.38 and 2.68 Mcal/kg DM and reported that there was no significant difference in the dry matter intake of goats in all treatments. He *et al*. (2013) reported in their study in pregnant goats on protein or energy restriction during late gestation (day 91- 144 of gestation) that the dry matter intake was not affected by energy or protein restriction.

2.3.1.3. On reproductive performance

Kusina *et al*.(2001) observed in their study on the effect of different dietary energy level on fertility in Mashona goat does that feeding Mashona goat does 0.27 MJ ME kg^{-1} $W^{0.75}$compared to 0.53 and 1.06 MJ ME kg^{-1} $W^{0.75}$, reduced fecundity and twinning rates and also that goats which were fed with 0.53 MJ ME kg^{-1} $W^{0.75}$diet suffices for optimum reproduction. Kusina *et al*. (2001) observed that low energy intake adversely affected kidding rate, and reduced pregnancy rate in goats. Koyuncu and Canbolat (2009) reported in their study on the effect of different dietary energy levels on the reproductive performance of Kivircik sheep that ewes that were supplemented with concentrate at the rate of 300-400g/head/day containing high energy (12.2 MJ/kg DM) at fourth and fifth month of gestation had improved lambing rate (85 per cent)and twinning rate (61 per cent) compared to diet containing 10.3MJ/kg DM energy. Kor and Demirel (2012) reported that high level of energy in diet 2.37 Mcal of ME had a higher rate of twins (29.40 per cent) compared to low energy diet of 1.58 Mcal of ME.

Madibela *et al.* (2002) could not find any significant difference in kidding rate (1.69 vs 1.65) and fertility rate (89.5 vs 90) when the Tswana goats were fed with concentrate ration containing 10.2MJ of ME/kg energy during gestation compared to those does that were maintained on pasture alone. Camelo *et al.*(2008) could not find any significant difference in the litter size of goats (1.6 vs 1.3) when the goats were either fed with high energy diet (1.8Mcal of ME) or low energy (0.9Mcal of ME) diet.

2.3.2. Effect of protein on the performance of does during late gestation.

2.3.2.1. On growth

Ocak *et al.* (2005) fed diets containing varying protein levels (117g, 165g) with constant energy (10.5 MJ ME/kg DM) to Karayaka crossbred ewes and

observed that live weight changes of ewes was increased (6.4 kg) compared to the control diet (117 g CP and 10.5 MJ of ME /kg dry matter. Ebrahimi *et al.*(2007) in their study on the effect of energy and protein levels on growth performance of Mehraban ram observed that increased dietary protein levels (10.5, 12.5 and 14.5) resulted in an increase in average daily gain (147.8, 178, 221.4 g). Nnadi *et al*. (2007) fed diets containing 9 per cent and 13 per cent CP during six weeks pre partum and concluded that West Afican dwarf goats fed with high protein diet (13 per cent) gained significantly more weight compared to low protein diet (9 per cent). Chobtang *et al*. (2009) observed in their study in adult goat that as the crude protein of the feed increased from 9 per cent to 15 per cent, the goat's final body weight (23.10 to 27.42 kg), the average weight gain (6.84 to 11.06 kg) and average daily gain (56.97 to 92.13 g/d, respectively) were also increased. Jadalla *et al.*(2012) in their study on the effects of dietary protein level on milk yield in goats of North Kordofan Sudan with four dietary protein levels(4.1 per cent, 7.6 per cent, 10per cent and 11.3 per cent), found that the average final body weight, total weight change and daily weight change were higher in does fed with 10per cent protein diets compared with the other three ration and the lowest final body weight was observed in the goats fed with 4.1 per cent protein. Saha *et al.* (2012) reported in their study on effect of feed supplementation on reproduction, lactation and growth performance of black Bengal goats that the average daily gain of does (66vs 53) was highest for high protein diet (80g) compared to low protein diet (40g).

He *et al*. (2013) reported in his study on protein or energy restriction during late gestation that at day 144 of gestation goats fed less protein diet (7.5per cent) weighed 5.4 per cent less (26.3 kg vs 27.8 ± 1 kg) than control diet of crude protein of 12.5 per cent. Sahu *et al.* (2013) in their study on different level of concentrate supplementation on the peri parturient (60 days pre partum) growth performance of Ganjam goats observed that the average daily gain(91.56± 3.71) and body weights of

pregnant does were highest in 300g concentrate supplemented group (72 per cent TDN) compared to 200g concentrate supplemented group or control on pasture.

Nuno *et al*. (2009) opined that different dietary protein levels in the diet (14,16and 18per cent) had no effect on the growth performance of Dorper lambs during fattening. He *et al.* (2013) could not find any significant difference in the average daily gain (1.4kg) in goats when protein was restricted (7.5 per cent) compared to the control diet with crude protein of 12.5per cent with average daily gain of 3.5kg.

2.3.2.2. On feed consumption

Chobtang *et al*. (2009) conducted an experiment in Thai goats and found that as dietary crude protein level increased (8, 10, 12 and 14per cent) dry matter intake (563.41 to 603.30 g/day), crude protein intake (47.00 to 84.81 g/d) and digestible crude protein intake (2.89 to 6.28 g/$W^{0.75}$/d) were also increased. Elamin *et al*.(2012) in his study on the digestibility and nitrogen balance of Sudan goat ecotypes fed different protein levels reported no significant difference in the dry matter intake (1.2 1.06, kg DM/ head /day) irrespective of protein in the diet. Jadalla *et al.* (2012) in their study on the effects of dietary protein level on milk yield of goats of North Kordofan, reported that the total and daily feed intake (0.56, 0.92, 0.85 and 0.94 kg) was increased linearly with the dietary crude protein levels (4.1per cent,7.6per cent,10per cent and 11.3per cent, respectively). Saha *et al.*(2012) reported in his study on effect of feed supplementation on reproduction, lactation and growth performance of black Bengal goats that there was no significant difference in the average daily DMI (4.6 and 4.5 per cent of live weight) when goats were fed with high protein diet (80g /day) or low protein diet (40g/day). He *et al.* (2013) reported that protein supplementation from 91 to 144 days of gestation that dry matter intake (1.10kg/d) of goats was unaffected by maternal dietary protein levels (7.5 per cent or 12.5 per cent) during late pregnancy.

2.3.2.3. On reproductive performance

Ocak *et al.* (2005) reported in their study on the effect of high dietary protein levels during late gestation in ewes that 1.4 per cent increase in the dietary crude protein content improved colostrum yield compared to control. Nnadi *et al*. (2007) conducted an experiment in West African Dwarf goats and concluded that goats when fed with high protein (13per cent) diet 6 weeks pre partum had improved the milk yield and kidding percentage (100per cent) compared to low protein diet of 9 per cent with kidding percentage of 87.7. Karikari and Blasu (2009) conducted an experiment in West African dwarf goats and found that the mean litter size of does that were supplemented with concentrate mixture with crude protein of 231g /kg DM of feed along with grazing was higher (1.81 ± 0.12) compared to those (1.5± 0.12) that were maintained on pasture only.

Kor and Demirel (2012) observed in his study on goats that does fed with high level of protein (92.97g CP/ head /day) had a higher rate of twins (29.40per cent). Mahboub *et al.* (2013) conducted an experiment in Egyptian goat and sheep to study the effect of maternal nutrition on behaviour and reported that grooming behaviour (360 seconds) of does were increased when goats were fed with diet containing 135per cent of the NRC(1985) requirement compared to the control fed with diet containing the NRC requirement (107 seconds).

2.4. EFFECT OF MATERNAL NUTRITION ON PERFORMANCE OF KIDS

The survivability of kids is influenced by many factors including maternal nutrition during pregnancy, process of birth, maternal behaviour and neonatal behaviour (Dwyer, 2003). Two- third of the birth weight of a developing foetus is gained during last six weeks of gestation. Hence adequate nutrition during late gestation is crucial for foetal development. Maternal nutrition during late pregnancy resulted in improved colostrum and/or milk availability for the offspring (Tygesen *et al.,*2008). Kenyon *et al.*(2011) studied the effect of nutrition during early pregnancy

in ewes and found no significant difference in mean birth weight of lambs of ewes that were given maintenance requirement, sub maintenance requirement or *ad libitum* feeding during day 21 to day 50 of pregnancy.

2.4.1. Effect of energy on performance of kids

Madibela *et al.*(2002) conducted an experiment to study the effect of supplementation on kidding in Tswana goats and concluded that does that fed with concentrate ration containing 10.2MJ of ME/kg dry matter energy during gestation had increased kid's average daily gain (94.2g/day vs 79g/day), weaning weight (14.2kg vs 11.9 kg) and kid's survival rate to weaning (93per cent) compared to survival rate of kids (86.2 per cent) of goats that were allowed to graze in pasture alone without any significant difference in mean birth weight (3kg) between the groups. Hossain *et al*. (2003) conducted an experiment in pregnant goats with experimental diets containing three levels of energy (10.02, 11.06 and 11.98 MJ of ME/kg DM) and concluded that the birth weight of kids (0.55, 0.63 and 0.75 kg, respectively) increased as dietary energy level increased. He *et al*. (2013) reported an increase in the birth weight of kids (1.8kg) of goats when the does were fed with feed of 9.34 MJ/kg DM energy during late gestation (day 91- 144 of gestation) compared to control group when fed with feed of 5.75 MJ/kg energy but could not find any significant difference in average daily gain between the groups (38g/day vs 40 g/day). Gekara and Marshall (2012) conducted an experiment in does with diets containing 20 per cent CP and 2.90 Mcal of ME/kg at three levels, 0.95per cent, 1.5per cent and 1.90 per cent of body weight on a dry matter basis and concluded that kids of does fed with high energy or protein diet (1.9 per cent of BW) gained faster weight (0.087 kg) compared to low energy or protein diet (0.022 kg).

Camelo *et al*. (2008) reported a decrease in birth weight of kids when the dams were fed with high energy diet 1.8 Mcal of ME (2.5 kg) compared to the lower energy diet of 0.9 Mcal of ME (3.3 kg) and also that there was more twinning

with high energy diet. Kor and Demirel (2012) conducted an experiment in goats with diets containing three levels of dietary energy (1.58, 2.37 and 2.76 Mcal of ME) each at three levels of CP, 61.98, 77.47 and 92.97g CP /head/day, respectively and concluded that there were no significant difference in litter size (1.16, 1.16 and 1.22) and weaning survival rate (86.36,95.45 and 90.91 per cent) among treatments.

2.4.2. Effect of protein on performance of kids

. Ocak *et al.*(2005) reported in their study on the effect of high dietary protein levels during late gestation in singleton-bearing ewes that lamb birth weight was increased (3.5 kg) when the dietary CP was increased with1.4 per cent compared with a birth weight of 3.1 kg in low protein diet (9 per cent CP) but there was a decrease in the lamb survival rate. Robertand Saun (2005) reported in their study on understanding the need for supplements, minerals and vitamin for pregnant doe, that does fed 15 per cent CP two weeks prior to gestation had improved foetal weight compared to diet containing 8 per cent CP where as does fed diet containing 18 per cent CP had a reduction in weight gain. Rastogi *et al*. (2006) reported that goats fed pregnancy allowance of 20g/kg $W^{0.25}$ concentrate mixture containing 8.5 per cent crude protein 120 days prior to parturition had kids with higher birth weight (2.3 kg) and average daily gain (94g/day). Nnadi *et al*. (2007) conducted an experiment in West African Dwarf goats and concluded that kids of goats that fed with high protein (13per cent) diet six weeks pre partum had significantly higher birth weight (1.18kg) and weaning weight of kids (3.30 kg) compared to kids of goats that were fed with low protein diet of 9 per cent (0.88 kg and 2.0 kg respectively).

Saha *et al.* (2012) reported in their study in Black Bengal goats that there was no significant effect on overall growth rate of kids, litter size (1.8,1.4 and 1.2). and birth weight of kids (0.97, 1.18 and 1.37 kg) when the does were either fed with 80g (NRC, 1981) and 40g crude protein per day six weeks before parturition.

2.5 INTERACTION EFFECT OF ENERGY AND PROTEIN

Sahluf *et al*. (1995) conducted a factorial experiment in 63 Alpine goats fed with diet containing three levels of metabolizable energy (1.8, 2.16 and 2.53 Mcal/kg DM) each at three levels of CP (8.5, 11.5 and 14.5 per cent) and found that the pre partum body weight gain was increased when dietary protein increased but unaffected by energy. Further they reported that kidding rate, litter weight and gestation length were unaffected by protein or energy amounts.

Acurero(2000) formulated experimental diets in goats with energy 1.97, 2.15 and 2.56 M cal of ME/kg, each with 9,12 and 15 per cent CP respectively during the gestation and concluded that the kidding rate (90 vs 60), litter size (1.4 vs 0.7) and twinning rate (55.9 vs 16.6) were significantly higher in those goats that received high-energy supplements compared to those fed with high protein and low energy diet. Al- Totanji and Lubbadeh (2000) conducted an experiment in 42 pregnant Shami goats to study the effect of varying protein and energy concentrations on reproductive performance with diets having three dietary energy concentrations (2.5, 2.3 and 2 Mcal/kg concentrate) and each at two crude protein levels and noted that pre partum weight gain was significantly higher for goats under high energy (2.5 Mcal/kg) ration than those under low (2 M cal/kg) or intermediate energy (2.3 Mcal/kg)rations. Further they reported that pre partum weight gain and body weight after kidding was significantly higher in goats fed with high energy. Average weight gain and weaning weight was higher for kids of goats fed with high and intermediate energy compared to those fed with low energy feed. The protein: energy ratio of pre-mating diets were more critical to obtain a reproductive response (Chaturvedi *et al.,*2006). Abbasi *et al*.(2011) in their study on the effect of dietary metabolizable energy and crude protein in Markhoz (Iranian Angora) male kids found that the average DM intake as well as average daily gain of the goats increased with increasing dietary energy (2.1,2.3and 2.5Mcal/kg DM) and crude protein (8,10 and 12 per cent)levels. Goats fed diet containing 2.5 Mcal of ME and 12 per cent CP showed

the highest amounts of ADG (104g) and DMI (864g/d). Differences in initial body weight was not substantial but final body weight was affected significantly when different treatments were fed and increased as dietary energy and crude concentrations increased. Eldar *et al*. (2012) reported a significant increase in the daily weight gain (0.04 and 0.05 kg) as the energy protein ratio of the feed fed increased (1/0.16 and 1/0.18),but the level of energy and protein did not significantly affected average feed intake (0.30 to 0.35 kg/day). Gekara and Marshall (2012) reported an increase in the average daily gain of kids of goats fed with concentrate mixture at the rate of 1.90 per cent of body weight (0.087 kg) but could not find any significant effect on average daily gain and body condition of does compared to those goats fed concentrate mixture at the rate of 0.95 and 1.5 percentage of body (0.022 kg) with 20 per cent crude protein and 2.90 Mcal of ME/kg DM.

2.6 DIGESTIBILITY

Saikia *et al.*(1995) reported in their study on Assamese goats fed isonitrogenous diets of about 12per cent crude protein and three levels of energy (60,65 and 70per cent TDN) and found that mean digestibility coefficient of dry matter (DM), ether extract (EE), crude fibre (CF), nitrogen free extract (NFE)and gross energy (GE) differed significantly between the groups, the lowest being in group fed with 12per cent crude protein and 60 per cent TDN and highest in group fed with 12per cent CP and 70 per cent TDN. Hossain *et al.*(2003) studied the effect of dietary energy and reported that digestibility of OM (62.25 to 73.68per cent) and CF (43.8 to 53.21per cent) significantly increased as the level of energy supplemented increased from 10.02 to 11.98 MJ of ME/kg DM. They also found that digestibility of DM,CP,NFE and EE was similar irrespective of level of energy supplementation. Chaturvedi *et al.* (2006) reported in his study on the effect of flushing on nutrient utilization and reproductive performance of ewes that the digestibility coefficient of dry matter, organic matter, crude protein, neutral detergent fibre and hemicellulose were higher (57.23,76.72,78.89,51.9, 81.64 respectively) when the ewes were supplemented prior

to breeding compared to the non- flushed group (50.8,68.66,68.39,45.38 and 74.42 respectively).Kumagai and Ngampongsai (2006) reported in their study on Thai native (TN) and Anglo Nubian × TN bucks that as the crude protein level increased, (14per cent,21per cent, 28per cent and 35 per cent), digestibility of crude protein, nitrogen excretion in urine and nitrogen retention increased. The digestibility of crude protein 69.8per cent versus 64.0 per cent) and blood urea N concentrations (32.2 mg/dl versus 26.7 mg/dl) of Thai native goats were found to be higher.

Chobtang *et al.*(2009) observed that crude protein digestibility (62.05, 67.39, 71.23 and 74.89per cent, respectively) increased linearly with increasing levels of crude protein levels in total mixed ration (8,10, 12 and 14per cent). Sayed (2009) in his study on the effect of different dietary energy levels revealed that digestion coefficients of dry matter (6.15per cent), crude protein (5.66per cent), crude fibre (11.93per cent), ether extract (8.91per cent) and nitrogen-free extract (4.24 per cent) improved when fed with high energy 93.5 Mcal/kg. Elamin *et al*.(2012) reported that the digestibility of the nutrients increased significantly with increased energy: protein ratio (1:0.14,0.16 and 0.18).The apparent digestibility coefficient of dry matter was found to be 59.15-63.94.

2.7 SERUM BIOCHEMICAL PARAMETERS

In studies of El-Sherif and Assad (2001) about the changes in blood constituents during pregnancy and lactation periods in Barki ewes, they could observe increased levels of urea and creatinine after 10-12 week of pregnancy. They also noticed an increased blood glucose level from fourth week of pregnancy to reach its maximum at parturition and further decline to normal level after one month of kidding. Kumagai and Ngampongsai (2006) reported an increase in the blood urea nitrogen levels (32.2 mg/dl versus 26.7 mg/dl) with increase in the dietary CP. Darmola *et al*. (2004) observed higher serum calcium and sodium levels in African dwarf goats during postpartum period when compared to the value prior to kidding. They could not observe any significant difference in serum levels of potassium, total

protein, albumin and triglyceride during peri partum period. Tanaka *et al*.(2004) reported that dietary restriction caused no variation in weekly plasma glucose levels between treated and control goats before breeding. Castillo *et al*.(2005) reported that serum concentration of glucose, non-esterified fatty acids, total protein and albumin did not differ significantly between non-pregnant and pregnant cows at any stage, and remained roughly constant during pregnancy. Iriadam (2007) reported that in Kilis goats the plasma calcium levels declined during late pregnancy, parturition and the third week postpartum. Abdelatif *et al*. (2009) found that haemoglobin concentration was increased (12.2±1.34)g/dl significantly in goats with the advancement of pregnancy. Karikari and Blasu (2009) reported in their study in adult goats that overall mean total serum protein (86.1± 0.76 gram per litre) was similar between flushed and non flushed group at mating. The serum glucose concentrations were also similar for the treatment groups and averaged 2.6±0.10milli mole per litre at mating.

Cynthia (2010) reported a significant increase in Hb concentration in goats during early gestation (9.64 gram per decilitre) which reduced by 45th (9.22 gram/dl) and 70th day of lactation (9.14). Cynthia (2010) reported that in does the glucose concentration significantly decreased in mid (36.67 milli gram per deci litre) and advanced gestation (39.17mg/dl) and 45th day of lactation,(41.43 mg/dl) whereas serum cholesterol level reduced during early gestation (43.22 g/dl) and increased during advanced gestation (56.73), seven (58.17) and 70 days (61.23) after kidding. She also reported increased levels of serum creatinine and urea in advanced pregnancy when compared to non-pregnant animals. Waziri *et al*. (2010) found a significant increase in cholesterol (52.96) and significant decrease in glucose concentration (48.32 mg/dl) from 12 weeks of gestation. El-Ebissy (2011) reported a reduced glucose concentration in Black head sheep and Merino sheep one week before kidding and four week after kidding. He also noticed no significant variation in values of Hb in Black head and Merino ewes during five and one week before kidding and four week after kidding.

Jadalla *et al.* (2012) reported in their study on the effects of dietary protein level on goats of North Kordofan Sudan that with different dietary crude protein (4.1per cent, 7.6per cent, 10per cent and 11.3 per cent), Hb was significantly different and goats fed with 4.1per cent protein had lower value (6.4g/dl) compared to other rations. Goats fed with 10 per cent protein showed highest Hb (12.6per cent) and blood protein values (16.5mg/dl) while highest glucose (15mg/100 ml), calcium (9.2 mg/100 ml) and phosphorus level (4.2 mg/100 ml)were found in goats on 7.6per cent crude protein followed by those fed on 10per cent and 11.3per cent protein. Abdelrahman (2014) reported that when kids were fed with reduced the dietary protein (75per cent of NRC, 2007 requirement) they showed an increased value for albumin (3.34 vs 2.33 g/dl) and total protein (6.17 vs 5.84 g/dl) in blood serum of the growing Baladi kids.

Materials and methods

3. MATERIALS AND METHODS

3.1 EXPERIMENTAL ANIMALS

Fifty adult female crossbred Malabari goats were selected from University Goat and Sheep farm, Mannuthy for experiment. The animals were grouped into two groups as control and experimental animals of twenty five animals each as uniform as possible with regard to age, body weight and parity. Additional 200 g concentrate with 18 per cent crude protein and 65 per cent total digestible nutrients were fed to all animals in experimental group two weeks prior to breeding. All the animals from control and experimental groups were examined for pregnancy by abdominal palpation. Pregnancy was further confirmed by scanning on third month of gestation. Eighteen pregnant animals from each group were selected randomly and maintained on the management conditions prevailing in the farm upto the fourth month of gestation. At last month of gestation both control and experimental group were divided into three subgroups of six animals. Each groups were allotted randomly to one of the dietary treatments T_1, T_2, T_3.

3.2 HOUSING AND MANAGEMENT

All the experimental animals were housed in the same shed with facilities for individual feeding and watering. Sheds were cleaned daily.

3.3 EXPERIMENTAL RATION

The animals in both groups were fed with standard concentrate mixture (ICAR 1998) containing 18 per cent crude protein and 65 per cent total digestible nutrients upto the last month of pregnancy. The same feed was used for supplementation in the experimental group two weeks prior to breeding. During last month of gestation three subgroups from each group (control and experimental) were allotted to one of the dietary treatments T_1, T_2 and T_3.

Concentrate mixture T_1, T_2, T_3 were formulated as follows

T_1- concentrate mixture with 18 per cent CP and 65 per cent TDN

T_2- concentrate mixture with 20 per cent CP and 65 per cent TDN

T_3- concentrate mixture with 18 per cent CP and 70 per cent TDN

The ingredient composition of concentrate mixture is presented in Table 1

3.4FEEDING

Rations were computed as per ICAR standards (ICAR 1998) depending on the body weight of the animals. All animals were fed with concentrate mixture as per ICAR 1998 standards and good quality green grass were fed *ad libitum*. Clean drinking water was made available to all animals throughout the experiment. Daily, the weighed quantity of concentrate mixture was fed to the doe in equal quantity at 8.00 am and 12 pm. Weighed quantity of the fodder were also given as per the requirement of each doe in the afternoon. The left over portion of the concentrate mixture and fodder was weighed daily and their moisture content was analysed to calculate the dry matter intake. Daily dry matter intake from concentrate mixture and fodder with respect to each doe were calculated throughout the experimental period. Body weight of does before the experiment, at the time of mating, at the time of kidding were recorded. Monthly body weights of all the pregnant does were recorded. After kidding all the animals were given the regular feed followed in the farm. Birth weight of kids and fortnightly body weight of kids for first month were recorded.

3.5 DIGESTIBILITY TRIAL

A digestibility trial was conducted in 12 animals (4 animals from each dietary treatments) towards the end of experiment (21st week of gestation) by total collection

method. Representative samples of three concentrate mixture and green grass fed were taken during the digestion trial were stored for chemical analysis. The balance feed and grass samples were collected from individual animals and their moisture content was determined daily.

The dung was collected manually as and when it was voided. All the precautions were taken to collect the dung quantitatively, uncontaminated by urine, feed residue or dirt. The dung collected each day was weighed accurately and packed in airtight double lined plastic bags and stored in deep freezer. At the end of the collection period, the preserved dung samples taken from each animal were pooled and used for chemical analysis.

3.6 ANALYSIS OF FEED

Proximate analysis of the feed and green grass were done as per the standard procedures (AOAC, 2012). Minerals such as calcium and phosphorus in the feed were analysed by conventional volumetric methods (AOAC, 2012).

Digestibility coefficient of nutrients was calculated from the data obtained on intake and outgo of dry matter and different nutrients during the digestion trial.

3.7 HAEMATOLOGICAL STUDIES

Blood samples were collected prior to breeding period and within 3 days of kidding. The samples were analysed for serum glucose level, blood urea nitrogen (BUN) (Kaneko *et al*., 2008), serum calcium (Christian *et al*., 1967) and serum phosphorus (Bernhart and Wreath, 1955). Blood haemoglobin was estimated by cyanomethaemoglobin method using reagents from Agappe diagnostics Ltd, Ernakulam, India. Plasma protein, blood urea nitrogen, serum calcium, serum phosphorus were determined using the blood analyzer (Mispa plus, SEAC radim group) and kits supplied by Agappe diagnostics, Ernakulam, India.

3.8 GROWTH PARAMETERS

Body weight of doe at mating, monthly body weight of pregnant doe , body weight of doe at kidding, birth weight of kids, fortnightly body weight of kids for first month were recorded.

3.9 REPRODUCTIVE PARAMETERS

Conception rate of does, litter size of both control and experimental animals were recorded.

3.10 STATISTICAL ANALYSIS

Data obtained on different parameters during the course of experiment were subjected to statistical analysis using analysis of variance (ANOVA) (Snedecor and Cochran, 1994).

Table1. Ingredient composition of the experimental concentrate mixtures, %

Ingredient	Percentage composition		
	T_1	T_2	T_3
Yellow maize	15	10	40
Wheat bran	30	29	17
Soya bean meal	21	28	24
Deoiled rice bran	30	29	15
Calcite	1	1	1
Common salt	1	1	1

Mineral mixture*	2	2	2

*Ksheeramin – Mineral mixture for cattle- Each kg contains elemental calcium, 240g, elemental phosphorus 120g, elemental magnesium 7g, elemental iron 5g, elemental zinc 4500mg, elemental manganese 1500mg, elemental copper 1200 mg, elemental iodine 275mg, elemental cobalt 150mg, elemental potassium 100mg.

Table 2. Calculated nutrient content of the experimental concentrate mixtures, %

Parameters	T_1	T_2	T_3
Total digestible nutrients, %	65.54	65.90	70.50
Digestible energy, kcal/kg	3108.42	3002.78	3529.53
Digestible crude protein, %	11.98	15.76	13.21

Results

4. RESULTS

The results obtained during the course of study are documented here under the following headings.

4.1 CHEMICAL COMPOSITION OF THE EXPERIMENTAL RATION

The per cent chemical composition of concentrate mixture and fodder are presented in Table 3.The three experimental rations T_1, T_2 and T_3 had 18.19, 20.16 and 18.24 per cent of crude protein, respectively. The fodder used for feeding had a crude protein content of 11.57 per cent on dry matter basis. The gross energy content of the three rations is 3817.6, 3804.97 and 3968.91 kcal/kg, respectively.

4.2 DAILY DRY MATTER INTAKE

Data on weekly average of daily dry matter intake of animals maintained on the three dietary treatments T_1, T_2 and T_3 in control group and experimental group during the last month of gestation are presented in Table 4,5 and in Fig.1.and 2 respectively. Consolidated data on the average dry matter intake, dry matter intake per 100 kg body weight, average dry matter intake per kg metabolic body weight, total digestible crude protein intake per day and total digestible nutrient intake per day are represented in Table 20.

4.3 BODY WEIGHT

Average initial body weight of animals in control group maintained on three treatments T_1, T_2 and T_3 during third month of gestation 25.17, 26.00 and 26.67 kg, respectively. Average body weight of animals in control group after kidding in treatments T_1, T_2 and T_3 are 26.08, 26.00 and 27.17 kg, respectively and the same for experimental group was 27.33, 26.83 and 28.33 kg, respectively. Summarized data on the average body weight of animals in control and experimental group in treatments T_1, T_2 and T_3 are presented in Table 6 and 7, respectively.

4.4 LITTER SIZE AND BIRTH WEIGHT

Litter size and individual birth weight of all animals in control group are listed in Table 8. Average birth weight of kids of animals in control group were1.56, 1.67 and 1.95 kg, respectively for T_1, T_2 and T_3 and is graphically illustrated in Fig. 3.

Litter size and individual birth weight of all animals in experimental group are presented in Table 9. Average birth weight of kids of animals in experimental group was 1.83, 2.07 and 2.35 kg, respectively and is graphically represented in Fig.4.

4.5 BODY WEIGHT OF KIDS

Average fortnightly body weight of kids of animals in control and experimental group maintained on three dietary treatments T_1, T_2 and T_3 are presented in Table.10

4.6 BODY WEIGHT GAIN

Data on the average fortnightly weight gain and cumulative total weight gain of kids of animals in control group maintained on three dietary treatments T_1, T_2 and T_3 are presented in Table 11 and average cumulative fortnightly weight gain is graphically represented in Fig.5. Data on the average fortnightly weight gain and cumulative total weight gain of kids of animals in experimental group maintained on three dietary treatments T_1, T_2 and T_3 are presented in Table 12 and average cumulative fortnightly weight gain is graphically represented in Fig. 6.

The summarized data on the body weight, total gain and average daily gain of kids of animals in control group maintained on three treatments T_1, T_2 and T_3 during last month of gestation are presented in Table 13 and graphically represented the average daily gain of kids in Fig.7. The summarized data on the body weight, total gain and average daily gain of the kids of animals in experimental group maintained on three treatments T_1, T_2 and T_3 are presented in Table. 14. The average daily gain of

kids of animals in experimental group were0.09, 0.10 and 0.12 kg respectively for T_1, T_2 and T_3 and is graphically depicted in Fig. 8.

4.7 HEMATO- BIOCHEMICAL PARAMETERS

The data on the values of haemoglobin, total protein, blood urea nitrogen (BUN), blood glucose, plasma calcium and phosphorus content of the blood samples collected from animals of both control group and experimental group prior to breeding and at the day of kidding are shown respectively in Table 15 and Table 16.The summarised data of these parameters of animals in control group at the day of kidding are presented in Fig. 9 and the same that of animals in experimental group in Fig. 10, respectively.

Blood haemoglobin levels of animals in control group maintained on three treatments T_1, T_2 and T_3prior to breeding were 8.05, 8.30 and 8.48 g/dl, respectively and after kidding were 9.28, 9.30 and 9.15 g/dl, respectively. The serum biochemical parameters of animals in control group prior to breeding and maintained on three dietary treatments T_1, T_2, and T_3 in last month of gestation were 6.38, 6.34 and 6.27 g/ dl for total proteins and 12.98, 13.85 and 13.9 g/ dl for blood urea nitrogen and 54.27, 56.5 and 53.14 mg/ dl for glucose, respectively. The serum biochemical parameters of animals in control group at the day of kidding maintained on three dietary treatments T_1, T_2, and T_3 were 6.50, 8.02 and 6.42 g/ dl for total proteins and 14.75, 19.2 and 15.93 g/ dl for blood urea nitrogen and 57.99, 62.78 and 58.58 mg/ dl for glucose, respectively. The mean values obtained for serum minerals in animals of three dietary treatments T_1, T_2 and T_3 were 10.44, 10.54 and 10.46 mg/dl for calcium and6.59, 6.74 and 6.53 mg/ dl for phosphorus prior to breeding. The average values for the blood collected at the day of kidding were 10.67, 10.64 and 10.64 mg/dl for calcium and 8.09, 7.49 and 6.69 mg/ dl for phosphorus respectively for T_1, T_2, and T_3.

The average values for blood haemoglobin of animals in experimental group maintained on three treatments T_1, T_2 and T_3 prior to breeding were 8.50, 8.83 and

8.33 g/dl, respectively and at the day of kidding were 11.14, 10.55 and 10.96 g/dl, respectively. The average values of blood of animals in experimental group collected prior to breeding were 6.35, 6.40 and 6.36 g/ dl for total proteins and 14.15, 14.08 and 14.52 g/ dl for blood urea nitrogen and 57.33, 58.56 and 56.59 mg/ dl for glucose, respectively in the three dietary groups. The serum biochemical parameters of animals in experimental group at the day of kidding maintained on three dietary treatments T_1, T_2, and T_3 were 6.42, 8.01 and 6.60 g/ dl for total proteins and 16.75, 19.41 and 16.81g/ dl for blood urea nitrogen and 59.44, 60.29 and 58.80 mg/ dl for glucose, respectively.

The mean values obtained for serum minerals in animals of experimental group maintained on three dietary treatments T_1, $T_2$and T_3 were 10.58, 10.59 and 10.39 mg/dl for calcium and 6.68, 6.67 and 6.44mg/dl for phosphorus prior to breeding and at the day of kidding were 10.65, 10.79 and 10.58 mg/dl for calcium and 7.92, 8.35 and 6.50 mg/dl for phosphorus respectively.

4.8 DIGESTIBILTY TRIAL

The chemical and mineral compositions of the dung voided by the experimental animals during the digestion trial are given in Table 18.The calcium content of the dung of animals belonging to groups maintained on rations T_1, T_2 and T_3 were 2.83, 3.24 and 3.20 per cent and phosphorus contents were 2.24, 2.39 and 1.98 per cent respectively.

4.9 AVAILABILITY OF NUTRIENTS

Data on percentage availability of nutrients of experimental rations T_1, T_2 and T_3 are presented in Table 19 and graphically depicted in Fig.11. The percentage availability of the three experimental rations T_1, T_2 and T_3 were 62.66, 64.05 and 63.42 for DM, 66.57, 78.77 and 72.86 for CP, 68.98, 70.79 and 71.40 for EE, 42.89, 46.14 and 45.93 for CF and 72.88, 74.67 and 71.89 for NFE.

4.10. ECONOMICS OF PRODUCTION

Data on cost of feed per kg, cost of feed during flushing, cost of feed during feeding trial of 30 days, total feed cost and total kid's weight obtained after one month is represented in Table 21.The cost of ingredients used for the study was calculated as per the rate contract fixed by the College of Veterinary and Animal Sciences, Mannuthy for the year 2013–2014. The cost of feed per kg was Rs. 19.72, 21.12 and 20.70 for groups T_1, T_2 and T_3, respectively.

4.11 EXPERIMENT AND CONTROL GROUP COMPARISON

4.11.1 Litter size and birth weight

Consolidated data on the litter size of does, body weight, total gain and average daily gain of kids of both control and experimental group is represented in Table 17.

Table 3. Chemical composition of the three experimental concentrate mixtures and fodder (on dry matter basis), %

Parameter	Concentrate mixture			Fodder
	T_1	T_2	T_3	
Dry matter	90.43±0.04	90.45± 0.16	90.65±0.13	17.51±0.36
Crude protein	18.19±0.07	20.16±0.03	18.24±0.02	11.57±0.12
Ether extract	2.60±0.03	2.85±0.16	3.12±0.48	3.09±0.03
Crude fibre	8.60±0.09	8.73±0.13	7.32±0.17	26.17±0.11
Total ash	7.83±0.25	8.00±0.12	7.19±0.17	6.60±0.15
Nitrogen free extract	62.79±0.20	60.25±0.26	64.42±0.11	53.38±0.15
Acid insoluble ash	4.18±0.07	4.87±0.09	3.97±0.04	1.59±0.05
Calcium	1.08±0.05	1.01±0.01	1.00±0.03	0.93±0.20
Phosphorus	1.28±0.02	1.28±0.16	1.15±0.02	0.51±0.02
GE (kcal/kg)	3817.6±0.04	3804.97±0.10	3968.91±0.49	3757.41±0.95

Table 4. Weekly average of daily dry matter intake* of animals in control group maintained on three experimental rations in last month of gestation, kg

Weeks	T_1	T_2	T_3	P value
1	1.06±59.22	1.08±28.31	1.03±53.12	0.45
2	1.07±56.96	1.10±17.7	1.09±41.98	0.85
3	1.10±41.35	1.12±22.44	1.02±18.62	0.78
4	1.10±48.64	1.13±30.64	1.05±20.88	0.69

*Average of six values

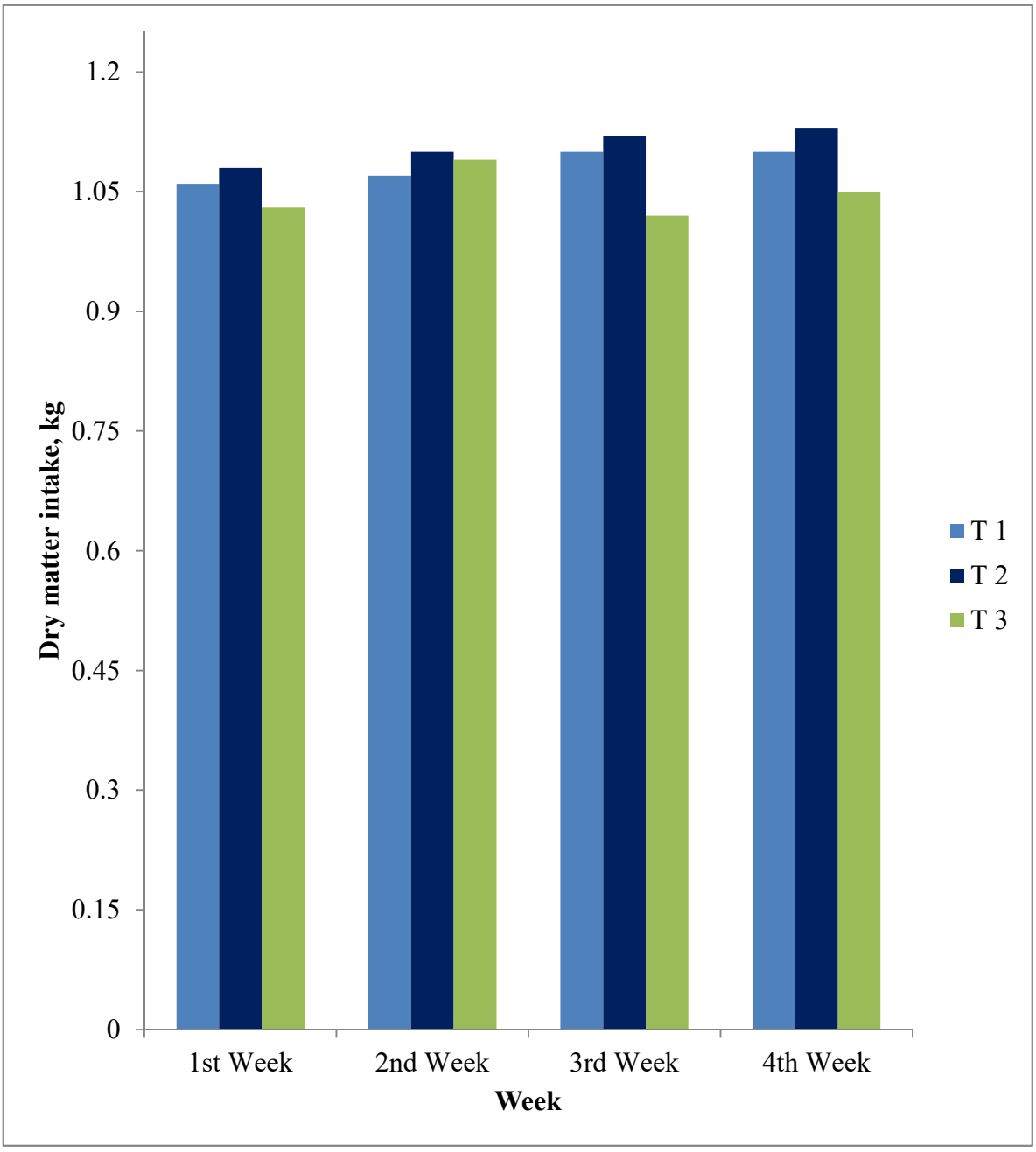


Fig. 1. Weekly average of daily dry matter intake of animals in control group maintained on three experimental rations in last month of gestation, kg

Table 5. Weekly average of daily dry matter intake* of animals in experimental group in last month of gestation maintained on three experimental rations, kg

Weeks	T_1	T_2	T_3	P value
1	1.19±39.97	1.25±44.76	1.15±33.46	0.27
2	1.25±47.13	1.27±49.09	1.19±18.49	0.33
3	1.26±52.51	1.28±50.43	1.18±17.65	0.28
4	1.24±58.43	1.23±49.13	1.13±26.87	0.22

* Average of six values

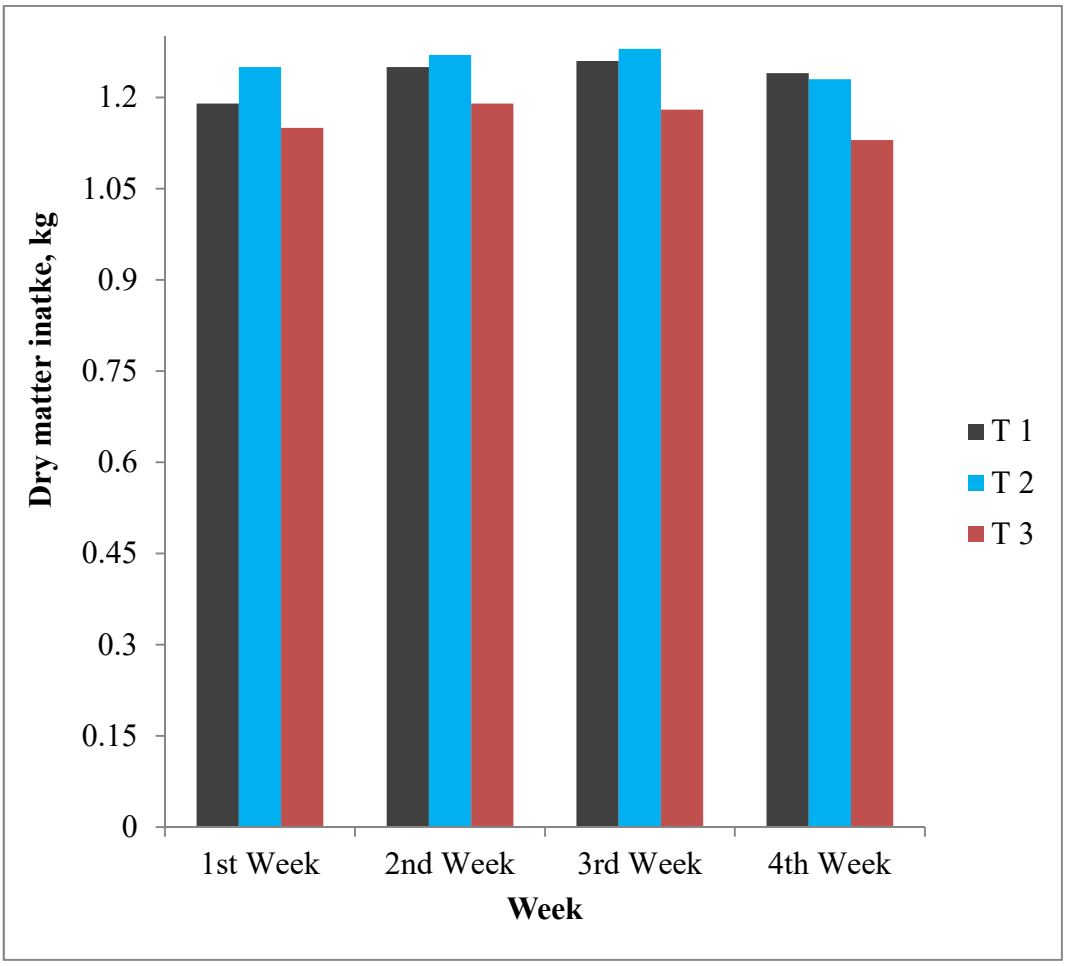


Fig.2. Weekly average of daily dry matter intake of animals in experimental group in last month of gestation maintained on three experimental rations, kg

Table 6. Summarized data* on the average body weight of animals in control group, kg

Parameters, kg	T_1	T_2	T_3	P Value
Initial body weight at the start of feeding trial	24.21±0.56	24.75±0.32	24.32±0.81	0.83
Body weight at 16^{th} week of gestation	27.50±0.89	27.38±1.52	28.43±0.67	0.74
Body weight after kidding	25.68±1.02	26.13±1.14	26.33±0.52	0.93

*Average of six values

Table 7. Summarized data* on the average body weight of animals in experimental group before flushing, prior to breeding and after kidding, kg

Parameters, kg	T_1	T_2	T_3	P Value
Body weight before flushing	25.67±0.80	25.17±1.17	25.67±0.72	0.91
Body weight prior to breeding	26.5±0.67	26.50±1.38	26.33±0.67	0.74
Body weight at 16^{th} week of gestation	28.33±0.63	27.50±0.37	28.33±0.53	0.82
Body weight after kidding	26.44±1.09	26.83±1.38	26.69±0.67	0.55

* Average of six values

Table 8. Litter size of animals in control group and birth weight of kids (kg) of control animals* maintained on three different experimental rations

Treatment	Animal No.	Litter size	Birth weight of kids in a litter (kg)			Average birth weight of kids
			1	2	3	
T_1	1	1	1.06			1.06
	2	1	0.96			0.96
	3	1	2.20			2.20
	4	2	1.80	1.50		1.65
	5	3	2.10	1.80	1.40	1.77
	6	1	1.70			1.70
Group average		**1.50±0.34**				**1.56±0.19[a]**
T_2	1	1	1.11			1.11
	2	1	1.73			1.73
	3	2	1.14	1.00		1.07
	4	2	2.40	2.32		2.36
	5	2	1.90	2.00		1.95
	6	1	1.80			1.80
Group average		**1.50±0.22**				**1.67±0.19[ab]**
T_3	1	1	1.52			1.52
	2	2	2.37	2.04		2.21
	3	1	1.70			1.70
	4	2	2.00	2.20		2.10
	5	2	2.10	2.30		2.20
	6	2	2.10	1.90		2.00
Group average		**1.67±0.21**				**1.95±0.12[b]**
P Value		**0.29**				**0.02***

***** Average of six values

a,b - Means with different superscripts within the same column differ significantly *($P < 0.05$)

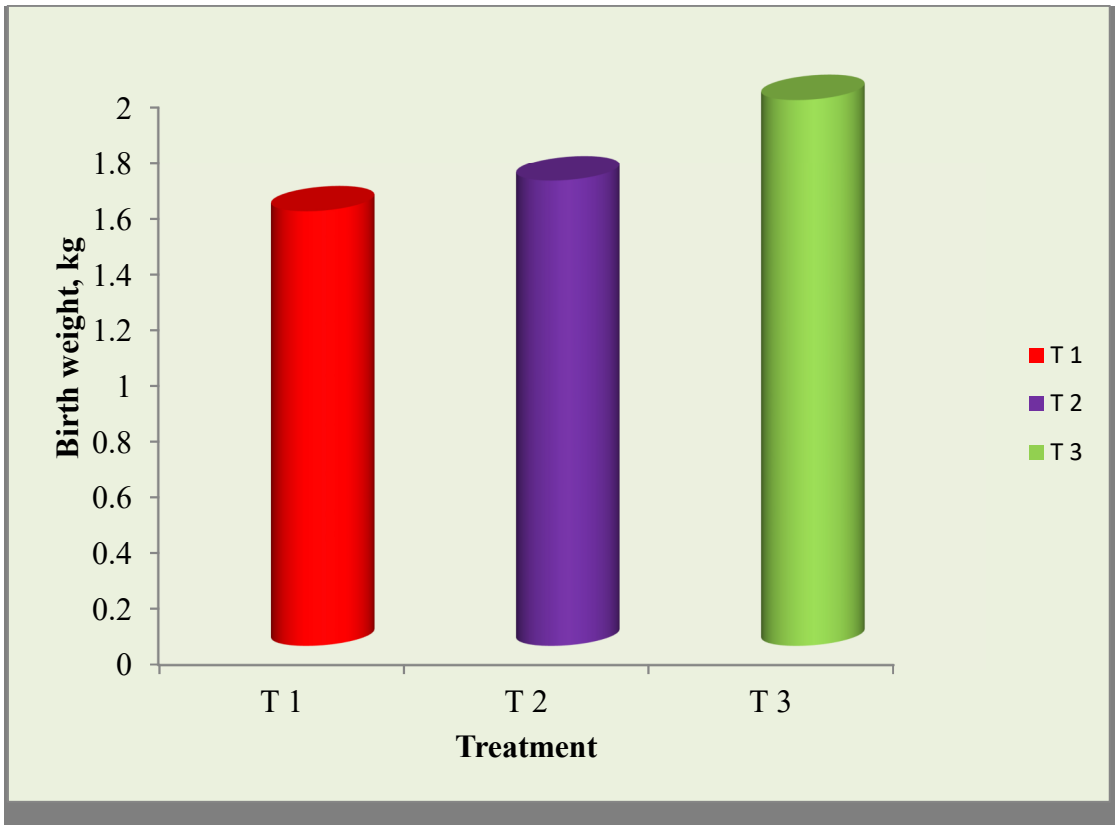


Fig. 3. Average birth weight of kids of animals in control group maintained on three experimental rations, kg

Table 9.Litter size of animals in experimental group and birth weight of kids (kg) of experimental animals* maintained on three different experimental rations

Treatment	Animal No.	Litter size	Birth weight of kids in a litter (kg)		Average birth weight of kids (kg)
			1	2	
T 1	1	2	1.81	1.80	1.81
	2	2	1.39	1.50	1.45
	3	1	1.66		1.66
	4	1	2.01		2.01
	5	2	2.73	1.40	2.07
	6	2	1.80	2.10	1.95
Group average		**1.67±0.21**			**1.83±0.97[a]**
T 2	1	2	1.74	1.71	1.73
	2	2	2.54	2.00	2.27
	3	1	1.75		1.75
	4	2	2.74	2.10	2.42
	5	2	2.50	2.00	2.25
	6	2	1.80	2.20	2.00
Group average		**1.83±0.17**			**2.07±0.12[ab]**
T 3	1	2	1.82	1.68	1.75
	2	2	1.93	2.16	2.05
	3	1	2.93		2.93
	4	2	2.26	2.30	2.28
	5	2	2.72	2.20	2.46
	6	2	2.40	2.41	2.41
Group average		**1.83±0.17**			**2.35±0.15[b]**
P value		**0.87**			**0.03***

*Average of six values

a,b - Means with different superscripts within the same column differ significantly

* ($P < 0.05$)

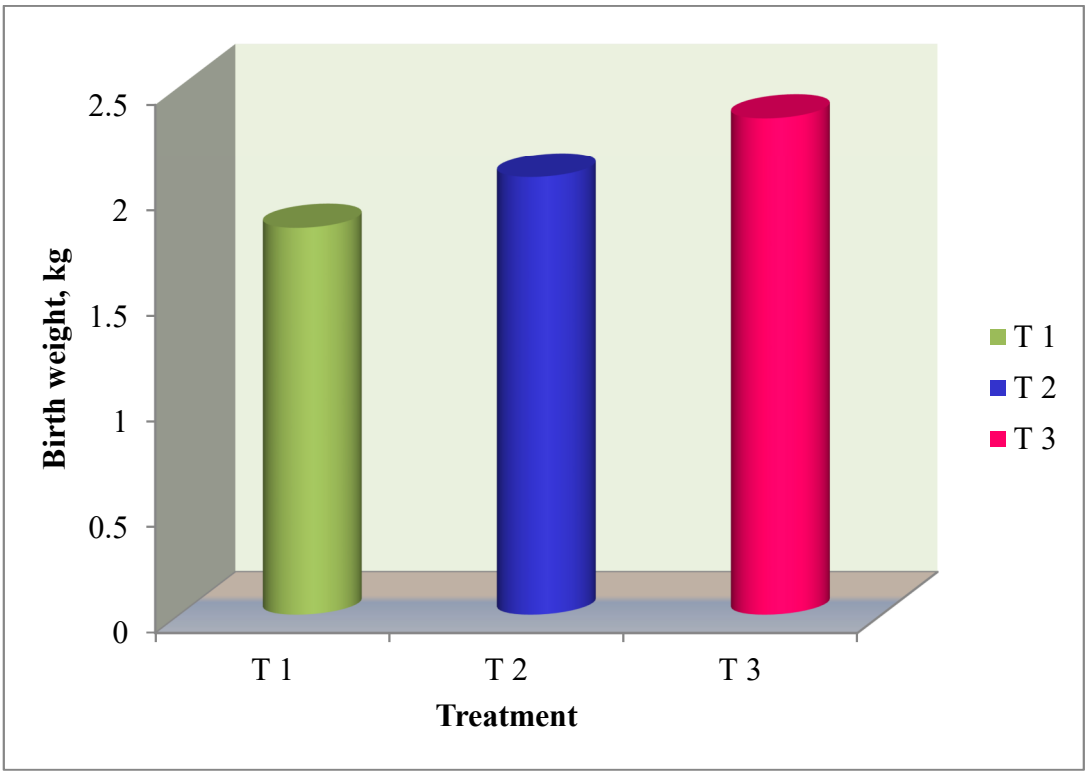


Fig. 4. Average birth weight of kids of animals in experimental group maintained on three experimental ration in last month of gestation, kg

Table 10.Fortnightly body weight* of kids of animals in control and experimental group maintained on three experimental rations, kg

Treatment	Fortnightly body weight of kids (kg)			
	Control		Experiment	
	1	2	1	2
T_1	2.90±0.39[a]	4.07±0.29[a]	3.27±0.18[a]	4.44±0.10[a]
T_2	3.11±0.37[ab]	4.58±0.21[b]	3.81±0.19[b]	5.12±0.98[b]
T_3	3.87±0.18[b]	5.14±0.15[c]	3.95±0.17[b]	5.83±0.46[c]
P value	0.02*	0.01**	0.02*	0.01**

*Average of six values

a,b,c- Means with different superscripts within the same column differ significantly

** (P< 0.01) * (P < 0.05)

Table 11.Data on the weight gain* of kids of control animals maintained on three experimental rations, kg

Weight gain (kg)	Treatments			P value
	T1	T2	T3	
1st Fortnight	1.35±0.23	1.45±0.23	1.92±0.18	0.13
2nd Fortnight	1.17±0.16	1.47±0.19	1.27±0.18	0.20
Cumulative Total weight gain	2.52±0.15[a]	2.92±0.13[b]	3.19±0.13[c]	0.02*

*Average of six values

a,b,c- Means with different superscripts within the same row differ significantly

* ($P < 0.05$)

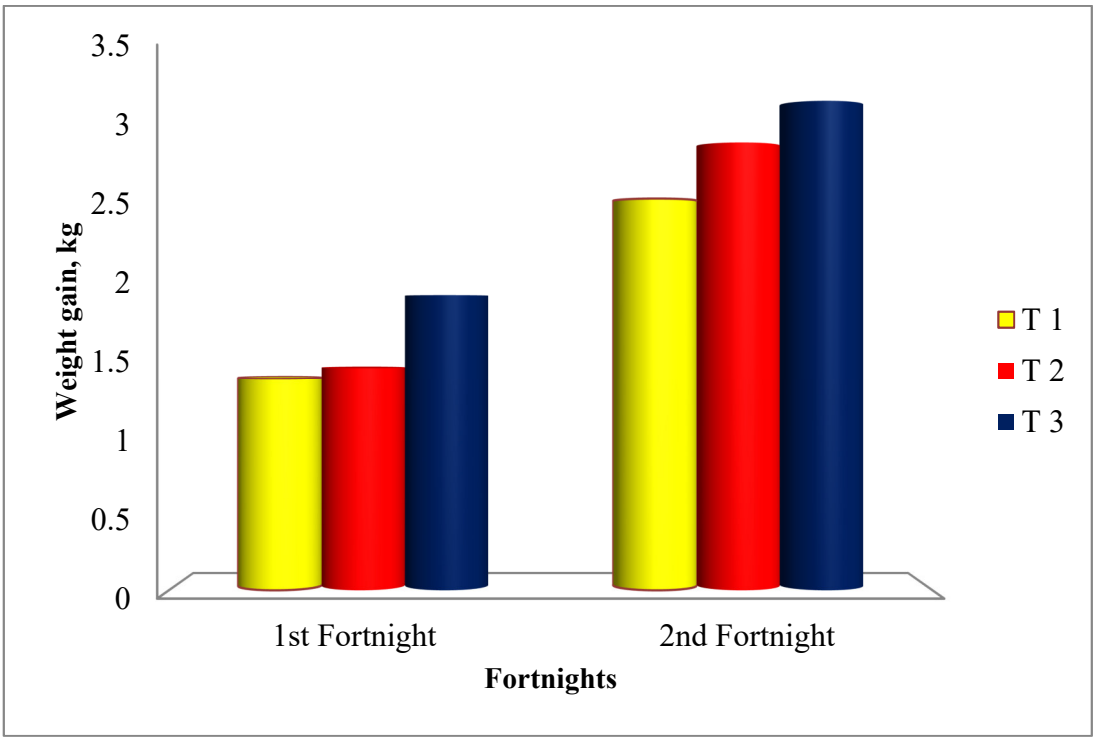


Fig. 5. Average cumulative fortnightly weight gain of kids of animals in control group maintained on three experimental rations, kg

Table 12. Data on the weight gain* of kids of experimental animals maintained on three experimental rations, kg

Weight gain (kg)	Treatments			P value
Fortnightly weight gain	T_1	T_2	T_3	
1	1.44± 0.22	1.74 ±0.26	1.60 ±0.17	0.29
2	1.17± 0.33	1.31± 0.17	1.88 ±0.40	0.54
Cumulative Total weight gain	2.61 ± 0.11^{a}	3.05 ± 0.11^{b}	3.48 ± 0.31^{c}	0.04*

* Average of six values

a,b,c- Means with different superscripts within the same row differ significantly

* ($P < 0.05$)

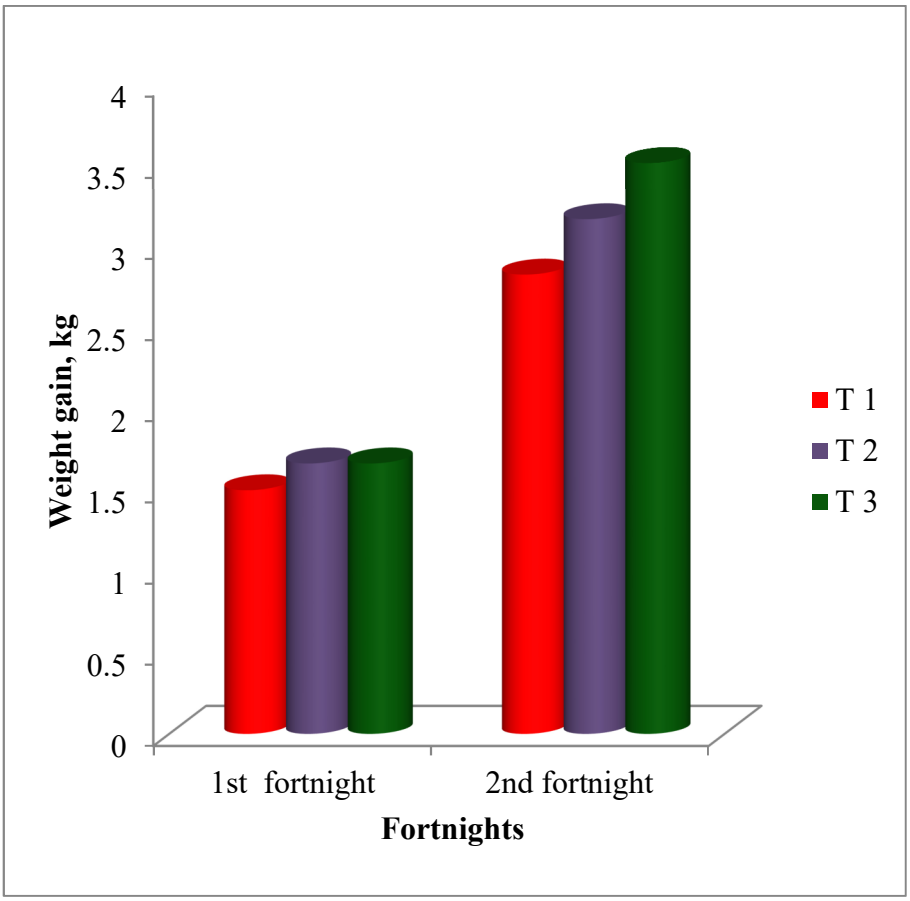


Fig. 6. Average cumulative fortnightly weight gain of kids of animals in experimental group maintained on three experimental rations in last month of gestation, kg

Table 13. Summarized data* on body weight, total gain and average daily gain of kids of animals in control group maintained on three experimental rations

Parameters, kg	T_1	T_2	T_3	P value
Initial body weight	1.56 ± 0.19^{a}	1.67 ± 0.19^{ab}	1.95 ± 0.12^{b}	0.02*
Final body weight	4.07 ± 0.29^{a}	4.58 ± 0.21^{b}	5.14 ± 0.15^{c}	0.01**
Total gain	2.52 ± 0.15^{a}	2.91 ± 0.13^{b}	3.19 ± 0.13^{c}	0.02*
Average daily gain	0.08 ± 0.01^{a}	0.10 ± 0.00^{b}	0.11 ± 0.00^{c}	0.05*

* Average of six values

a,b,c- Means with different superscripts within the same row differ significantly

** ($P< 0.01$) * ($P < 0.05$

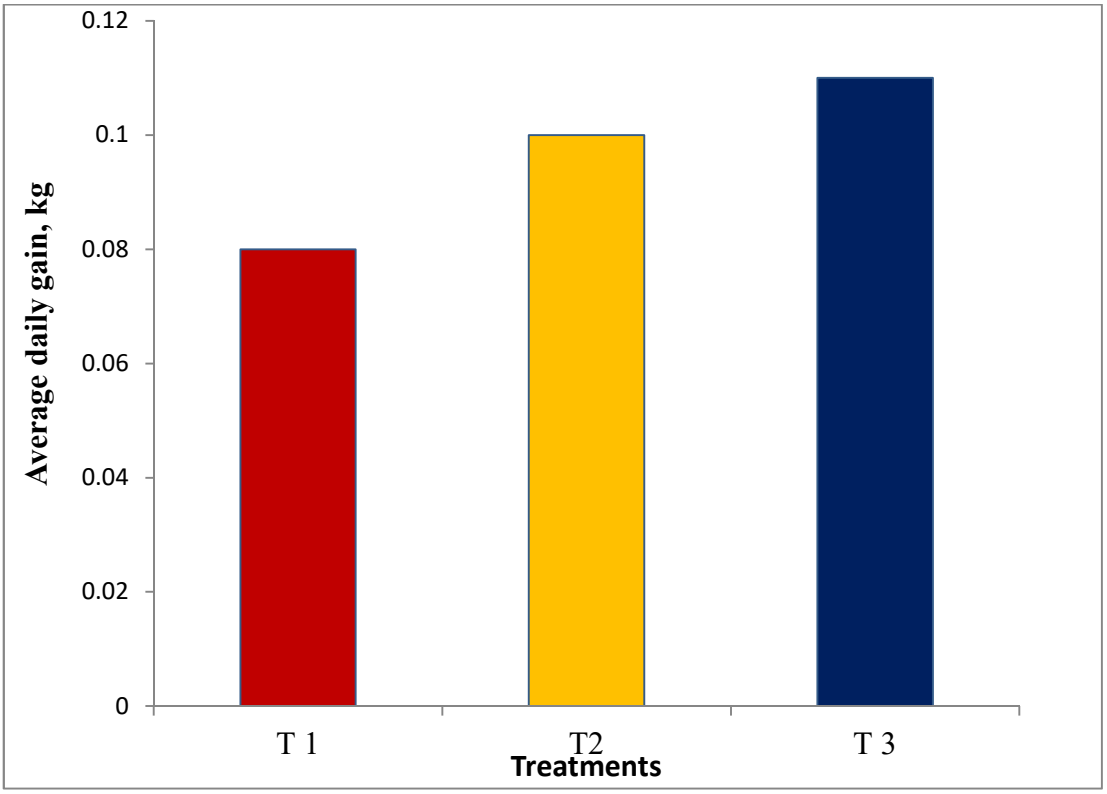


Fig. 7. Average daily gain of kids of animals in control group maintained on three experimental rations, kg

Table 14. Summarized data* on body weight, total gain and average daily gain of kids of experimental animals maintained on three experimental rations, kg

Parameters, kg	T_1	T_2	T_3	P value
Initial body weight	1.83 ± 0.10^{a}	2.07 ± 0.12^{ab}	2.35 ± 0.15^{b}	0.03*
Final body weight	4.44 ± 0.11^{a}	5.12 ± 0.12^{b}	5.83 ± 0.46^{c}	0.01**
Total gain	2.61 ± 0.11^{a}	3.05 ± 0.11^{b}	3.48 ± 0.31^{c}	0.04*
Average daily gain	0.09 ± 0.00^{a}	0.10 ± 0.01^{b}	0.12 ± 0.01^{c}	0.03*

*Average of six values

a,b,c- Means with different superscripts within the same row differ significantly

** ($P< 0.01$) * ($P < 0.05$

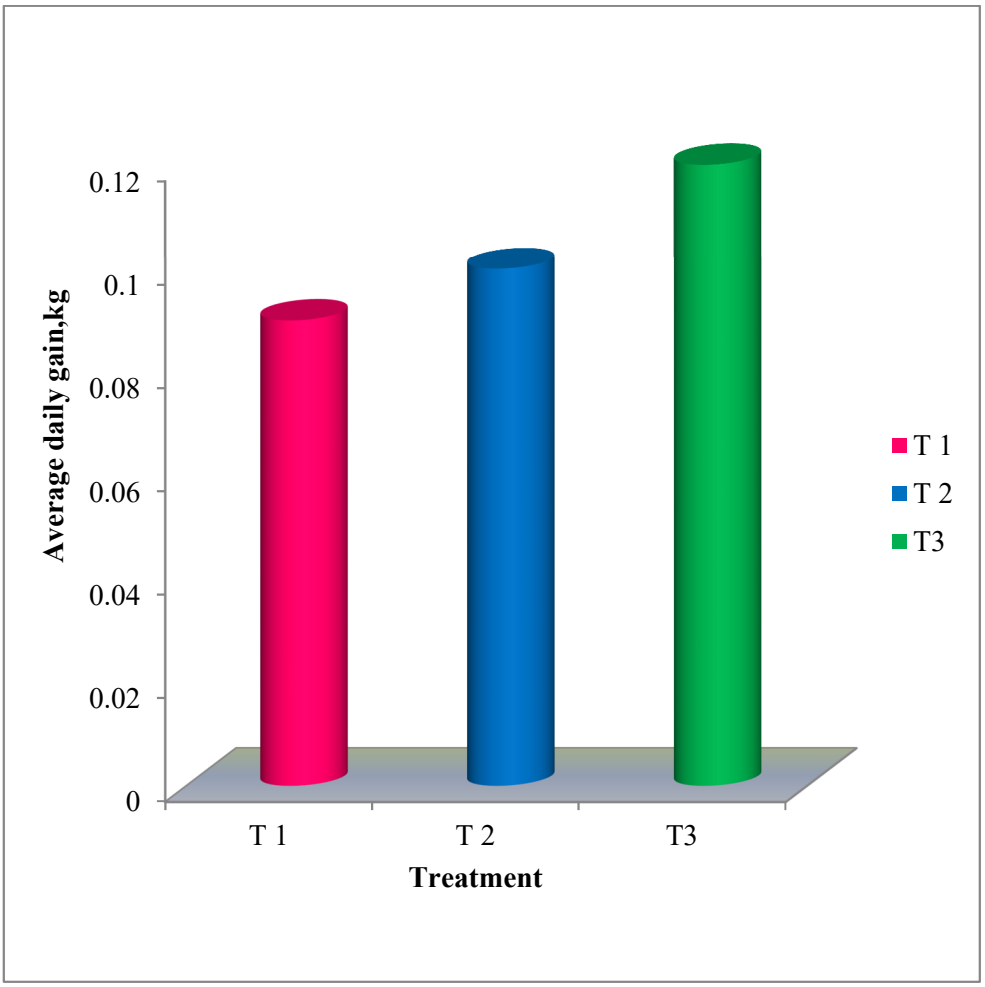


Fig. 8. Average daily gain of kids of animals in experimental group maintained on three experimental rations, kg

Table 15.Haematological parameters* of the animals in control group maintained on the three experimental rations

Parameter		T 1	T 2	T 3	P value
Blood haemoglobin, g/dl	Prior to breeding	8.05±0.31	8.30±0.22	8.48±0.19	0.22
	At kidding	9.28±0.48	9.30±0.48	9.15±0.23	1.00
Total plasma protein, g/dl	Prior to breeding	6.38±0.21	6.34±0.17	6.27±0.09	0.34
	At kidding	6.50±0.22[a]	8.02±0.01[b]	6.42±0.22[a]	0.01**
Blood urea nitrogen, g/dl	Prior to breeding	12.98±0.40	13.85±0.31	13.90±0.37	0.07
	At kidding	14.75±0.42[a]	19.20±0.17[b]	15.93±0.68[c]	0.01**
Glucose, mg/dl	Prior to breeding	54.27±2.17	56.5±2.25	53.14±0.95	0.44
	At kidding	57.99±2.91	62.78±2.83	58.58±1.17	0.34
Calcium, mg/dl	Prior to breeding	10.44±0.21	10.54±0.22	10.46±0.22	0.83
	At kidding	10.67±0.21	10.64±0.22	10.64±0.21	0.82
Phosphorus, mg/dl	Prior to breeding	6.59±0.22	6.74±0.25	6.53±0.34	1.00
	At kidding	8.09±0.01[a]	7.49±0.21[b]	6.69±0.16[c]	0.01**

*Average of six values

a,b,c - Means with different superscripts within the same row differ significantly** ($P< 0.01$)

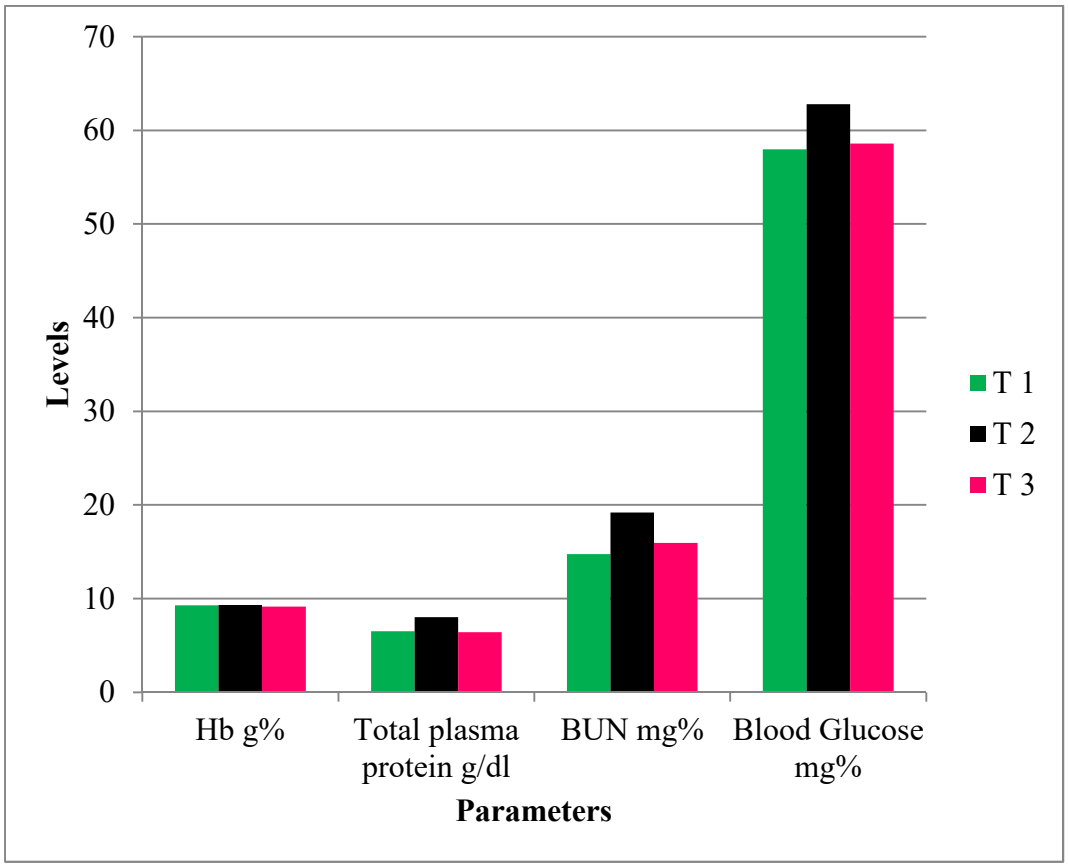


Fig. 9. Haematological parameters of animals in control group maintained on the three experimental rations, collected at the day of kidding.

Table 16. Haematological parameters* of animals in experimental group maintained on the three experimental rations

Parameter		T 1	T 2	T 3	P value
Blood haemoglobin, g/dl	Prior to breeding	8.50±0.22	8.83±0.31	8.33±0.33	0.48
	At kidding	11.14±0.40	10.55±0.31	10.96±0.22	0.27
Total plasma protein, g/dl	Prior to breeding	6.35±0.17	6.40±0.33	6.36±0.17	0.76
	At kidding	6.42±0.22[a]	8.01±0.01[b]	6.60±0.19[a]	0.01**
Blood urea nitrogen, g/dl	Prior to breeding	14.15±0.34	14.08±0.23	14.52±0.46	0.67
	At kidding	16.75±0.48[a]	19.41±0.22[b]	16.81±0.31[a]	0.01**
Glucose, mg/dl	Prior to breeding	57.53±1.73	58.56±1.68	56.59±1.78	0.68
	At kidding	59.44±2.25	60.29±1.82	58.80±2.33	0.91
Calcium, mg/dl	Prior to breeding	10.58±0.21	10.59±0.22	10.39±0.17	0.24
	At kidding	10.65±0.21	10.79±0.17	10.58±0.21	0.79
Phosphorus, mg/dl	Prior to breeding	6.68±0.22	6.67±0.21	6.44±0.22	0.83
	At kidding	7.92±0.42[a]	8.35±0.21[b]	6.50±0.25[c]	0.01**

*Average of six values

a,b,c - Means with different superscripts within the same row differ significantly

** ($P < 0.01$)

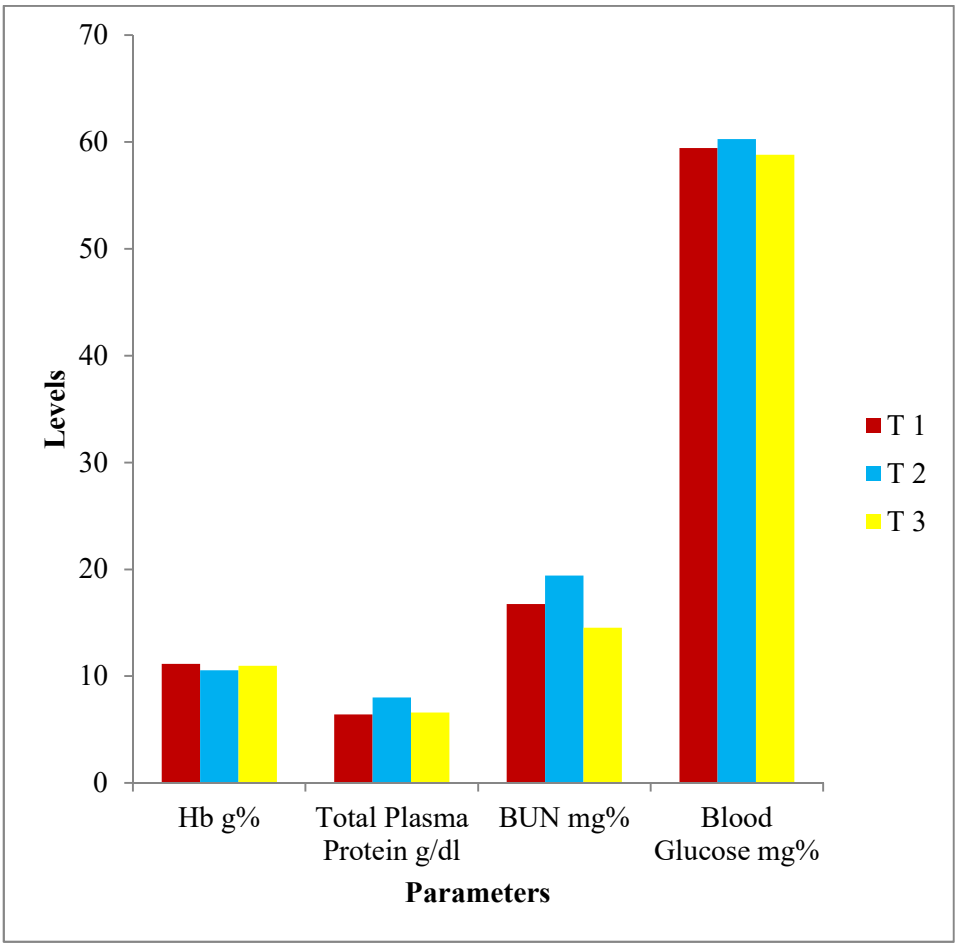


Fig. 10.Haematological parameters of animals in experimental group maintained on the three experimental rations, collected at the day of kidding.

Table 17.Consolidated data* on the litter size of doe, body weight, total gain and average daily gain of kids of animals in both control and experimental group maintained on three experimental rations

Parameters	Control			Experiment		
	T_1	T_2	T_3	T_1	T_2	T_3
Litter size	1.50±0.34^{ns}	1.50±0.22^{ns}	1.67±0.21^{ns}	1.67±0.21^{ns}	1.83±0.17^{ns}	1.83±0.17^{ns}
Initial body weight (kg)	1.56±0.19	1.67±0.19	1.95±0.12	1.83±0.10	2.07±0.12	2.35±0.15
Final body weight (kg)	4.07±0.29	4.58±0.21	5.14±0.15	4.44±0.11	5.12±0.12	5.83±0.46
Total gain (kg)	2.51±0.15	2.91±0.13	3.19±0.13	2.62±0.11	3.05±0.11	3.48±0.31
Average daily gain (kg)	0.08±0.01	0.10±0.00	0.11±0.00	0.09±0.00	0.10±0.01	0.12±0.01

* Average of six values
ns- non significant

Comparing average birth weight, final weight, total weight gain and average daily gain

- Between CT_1, ET_2 and ET_3- CT_2, CT_3 similar, higher than CT_1, ($P < 0.05$)
- Between CT_2, ET_1 and ET_3- CT_2, ET_1 similar,ET_3 higher average birth weight, final weight,($P<0.05$)
- Between CT_3, ET_1 and ET_{2-} CT_3, ET_2 similar final weight and higher than ET_1 ($P< 0.01$)
- Between ET_1, CT_2 and CT_3- Final body weight and total weight gain – CT_3 Significantly higher ($P<0.05$) than CT_2 and ET_1, CT_2 and ET_1 similar. Average daily gain- CT_3 and CT_2 significantly higher than ET_1($P<0.05$)
- Between ET_2, CT_1 and CT_3- CT_3 and ET_2 similar, higher than CT_1 ($P< 0.05$)
- Between ET3, CT1 and CT2- CT1 and CT2 similar, ET3 higher than both ($P<0.05$)

Table 18. Chemical composition of the dung* from the experimental animals, % (on dry matter basis)

Parameters, %	T_1	T_2	T_3
Dry matter	52.65±0.27	53.01±0.77	53.27±0.26
Crude protein	7.24±0.30	6.73±0.34	7.13±0.90
Ether extract	1.05±0.02	1.45±0.04	1.16±0.11
Crude fiber	9.82±0.41	12.68±0.32	9.95±1.17
Total ash	22.87±0.41	23.88±0.69	22.53±0.32
Nitrogen free extract	20.67±0.80	30.56±0.80	24.51±1.86
Acid insoluble ash	9.23±0.52	9.28±0.24	10.19±0.22
Calcium	2.83±0.07	3.24±0.10	3.20±0.08
Phosphorus	2.24±0.13	2.39±0.12	1.98±0.02

*Average of 4 values

Table 19.Apparent digestibility coefficient of nutrients* of the three experimental rations, %

Parameters, %	T_1	T_2	T_3
Dry matter	62.66±0.26	64.05±0.42	63.42±0.26
Crude protein	66.57±0.36	78.77±0.49	72.86±1.67
Ether extract	68.98±0.70	70.79±0.21	71.40±0.86
Crude fiber	42.89±0.40	46.14±0.25	45.93±0.87
Nitrogen free extract	72.88±0.13	74.67±0.13	71.89± 0.77

* Average of 4 values

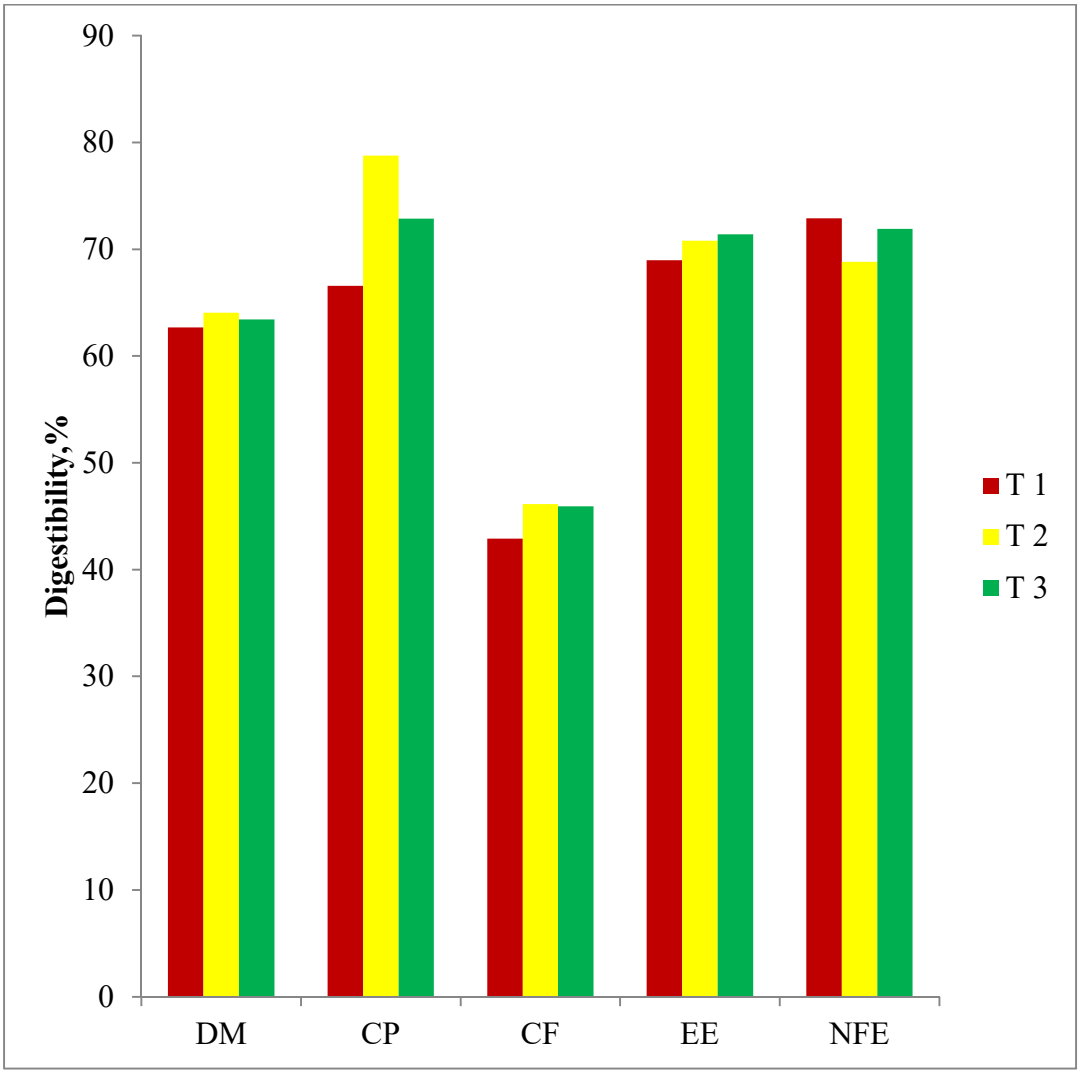


Fig. 11. Digestibility coefficient of nutrients of experimental rations, %

Table 20. Consolidated data* on the dry matter intake, DCP intake and TDN intake of goats fed with three experimental rations in last month of gestation

Parameters	T_1	T_2	T_3
Average total dry matter intake/day, kg	1.16	1.15	1.15
Average dry matter intake/100 kg body weight, kg	4.05	4.07	3.75
Average dry matter intake / kg metabolic body weight of goats, kg	0.50	0.50	0.49
Total DCP intake(g)/day	139.24	181.21	151.69
Total TDN intake (g)/day	761.74	757.71	809.54

* Average of 4 values

Table 21.Cumulative data on the cost of concentrate mixture and economics

	Control			Experiment			
	T_1	T_2	T_3	T_1	T_2	T_3	P value
Cost of concentrate mixture /kg (Rs)	19.72	21.12	20.70	19.72	21.12	20.70	
Cost of concentrate mixture during flushing@ 200g/d-14days (Rs)	0.00	0.00	0.00	331.26	331.26	331.26	
Cost of concentrate mixture during feeding trial (Rs)	3529.36	3757.76	3626.68	3587.08	3777.44	3620.31	
Total cost of concentrate mixture (Rs)	3529.36	3757.76	3626.68	3918.34	4108.70	3951.57	
Total weight of the kids in one month/group	37.55	39.80	51.90	44.00	56.15	61.95	
Cost of chevon** (Rs.)	6759.00	7164.00	9342.00	7920.00	10107.00	11151.00	
Total Returns (Rs.)	3229.64	3406.24	5715.32	4001.66	5998.30	7199.43	
Returns per goat (Rs.)	528.60± 266.73^{a}	595.46± 175.63^{a}	964.72± 200.09^{ab}	679.79± 138.06^{a}	1034.80± 123.85^{ab}	1236.69± 93.34^{b}	0.049*

a,b - Means with different superscripts within the same row differ significantly.

* ($P < 0.05$)

**Calculated as per Rs.180 for 1 kg live weight of the kids

Discussion

5. DISCUSSION

The results obtained during the present research work are discussed below.

5.1 CHEMICAL AND MINERAL COMPOSITION OF RATIONS

The per cent chemical composition of concentrate mixture and green grass fed to the experimental goats in last month of gestation are presented in the Table 3. The concentrate mixture formulated with 18, 20 and 18 per cent CP and 65, 65 and 70 per cent TDN contained 90.43, 90.45 and 90.65 per cent DM, 18.19, 20.16 and 18.24 per cent CP, 2.60, 2.85 and 3.12 per cent EE, 8.60, 8.73 and 7.32 per cent CF, 7.83, 8.00, 719 per cent total ash, 4.18, 4.87 and 3.97 per cent acid insoluble ash and 62.79, 60.25, and 64.42 per cent NFE, 3817.6, 3804.97 and 3968.91 kcal/kg feed GE, respectively.

Fodder used for the study contained 17.51 per cent DM, 11.57 per cent CP, 3.09 per cent EE, 26.17 per cent CF, 6.60 per cent total ash, 1.59 per cent acid insoluble ash and 53.38 per cent NFE and 3754.41 kcal/kg GE .Data on mineral composition of the three experimental rations are given in Table 3.The percentage of calcium were 1.08, 1.01 and 1.00per cent, phosphorus were 1.28, 1.28 and 1.15per cent respectively. Similar values of chemical composition were also reported by Rani (2006), Vinu (2012), George (2013) and Roshma (2014).

5.2 DRY MATTER INTAKE

The weekly average daily DMI of experimental goats given the dietary treatments T_1, T_2 and T_3 in control and experimental group are presented in Table 4 and 5.The average daily DMI of goats recorded at weekly intervals ranged from 1.06 to 1.1, 1.08 to 1.13 and 1.03 to 1.09 kg in control group and 1.19 to 1.26, 1.23 to 1.28 and 1.13 to 1.19 kg in experimental group, respectively and the values did not differ significantly ($P > 0.05$) in both groups and treatments. From the results on weekly average daily DMI, it can be concluded that feeding concentrate containing high

protein of 20 per cent or high energy of 70 per cent TDN had no significant effect on DMI in does during last month of gestation.

Consolidated data on the average dry matter intake, dry matter intake per 100 kg body weight, average dry matter intake per kg metabolic body size, total digestible crude protein intake per day and total digestible nutrient intake per day are represented in Table 20.The dry matter intake per 100 kg body weight ranged from 3.75 to 4.07 and DMI per metabolic body size of goats was in the range of 0.49 to 0.50 and the values were according to the requirement given in ICAR (1998). Total DCP intake ranged from 139.24 to 181.21g/day and TDN intake ranged from 757.71 to 809.54g/day which indicates that the animals met the requirement of protein and energy (71g DCP and 645g TDN)for a 30 kg pregnant doe (ICAR 1998).

In agreement with the results, of both control and experimental goats, Mahgoub *et al*.(2005) could not observe any significance difference in DMI of goats which were fed on concentrate mixture with varying metabolizable energy levels ranging from 2.1 to 2.68 Mcal/kg DM. These findings are also in agreement with He *et al.* (2013) who found no significant difference in DMI of goats fed concentrate mixture containing 5.75 MJ/kg and 9.34 MJ/kg.

In contrast to the results of both control and experimental animals, Yagoub and Babiker (2008) reported increased feed intake with increased energy level in goats when they were fed with concentrate mixture containing different energy levels ranging from 9.6 to 11.5 MJ/kg. Sayed (2009) reported decreased feed intake with increased levels of energy when goats were fed with energy ranging from 2.9 to 3.2 Mcal/kg and it ranged from 1.14 to 1.32 kg/d.

In accordance with the findings of both control and experimental group ,Saha *et al*. (2012) reported no significant difference in DMI in goats with varying CP concentrations ranging from 40g/day to 80g/day. Jadalla *et al.* (2012) reported increased feed intake as the dietary crude protein level increased from 4.1 to 11.3 per

cent. Similar values of average daily DMI at weekly intervals as observed in the present study were also reported by Elamin *et al.*(2012) and He *et al.*(2013) and it ranged from 1.06 to 1.2 kg/d in goats during last month of gestation.

5.3 GROWTH

The average monthly body weight of goats in the treatments T_1, T_2 and T_3 ranged from 26.83 to 31.33, 26.00 to 31.67 and 26.67 to 33.14 kg, respectively. The average body weight of animals in control group at 16^{th} week of gestation were 27.50, 27.38 and 28.33 for treatments T_1, T_2 and T_3, respectively. The mean values of body weight of animals in experimental group before flushing were 25.67,25.17 and 25.67 kg, prior to breeding were 26.5, 26.5 and 26.33 kg and after kidding in treatments T_1, T_2 and T_3 were 26.44, 26.83 and 26.69 kg, respectively. Similar values of body weight during gestation and after kidding as observed in the present study was also reported by He *et al.* (2013) and it ranged from 24.8 to 27.8 kg.

The results on monthly body weight of pregnant goats revealed no significant difference ($P>0.05$) between the three dietary treatments in two groups. Statistical analysis of the data revealed no significant difference ($P >0.05$) on the body weight of goats after kidding for both control experimental group animals belonging to three dietary treatments T_1, T_2 and T_3.

Present results on the mean body weight of does during gestation in both groups belonging to all dietary treatments are in agreement with Camelo *et al*. (2008) who observed that the body weight of goats during gestation was not affected by increasing energy in the concentrate mixture from 0.9 to 1.8 Mcal ME.

In contrary to the results, Koyuncu *et al.* (2009) and Hafez *et al.* (2011) observed 10.9 per cent increase in body weight of does during gestation fed diet containing energy ranging from 10.3 to 12.2 MJ/kg. Kulkarni *et al*. (2014) who studied the effect of supplementing concentrate mixture in last two months gestation

reported that goats fed with feed of 14.76 per cent crude protein and 66.27per cent TDN had higher average body weight after kidding compared to goats maintained in the farmer's feeding practices.

5.4 LITTER SIZE

Data presented in Table 8 revealed that goats in control group fed with three dietary treatments T_1, T_2 and T_3in last month of gestation had litter size of 1.5,1.5 and 1.67 respectively and the same for experimental group were 1.67, 1.83 and 1.83, respectively in Table 9.Similar values of litter size as observed in the present study were also reported by Karikari and Blasu (2009), Koyuncu and Canbolat (2009) and Saha *et al*. (2012) and it ranged from 1.56 to 2.00 in goats. Statistical analysis of the data revealed no significant difference ($P>0.05$) in the litter size of does between the groups as well as treatments. From the results on litter size of does, it can be concluded that feeding extra 200g of concentrate mixture 2 weeks prior to breeding to experimental goats had no effect on the litter size in goats, may be because of the better nutritional status of the animals and also since litter size is a genetic character with low heritability that mainly depends on breed. Luginbuhl and Poore (1998) reported that animals with extremely good body condition did not respond to flushing.

The result of the present study is in agreement with Camelo *et al*. (2008) who observed no significant difference in litter size of does which supplemented with either 600g or 300g of extra feed prior to breeding. These findings were also in agreement with Safari *et al*. (2012) who found no significant difference in litter size of goats fed with 400g, 200g and control does 20 days prior to mating.

In contrary to the results of the present study, Karikari and Blasu (2009) reported higher litter size in goats supplemented with 230g of concentrate mixture extra along with grazing compared to those were allowed to pasture alone prior to

breeding. Hafez *et al.*(2011) also reported higher litter size in Zaraibi goats fed diet having two dietary energy 4469 Kcal/kg and 4193Kcal/kg feed prior to breeding.

5.5 BIRTH WEIGHT OF KIDS

The average birth weight of kids of goats in control group maintained under three dietary treatments T_1, T_2 and T_3in last month of gestation were1.56, 1.67 and 1.95 kg, respectively (Table 8) and the same for experimental group were 1.83, 2.07 and 2.35 kg, respectively (Table 9). Reports of average birth weight of kids as observed in the present study were made also by Afsal (2003), Rastogi *et al*. (2003), Mahboub *et al.* (2013) and Murniati *et al.* (2013). Statistical analysis of the data revealed that there exist significant difference in the average birth weight of kids between the groups ($P<0.01$) as well as between the treatments ($P< 0.05$). Thus it was observed that feeding of does with extra 200g of concentrate mixture (18 per cent CP and 65 per cent TDN) two weeks prior to breeding had significant effect ($P <0.05$) on the average birth weight of the kids which was 1.56 kg in the control group and 1.83 kg in the experimental group. Moreover kids of goats fed on T_3 feed (high energy) had significantly higher birth weight compared to T_1 and T_2. The availability of more nutrients especially energy during the development period of the foetus might have been the reason for the higher birth weight of kids in flushed and high energy supplemented group. Rastogi *et al*. (2006) reported that the last month of gestation is the period of rapid foetal growth thus necessitating supplementation of pregnancy allowance.

The results of the present study is in agreement with Hafez *et al.* (2011) who reported an increase in the average birth weight when supplemented with high energy feed prior to breeding and He *et al*. (2013) who reported an increased birth weight when does were fed with feed of 9.34 MJ/kg feed during 91-144 day of gestation compared to those fed with 5.75 MJ/kg feed.

In contrary to the results, Rastogi *et al.* (2003) observed an increase in the average birth weight of kids of goats fed with 40g of concentrate mixture per kg $W^{0.75}$120 days post mating to term with high crude protein of 22 per cent compared to goats that fed concentrate mixture 60 days post mating and Nnadi *et al.* (2007) reported that goats fed with high protein of 13 per cent, six weeks pre partum had higher birth weight compared to those fed with low protein diet of 9 per cent. In contrast to the present findings, Camelo *et al*. (2008) found that goats when supplemented with high energy diet of 1.8 Mcal energy, the birth weight was significantly lower compared to those fed with low energy feed of 0.9 Mcal/kg.

5.6 GROWTH PERFORMANCE OF KIDS

The fortnightly average body weight of kids of goats in control group and experimental group maintained on three dietary treatments, T_1, T_2 and $T_3$are documented in Table 10. The average birth weight and final body weights of kids belonging to three treatments in control group were 1.56, 1.67 and 1.95 and 4.07, 4.58 and 5.14kg, respectively. The average birth weight and final body weights of kids belonging to three treatments in experimental group were 1.83, 2.07 and 2.35 and 4.44, 5.12 and 5.83kg, respectively. The results on first fortnightly body weight of kids of goats in both control and experimental group revealed that there exist significant difference ($P< 0.05$) between treatments. Moreover kids of goats fed on T_3 feed had significantly higher first fortnight weight compared to $T_1$and T_2.Second fortnightly weight was significantly different for treatments ($P< 0.01$)and kids of goats in T_3 group had higher fortnightly weight compared to T_1 and T_2.Statistical analysis of the data also revealed significant difference between treatments for average birth weight ($P<0.05$) and final body weight ($P <0.01$) and kids of goats fed on T_3 feed had significantly higher first and final body weight compared to T_1 and T_2.The data on the fortnightly weight gain and cumulative total weight gain of kids in both control and experimental group animals are documented in Tables 11 and 12. Statistical analysis of the data revealed no significant difference ($P >0.05$) in

fortnightly weight gain between treatments but the cumulative total weight gain of kids was significantly higher for T_3which is different from T_1 and T_2.

Data presented in Tables 13 and 14 revealed that the kids of goats in treatmentsT_1, T_2 and T_3in both control and experimental group had an average daily body weight gain of0.08, 0.10 and 0.11 kg, respectively in control group and that in experimental group with 0.09, 0.10 and 0.12 kg, respectively. Statistical analysis of the data on average daily body weight gain and total weight gain revealed that there exist significant difference ($P > 0.05$) between treatments T_1,T_2 and T_3.Average daily body weight gain and total weight gain was significantly higher for high energy supplemented group (T_3) compared to those fed with control (T_1) and high protein (T_2) feed in both control and experimental group.

Consolidated data on the litter size of does, body weight, total gain and average daily gain of kids of both control and experimental group is represented in Table 17. Considering the results in Table 17, when comparing the control group fed with control ration with that of experimental group fed with high protein and high energy diet, revealed that average birth weight, final weight, total weight gain and average daily gain of experimental high energy fed group was higher and significantly different ($P<0.05$) from control group T_1 but was similar to experimental high protein (T_2) fed group.

Comparing control high protein (T_2) fed group with that of experimental group fed with control ration (T_1) and high energy (T_3) it could be observed that experimental high energy group had higher average birth weight, final weight, total weight gain and average daily gain which is significantly different ($P<0.05$) from experimental group fed with control ration and control group fed with high protein feed (T_2). Analysis of the data between control group high energy (T_3) supplemented animals with that of experimental group fed with control ration and high protein diet revealed that even though not flushed merely energy supplementation in last month of

gestation had a significant difference in final weight ($P<0.05$) compared to experimental group fed with control ration. But there was no significant difference ($P>0.05$) in average birth weight, total weight gain and average daily gain.

A significant difference in final weight, total weight gain and average daily gain could be observed between experimental group fed with control ration and control high protein and energy supplemented group but there was no difference ($P> 0.05$) in the average birth weight. Final weight, total weight gain and average daily gain was higher for control high energy (T_3) supplemented group compared to control group fed with both control ration (T_1) and high protein feed (T_2).Comparing experimental high protein (T_2) group with control group fed with control and high energy diet, both control high energy supplemented group and experimental high protein fed group had higher final weight, average daily gain and total weight gain ($P< 0.05$) compared to control group fed with control ration (T_1) but non -significant ($P>0.05$) in case of average birth weight.

Between the experimental high energy supplemented group and control group fed with control ration and high protein supplemented does in last month of gestation, it could be observed that the experimental high energy group ($P<0.05$) had higher average birth weight, final weight, total weight gain and average daily gain compared to both control group fed with control ration and high protein. Thus protein and energy supplementation in last month of gestation resulted in body weight, total gain and average daily gain in both control and experimental group. This may be because of the high plane of feeding especially towards the end of gestation, thus increasing the birth weight of kids and greater milk yield of doe thus increasing the survivability and growth of the kids. Similar values on ADG of kids as observed in the kids of both control and experimental group of the present study were also reported by Madibela *et al*. (2002), and Rastogi *et al.*(2006) for kids of one month of age and the values ranged from 79g to 94g.

Present results on the growth performance of kids of goats in both groups are in agreement with Madibela *et al*. (2002)and Mahboub *et al.* (2013) who observed that the average daily gain and weaning weight of kids was increased when the goats were fed high energy of 10.2 MJ/kg compared to those fed on pasture alone and with concentrate mixture which supplied 35 per cent extra to the NRC requirement (1985) compared to that of goats fed as per the NRC requirement. The present study was also in agreement with Gekara and Marshall (2012) who reported that the average daily gain was increased when the energy in the diet was increased with constant crude protein. In contrary to the results obtained in the present study Nnadi *et al*. (2007) observed that the average daily gain and weaning weight of kids was increased when the goats were fed high protein of 13 per cent compared to those fed with low protein diet of 9 per cent .Saha *et al*.(2012) and He *et al.* (2013) who found no improvement in ADG of kids when the CP content of feed was increased from 40 to 80g and when energy was increased from 5.75 to 9.34 MJ/kg in does during last month of gestation.

5.7 HEMATOLOGICAL PARAMETERS

The haematological parameters of the experimental goats such as haemoglobin, total protein, blood urea nitrogen, blood glucose, serum calcium and serum phosphorus estimated prior to breeding and at the day of kidding are listed in Tables 15 and 16,respectively.

5.7.1 Blood Haemoglobin

The average blood haemoglobin concentrations of goats in treatments T_1, T_2 and $T_3$of control group were 8.05, 8.30 and 8.48 g/dl prior to breeding and 9.28, 9.30 and 9.15g/dl at the day of kidding respectively and that of experimental group were 8.50, 8.83 and 8.33 g/dl prior to breeding and 11.14, 10.55 and 10.96 g/dl, at the day of kidding respectively. The values of blood haemoglobin concentration in the present study were comparable with the values reported by Viana *et al.*(2003), Waziri *et al.* (2010) and Jadalla *et al.*(2012), Rejitha (2013) and Roshma (2014) in pregnant

goats and it ranged from 8 to 12 g/dl. There was no significant difference (P>0.05) between the treatments and the values of haemoglobin recorded in the present study were within the normal range reported for the species and are in agreement with El-Ebissy (2011) who reported that haemoglobin level did not show any variation during one week before kidding and four week after kidding.

5.7.2 Total Plasma Protein

The average total plasma protein concentrations of the goats were 6.38, 6.34 and 6.27 g/ dl prior to breeding and 6.50, 8.02 and 6.42 g/ dl at the day of kidding for treatments T_1, T_2 and $T_3$of control group respectively. The average total plasma protein concentrations of the goats were 6.35, 6.40 and 6.36 g/ dl prior to breeding and 6.42, 8.01 and 6.60 g/ dl at the day of kidding for treatments T_1, T_2 and $T_3$of experimental group respectively. The total plasma protein concentration recorded for goats of the present study were within the normal range. The plasma protein concentration of the goats reported in the present study were comparable to the values reported by Karikari and Blasu. (2009), Mosaad and Derar (2009),Waziri *et al.* (2010), Rejitha (2013) Abdelrahman (2014), and Roshma (2014). Higher values ranging from 16.5 to19.1 g/dl were reported by Jadalla *et al.* (2012) in adult goats.

The total plasma protein was higher in T_2 which was significantly different (P <0.01) from T_1 and T_3 in both control and experimental group. Abdelrahman (2013) reported that the improvement in the total protein values may be due to the increase of amino acid absorption from the dietary protein. In agreement with the present results, Kumagai and Ngampongsai (2006) reported that the total plasma protein level increased with increased dietary crude protein level of 14 per cent compared to those of 10 per cent in goats. In contrast to the study Waziri *et al*. (2010) reported that plasma protein level did not show any variation during the gestation period in Sahel goats.

5.7.3 Blood urea nitrogen

The average values for blood urea nitrogen of the goats were 12.98, 13.85 and 13.9 g/dl prior to breeding and 14.75, 19.20 and 15.93 g/dl at the day of kidding for treatments T_1,T_2 and $T_3$of control group respectively. In experimental group the average values noted for BUN were 14.15, 14.08 and 14.52 g/ dl prior to breeding and 16.75, 19.41 and 16.81 g/ dl at the day of kidding for treatments T_1, T_2 and T_3respectively. The blood urea nitrogen of the goats reported in the present study were comparable to the values reported by Kia *et al*. (2012) and Murniati *et al*.(2013).Lower values ranging from 6.2 to 10.27 mg/dl were reported by Barakat *et al*. (2007) in pregnant goats.

The blood urea nitrogen recorded for goats of the present study were within the normal range and however it was higher in T_2 which was significantly different ($P > 0.01$) from T_1 and T_3 in both control and experimental group after kidding. In agreement with the present results, Kumagai and Ngampongsai (2006) reported that blood urea nitrogen level increased with increased dietary crude protein level of 14 per cent compared to those of 10 per cent in goats.

5.7.4 Blood Glucose

The average blood glucose concentrations of goats for treatments T_1, T_2 and T_3were 54.27, 56.5 and 53.14 mg/ dl prior to breeding and 57.99, 62.78 and 58.58 mg/ dl at the day of kidding for control group and 57.53, 58.56 and 56.59 mg/ dl prior to breeding and 59.44, 60.29 and 58.80 mg/ dl for experimental group at the day of kidding, respectively and there was no significant difference ($P>0.05$) between the treatments as well as group.. The values of plasma glucose concentration recorded in the present study were within the normal range reported for the species. The values of blood glucose concentration in the present study were comparable to the values reported by Tanaka *et al.* (2004), Barakat *et al.* (2007), Mosaad *et al*. (2009), Kia *et al*.(2012), Rejitha (2013) and Roshma (2014) which ranged from 51.6 to 63.67 mg/dl.

In agreement with the present results, He *et al*.(2013) reported that blood glucose level did not show any variation due to altering dietary protein concentrations from 7.5 to 12.5 per cent in pregnant goats.

5.7.5 Serum Calcium

The average serum calcium values obtained were 10.44, 10.54 and 10.46 mg/dl prior to breeding and 10.67, 10.64 and 10.64 mg/dl at the day of kidding for control group and 10.58, 10.59 and 10.58 mg/dl prior to breeding and 10.65, 10.79 and 10.58 mg/dl at the day of kidding for experimental group in treatments T_1, T_2 and T_3 respectively and the values did not differ significantly ($P > 0.05$) between the treatments and groups. The values of serum calcium concentration of goats in the present study were within the normal range reported for the species and comparable with the values reported by Barakat *et al*.(2007), Mosaad *et al*.(2009),Jadalla *et al.* (2012) and Kia *et al*. (2012) ranging from 9 to 11 mg/dl.

In agreement with the present results, Waziri *et al.*(2010) reported that serum calcium level did not show any variation during the gestation period of goats.

5.7.6 Serum Phosphorus

The serum phosphorus concentrations in the experimental animals prior to breeding were 6.59, 6.74 and 6.53 mg/ dl and 8.09, 7.49 and 6.69 mg/ dl at the day of kidding for treatments T_1, T_2 and T_3in control group and 6.68, 6.67 and 6.44mg/ dl prior to breeding and 7.92, 8.35 and 6.50 mg/dl at the day of kidding for experimental group in treatments T_1, T_2 and T_3respectively and the values were significantly different between treatmentsT_1, T_2 and $T_3$with T_2 having the highest serum phosphorus value. The values were within the normal range and similar concentration in adult goats as observed in the present study were also reported by Barakat *et al*.(2007), Mosaad *et al*. (2009) ,Jadalla *et al.* (2012) and Kia *et al*. (2012) which ranged from 5 to 8 mg/dl.

5.8. NUTRIENT DIGESTIBILITY

The digestibility coefficients of nutrients in the experimental rations estimated from digestion trial in goats of three dietary treatments are presented in Table 19 and Fig. 11.

5.8.1 Dry Matter

Digestibility coefficient of DM observed in the present study was 62.66, 64.05 and 63.42 per cent for the goats in treatments T_1, T_2 and T_3respectively. Similar values of dry matter digestibility as observed in the present study were also reported by Hossain *et al.* (2003), Chaturvedi *et al.*(2006), Sayed (2009) and Roshma (2014) ranging from 57 to 76 per cent .

5.8.2 Crude Protein

Digestibility coefficient of CP was 66.57, 78.77 and 72.86 per cent for the treatments T_1,T_2 and T_3 respectively. Shahjalal *et al.* (2000) found that goats fed with high protein diet had significantly higher values for the digestibility of CP and EE compared to those received the low protein diets. The CP digestibility values obtained in the present study were also reported by Hossain *et al.* (2003), Chaturvedi *et al.*(2006), Chobtang *et al*.(2009), Mosaad *et al*.(2009), Sayed (2009) and Roshma (2014) in goats of similar age groups and it ranged from 59 to 80 per cent.

5.8.3 Ether Extract

Digestibility coefficient of EE recorded in the present study was 68.98, 70.79 and 71.40 per cent for the treatments T_1, T_2 and T_3respectively. Hossain *et al.*(2003) reported that ether extract digestibility was increased to 72.14 per cent when goats were fed with high energy feed of 11.98 MJ ME/kg DM. The values reported in the present study were comparable to that of Chaturvedi *et al.* (2006), Chobtang *et*

al.(2009), Mosaad *et al*. (2009), Sayed (2009) and Roshma (2014)in goats of similar age groups and it ranged from 62 to 81 per cent.

5.8.4 Crude Fibre

Digestibility of CF observed in the present study was 42.89, 46.14 and 45.93 per cent for the treatments T_1, T_2 and T_3respectively. Hossain *et al.*(2003) reported that crude fibre digestibility increased significantly as levels of dietary supplementation was increased CF digestibility values obtained in the present study were comparable to the values reported by Hossain *et al.*(2003), Chobtang *et al*.(2009), Mosaad*et al*. (2009),Sayed (2009) and Roshma (2014) in goats of similar age groups and it ranged from 40 to 72 per cent.

5.8.5 Nitrogen Free Extract

Digestibility of NFE observed in the present study was 72.88, 74.67 and 71.89 per cent for the treatments T_1,T_2 and T_3respectively.The similar digestibility values as observed in the present study ranging from 69 to 80 were also reported by Hossain *et al.*(2003), Chaturvedi *et al.*(2006), Chobtang *et al*.(2009), Mosaad *et al*.(2009), Sayed (2009) and Roshma (2014) in goats of similar age groups.

5.9. ECONOMICS OF PRODUCTION

Data on cost of feed per kg, cost of feed during flushing, cost of feed during feeding trial of 30 days, total feed cost and total kid's weight obtained after one month is represented in Table 21.The cost of ingredients used for the study was calculated as per the rate contract fixed by the College of Veterinary and Animal Sciences, Mannuthy for the year 2013–2014. The cost of feed per kg was Rs. 19.72, 21.12 and 20.70 for groupsT_1, T_2 and T_3, respectively. The total cost of the feed for flushing and feeding trial was calculated as Rs.3529.36, 3757.76 and 3626.68, for control group T_1, T_2 and T_3respectively and the same for experimental group was Rs. 3918.34, 4108.70 and 3951.57. Return to the farm on considering the sale of kid for

meat at the rate of Rs. 180/ kilogram of the live weight calculated as Rs. 3229.64, 3406.24 and 5715.32 for control group T_1, T_2 and T_3respectively and the same for experimental group was Rs.4001.66, 5998.30 and7199.43, respectively.

Summary

SUMMARY

An experiment was conducted to study the effect of nutrient supplementation on litter size of Malabari does and growth rate of kids. Fifty adult female crossbred Malabari goats were selected from University Goat and Sheep farm, Mannuthy for experiment. The animals were grouped into two groups as control and experimental animals of twenty five animals each as uniform as possible with regard to age, body weight and parity. They were fed with concentrate mixture containing 18 per cent crude protein and 65 per cent total digestible nutrients (farm ration) and offered fresh hybrid napier grass as the sole roughage. Additional 200 g concentrate with 18 per cent crude protein and 65 per cent total digestible nutrients (farm ration) were fed to all animals in experimental group two weeks prior to breeding. All the animals from control and experimental groups were examined for pregnancy by abdominal palpation. Pregnancy was further confirmed by scanning on third month of gestation. Eighteen pregnant animals from each group were selected randomly and maintained on the management conditions prevailing in the farm upto the fourth month of gestation. At last month of gestation both control and experimental group were divided into three subgroups of six animals. Each groups were allotted randomly to one of the three dietary treatments T_1 (18 per cent crude protein and 65 per cent total digestible nutrients),T_2(20 per cent crude protein and 65 per cent total digestible nutrients) and T_3(18 per cent crude protein and 70 per cent total digestible nutrients). Goats were fed as per ICAR (Ranjhan,1998). Fresh hybrid napier grass was offered as the sole roughage.

Individual data on daily feed intake of concentrate and green grass were recorded throughout the trial. The left over portion of the concentrate mixture and green grass were weighed daily and their moisture content was analysed to calculate the daily DMI. Body weight before the experiment and monthly body weight of pregnant animals were recorded. After kidding body weight of the doe and kid's birth weight were recorded. Weekly body weight of kids of both control and experimental

animals maintained on three rations T_1, T_2 and T_3 in last month of gestation were recorded upto one month. Blood samples were collected at the beginning (before flushing) and on the day of kidding to estimate blood haemoglobin, plasma total protein, blood urea nitrogen, glucose, calcium and phosphorus. A digestibility trial was conducted in 12 animals (four animals from each dietary treatments) towards the end of experiment (21^{st} week of gestation) by total collection method to arrive at the digestibility coefficient of nutrients. All the goats were maintained under identical conditions of feeding and management throughout the experimental period.

The average litter size of goats in the control group were 1.5, 1.5 and 1.67, respectively belonging to three dietary treatments T_1, T_2 and T_3 in last month of gestation. In the experimental group, the average litter size of goats fed with three treatments T_1, T_2 and T_3 were 1.67, 1.83 and 1.83 respectively. Statistical analysis of the data on litter size revealed that there was no significant difference ($P> 0.05$) between treatments.

The average birth weight of kids of goats in control group belonging to dietary treatments T_1,T_2 and T_3 in last month of gestation were 1.56, 1.67 and 1.95 kg, respectively and the same for goats in experimental group were 1.83, 2.07 and 2.35 kg, respectively. Statistical analysis of the data revealed that feeding of does with extra 200g of concentrate mixture (18 per cent CP and 65 per cent TDN) two weeks prior to breeding had no significant effect ($P >0.05$) on the litter size of does and average daily gain of kids but there was a difference in the average birth weight of the kids which was 1.56 kg in the control group and 1.83 kg in the experimental group. Statistical analysis of the data revealed that kids of goats fed with T_3 had significantly higher average birth weight ($P < 0.05$) in both group compared to control (T_1) but T_2 had no significant difference between T_3 and T_1.The final body weight was 4.07, 4.58 and 5.14 kg, for kids of goats in control group belonging to dietary treatments T_1, T_2 and T_3 in last month of gestation, after one month and the same for experimental group was 4.44, 5.12 and 5.83 kg respectively. Statistical

analysis of the data in both groups revealed that treatment T_3had significantly higher final weight ($P < 0.01$) compared to T_1 and T_2 where T_2 was also significantly higher than T_1. Total weight gain of kids of control goats belonging to dietary treatments T_1, T_2 and T_3 were 2.51, 2.91 and 3.19 kg and that for average daily gain were 0.08, 0.10 and 0.11 kg, respectively and the same for experimental goats were 2.62, 3.05 and 3.48 kg and 0.09, 0.10 and 0.12 kg respectively. Statistical analysis of the data of both control and experimental group revealed that treatment T_3 had significantly higher total weight gain ($P < 0.05$) and average daily gain ($P < 0.05$) compared to T_1 and T_2 where T_2 was also significantly higher than T_1. High energy supplemented experimental group (T_3) had better birth weight, final weight, total weight gain than control (T_1) and high protein (T_2) supplemented group. High energy (T_3) supplemented control and high protein supplemented (T_2) experimental group had higher final body weight for kids than in experimental group fed with T_1. There was no significant difference ($P >0.05$) in average birth weight, final weight, total weight gain and average daily gain between kids of high energy supplemented goats in control group and kids of high protein supplemented goats in experimental group.

Digestibility coefficient of nutrients were 62.66, 64.05 and 63.42 per cent for DM, 66.57, 78.77 and 72.86 per cent for CP, 42.89, 46.14 and 45.93 per cent for CF, 68.98, 70.79 and 71.40 per cent for EE and 72.88, 74.67 and 71.89 per cent for NFE for the dietary treatmentsT_1, T_2 and T_3, respectively.

The average blood haemoglobin concentration of goats in control group maintained on three dietary treatments T_1, T_2 and T_3in last month of gestation, on the day of kidding were 9.28, 9.30 and 9.15g/dl respectively and the average plasma protein concentrations were 6.50, 8.02 and 6.42 g/ dl, respectively. The average values of blood urea nitrogen and glucose for treatments T_1, T_2 and T_3were 14.75, 19.2 and 15.93 g/ dl and 57.99, 62.78 and 58.58 mg/ dl respectively. The average serum Ca values in control group animals were 10.67, 10.64 and 10.64 mg/dl and average serum P concentrations in the control group goats were8.09, 7.49 and 6.69

mg/dl. The average blood haemoglobin concentration of goats in experimental group maintained on three dietary treatments T_1,T_2 and T_3in last month of gestation, on the day of kidding were 11.14, 10.55 and 10.96 g/dl, respectively and the average plasma protein concentrations were 6.42, 8.01 and 6.60 g/dl, respectively. The average values of blood urea nitrogen and glucose for treatments T_1, T_2 and T_3were16.75, 19.41 and 16.81 g/ dl and 59.44, 60.29 and 58.80 mg/ dl, respectively. The average serum Ca values in experimental group animals were 10.65, 10.79 and 10.58 mg/dl and average serum P concentrations in the experimental group goats were7.92, 8.35 and 6.50 mg/dl. Statistical analysis of the data revealed that T_2 had significantly higher total plasma protein, blood urea nitrogen and serum phosphorus during kidding ($P< 0.01$) compared to T_1 and T_3 in both control and experimental group.

The calculated cost per kilogram of the concentrate mixture used in the feeding trial was Rs. 19.72 Rs. 21.12 and Rs. 20.70 for treatments T_1, T_2 and T_3, respectively. The total feed cost for the concentrate mixture was Rs. 3529.36, Rs.3757.76 and Rs. 3626.68 for T_1, T_2 and T_3, in the control group respectively and same for experimental group were Rs. 3918.34, Rs.4108.70 and Rs. 3951.57, respectively. By taking into account of the total weight of kids after one month, the returns over expenditure were Rs. 3229.64, 3406.24 and 5715.32, respectively for treatments T_1, T_2 and T_3 of control and Rs.4001.66, 5998.30 and 7199.43 for T_1, T_2 and T_3 of experimental group.

Critical evaluation of the results obtained in the present study revealed that feeding extra 200 g concentrate mixture two weeks prior to breeding had no effect on litter size of does and average daily gain in kids but the average birth weight of kids was higher. Moreover supplementation of energy and protein to does during last month of gestation resulted in better body weight and daily gain of kids at the end of first month in both control and experimental group. Thus feeding concentrate mixture with 18 per cent CP and 70 per cent TDN to does during last month of gestation improved the birth weight and total gain in kids and better returns over expenditure

compared to concentrate mixture with 20 per cent CP and 65 per cent TDN or 18 per cent CP and 65 per cent TDN.

On summarising the overall results of the study , it could be concluded that supplementation of concentrate mixture with 18 per cent CP and 70 per cent TDN to does in last month of gestation significantly improved average birth weight , final weight after 1st month, total weight gain and average daily gain of kids.

References

REFERENCES

Abbasi, R.E., Abdollahzadeh, F., Salehi, S. and Abdulkarimi, R. 2011.Effect of dietary metabolizable energy and crude protein on feed intake, carcass traits and mohair production by Markhoz –Iranian Angora male kids.*Global Vet.***7:**443-448.

Abdelatif, A.M., El Nageeb, M.E., Makawi, S.E.A. and Fadlalla, A.M. 2009. Blood constituents in cycling, gestating and lactating desert ewes (*Ovis aries*) in relation to dietary supplementation. *Global Vet.***3**: 248-259.

Abdelrahman, M.M. 2013.Protein requirement of three goat breeds raised in the semi arid region[abstract]. In: *Compendium, 4th International Balkan Animal Conference*; 3rd to 5th October, 2013, Turkey. Namik Kemal University.p.3.Abstract No.1.

Abdelrahman, M.M. and Alijumaah, R.S. 2014. Dietary protein level and performance of growing Baladi kids. *Ir.J.Vet.Res.***15:** 353-358.

Abdullah, A.Y. and Musallam, H.S. 2007. Effect of different levels of energy on carcass composition and meat quality of male black goats kids. *Livestock Sci.***107:** 70–80.

Abecia, J.A., Sosa, C., Forcada, F. andMeikle, A. 2006.The effect of undernutrition on the establishment of pregnancy in the ewe. *Reprod. Nutr. Dev.* **46**: 367–378.

Acurero, M. M. 2000. Supplemetation strategies in sheep. *Livestock Sci*. **63**: 66-72.

Afsal, K. 2003. Fertility of oestrus synchronized crossbred Malabari does inseminated with Boer buck semen. M.V.Sc thesis, Kerala Agricultural University, Thrissur, 41p.

Al-Totanji, W. and Lubbadeh, W.2000. Effect of feeding different levels of energy and protein during the last two months of gestation on Shami goats performance in Jordan Valley. *J. Agric. Sci.***27**: 165 175.

AOAC. 2012. Official Methods of Analysis. (19thEd,).Association of Official Analytical Chemists, Gaithersburg, Meryland, USA.

Barakat,S.E.M., Al-Bhanasawi, N.M., Elazhari, G.E. and Bakhiet, A.O.2007. Comparison of blood serum glucose, beta hydroxyl butyric acid, calcium concentration in pregnancy and lambed ewes .*J.Anim Vety.Adv*.**6**:768-772.

Bernhart, D.N. and Wreath, A. 1955.Calorimetric determination of phosphorus by modified phosphomolybdate method.*Anal. Chem*. **27**:440-441.

Camelo, A.A., Valencia, E., Rodriguez, A. and Randel, P.F. 2008.Effect of flushing with two energy levels on goat reproductive performance. *Livestock Res. Rural Dev.***20**:1-7.

Castillo, C., Hernandez, J., Bravo, A., Lopez-Alonso, M., Pereira, V. and Benedito, J.L. 2005.Oxidative status during late pregnancy and early lactation in dairy cows.*Vet. J*. **169**: 286-292.

Chaturvedi, O.H., Bhatta,R., Verma, D.L. and Singh,N.P. 2006. Effect of flushing on nutrient utilization and reproductive performance of ewes grazing on community rangeland. *Asian –Aust. J.Anim.Sci*. **19**:521-525.

Chobtang, J., Intharak, K. and Isuwan, A. 2009.Effects of dietary crude protein levels on nutrient digestibility of Thai indigenous male goats. *Songklanakarin J.Sci.Technol.***31**: 591-596.

Chowdhury, S. A., Bhuiyan, M. S. A. and Faruk, S. 2002. Rearing Black Bengal goat under semi-intensive management and effect on physiological and reproductive performance. *Asian-Aust. J. Anim. Sci.***15** : 477-484.

Christian, G., Thin, A.T. and Patricia, A.T. 1967.Estimation of calcium and magnesium in serum and urine by atomic absorption spectrophotometry. *J. Clin. Pathol.***20**: 280-282.

Cynthia, J. 2010. Antioxidant status and metabolic profile of goats during pregnancy and lactation. M.V.Sc. thesis, Kerala Agricultural University, Thrissur, 101p.

Darmola, J.O., Adeloye, A.A. and Soladoye, A.O. 2004. Changes in some haematological and biochemical parameters during pre-partum and post-partum periods in female west African dwarf goats. *J. Agric. Res. Dev.***3**:119-128.

De Santiago-Miramontes, M.A., Luna-Orozco, J.R., Meza-Herrera, C.A., Rivas-Munoz, R., Carrillo,E., Veliz-Deras,F.G.and Mellado,M.2011.The effect of flushing and stimulus of estrogenized does on reproductive performance of anovulatory-range goats.*Trop. Anim. Health Prod*.**43**:1595–1600.

Devendra,C. 1983. The energy and protein requirements during pregnancy of Katjang goats in Malaysia. *MARDI. Res.Bull.***11**: 193-205.

Dwyer, C. M. 2003. Behavioural development in the neonatal lamb: effect of maternal and birth related factors.*J.Anim Sci.***59**: 1027-1110.

Ebrahimi, R., Ahmadi, H.R., Zamiri, M.J. and Rowghani, E. 2007. Effect of energy and protein levels on feedlot performance and carcass characteristics of Mehraban ram lambs. *Pak. J. Biol. Sci.***15**: 1679-1684.

Economides, S. 1991. Nutrition and management of sheep and goats.*J. Agric. Sci. Camb.***95**: 493–495.

Elamin, K.M., Eldar, T.A., Amin, A.E., Abdalla, F.S. and Hassan, H.E. 2012. Digestibility and nitrogen balance of Sudan goat ecotypes fed different energy/ protein levels. *Asian J. Anim.Sci.***6**: 230-239.

Eldar, T.A., Elamin, K.M., Mohammed, A.E. and Hassan, H.E.2012. Effect of energy/ protein levels on the performance of sudan goat ecotypes. *J.Anim.Prod. Adv.***2**:146-152.

El-Ebissy, E.A.E.M. 2011. Relationship between metabolic parameters and TNFα in the peripartal period in ewes. M.V.Sc. thesis, University of Leipzig, Cairo, 93p.

Elfadil, A.S. 2001. Growth and carcass components for Nubian goats male and female fed on different energy and protein levels. PhD thesis, University of Khartoum, Sudan, 31p.

El-Shahat, K.H. and Abo-El maaty, A. M. 2010. The effect of dietary supplementation with calcium salts of long chain fatty acids and/or l-carnitine on ovarian activity of Rahmani ewes. *Anim. Reprod. Sci*.**117** : 78-82.

El-Sherif, M.M.A. and Assad, F. 2001. Changes in some blood constituents of Barki ewes during pregnancy and lactation under semi arid conditions. *Small Rum. Res*.**40**: 269-277.

Gekara, O. and Marshall, R. 2012.Nutritional strategies to mitigate the effects of negative energy balance on reproductive performance of early postpartum does. *Am. J. Anim. Vet. Sci*.**7** : 194-197.

George, D. 2013. Effect of high energy diet on early lactation in crossbred cows.M.V.Sc thesis, Kerala Veterinary and Animal Sciences University, Pookode, 95p.

Gunn, R.G., Doney, J.M. and Smith, W.F. 1984. The effect of level of pre-mating nutrition on ovulation rate in Scottish blackface ewes in different body conditions at mating. *Anim. Prod.***39**: 235-239.

Hafez, Y.H., Khalifa, E.I., El-Shafie, M. H., Abdel Khalek, T.M.M., Ahmed M.E. and Shehata E. I. 2011. Effect of energy flushing pre-mating and during mating season on production and reproduction performance of Zaraibi goats.*Egyptian J. Sheep and Goat Sci.***6**: 7- 14.

He,Z.X., Wu,D.Q., Sun,Z.H., Tan,Z.L., Qiao,J.Y., Ran,T., Tang,S.X., Zhou,C.S., Han,X.F., Wang,J.H. and Beuchemin,K.A. 2013. Protein or energy restriction during late gestation alters foetal growth and visceral organ mass: An evidence of intrauterine programming in goats. *Anim. Reprod. Sci.* **137**: 177-182.

Herrera, C.A.M., Hallford, D.M., Ortiz, J.A., Cuevas, R.A., Sanchez, J.M., Salinas, H., Mellado, M. and Bulnes, A.G. 2008. Body condition and protein supplementation positively affect periovulatory ovarian activity by non LH-mediated pathways in goats. *Anim. Reprod.Sci*.**106**: 412–420.

Hossain, M.E., Shahjalal, M., Khan, M.J. and Hasanat, M.S. 2003. Effect of dietary energy supplementation on feed intake, growth and reproductive performance of goats under grazing condition. *Pakist. J. Nutr.***2** :159-163.

Hosseini, S.M., Akbary, S.M., Sis, N.M. and Aghsaghali, A.M. 2008. Effect of different energy levels of diet on feed efficiency growth rate and carcass charecteristics of fattening Bahmaei lambs.*J. Anim. Vet. Adv.***7**: 1551-1554.

Hwangbo, S.,Choi, S.H., Kim,S.W., Son,D. S. and Park, H.S. 2009. Effects of crude protein levels in Total Mixed Rations on growth performance and meat quality in growing Korean Black goats.*Asian-Aust. J. Anim. Sci.***22**: 1133 – 1139.

ICAR [Indian Council of Agricultural Research].1998.*Nutrient Requirements of Livestock and Poultry*. (2nd Ed.).Indian Council of Agricultural Research, New Delhi, 15p.

Idris, A.O., Elemam, M.B., Kijora, C., El-Hag, F.M. and Salih, A.M. 2011. Effect of dietary supplementation, sex and birth type on body weight of desert ewes and their lambs growth performance in semi- arid area of Kordofan state Sudan. *Livestock Res. Rural Dev.***23**: 113-116.

Iriadam,M. 2007. Variation in certain haematological and biochemical parameters during the peri-partum period in Kilis does. *Small Rum.Res*.**73**: 54-57.

Jadalla, J. B., Ismail, I. A. and Mekki, D. M. 2012. Effects of Dietary Protein Level on milk yield, composition and some haematological parameters in dessert goats of North Kordofan, *Sudan. J. Anim. Prod. Adv.***2**: 379-388.

Jong,H.H. and Vegeter, J.J. 1950. Determination of serum proteins with the biuret test. *Pharm. Weekbl*. 85: 755-765.

Kaneko, J.J., Harvey, J.W. and Bruss, M.L. 2008.*Clinical Biochemistry of Domestic Animals.* (6thEd.) Academic Press, California, 351p.

Karikari, P.K. and Blasu, E.Y. 2009. Effect of nutritional flushing prior to mating on the performance of West Afican Dwarf goats mated in the rainy season. *Pakist. J. Nutr*. **8**: 1068-1073.

Kenyon, P.R. 2008. A review of in-utero environmental effects on sheep production.*Proc. N.Z. Soc. Anim. Prod*.**68**: 142-155.

Kerslake, J.I., Kenyona,P.R., Morrisa,S.T., Stafforda, K.J. and Morela, P.C.H.2010.Does offering concentrate supplement during late pregnancy affect twin- and triplet-bearing ewe and lamb performance. *N.Z. J. of Agric. Res*.**53**:315-325.

Kia, H.D., Chapdareh, W.M., Khani, A.H., Moghaddam, G. Rashidi, A. Sadri, S. and Alijani, S. 2012. Effects of flushing and hormonal treatment on reproductive performance of Iranian Markhoz goats.*J. Anim. Physiol Anim. Nutr.***96**: 1157–1164.

Kor, D. and Demirel, M. 2012.Effects of high level nutrition during mating period on the reproductive hormones and performance of goats. *J. Anim.Vet.Adv.* **11**: 3517-3521.

Koyuncu, M. and Canbolat, O. 2009.Effect of different dietary energy levels on the reproductive performance of Kivircik sheep under a semi-intensive system in the South-Marmara region of Turkey. *J.Anim. and feed Sci.***18**: 620-627.

Kulkarni, P., Veeranna, K.C., Rao, R.B.and Mageppa, H. 2014. Effect of supplementary feeding in osmanabadi goats:a participation action research analysis from India. *Int. J. Agr. Ext*. **2** : 205-210.

Kumagai, H. and Ngampongsai,W. 2006. Comparitive studies on dry matter intake, digestibility and nitrogen metabolism between Thai native and Anglo Nubian * TN bucks. *Small Rum.Res.***66**: 129-134.

Kusina, N. T., Chinuwo, T., Hamudikuwanda, H. Ndlovu, L. R. and Muzanenhamo, S. 2001 Effect of different dietary energy level intakes on efficiency of estrus synchronization and fertility in Mashona goat does. *Small Rum.Res.***39** : 283-288.

Luginbuhl, J.M. and Poore, M.H. 1998. Nutrition of meat goats. *Trop. Anim.Hlth.Prod*[online].**13**(1).Available: http://www.cals.ncsu.edu/an_sci/ extension / animal/meatgoat / MGNutr.htm. [3 Jan. 2015].

Madibela, O.R., Mosimanyana, B.M., Boitumelo, W.S. and Pelaelo, T.D. 2002. Effect of supplementation on reproduction of wet season kidding Tswana goats. *S.Afr.J.Anim. Sci.***32**: 14-22.

Mahgoub, O., Lu, C.D., Hameed, M.S., Richie,A., Al-Halhali, A.S. and Annamalai, K. 2005. Performance of Omani goats fed diets containing various metabolizable energy densities. *Small Rum.Res.***58**: 175–180.

Mahboub, H.D.H., Ramadan, S.G.A., Helal, M. A.Y. and Aziz, E.A.K. 2013.Effect of maternal feeding in late pregnancy on behaviour and performance of Egyptian goat and sheep and their off spring.*Global Vet.***11**: 168-176.

Mahmoud, G.B., Abdelraheem, S.M., Senosy, W. and Derar, R.I. 2012.Impact of a short period-energy supplementation on the ovarian follicular dynamics, blood metabolites and sex hormones in ewes. *J. Agric.Econ. Dev*. **1**: 145-152.

Majumdar,B.N. 1960. Studies on goat nutrition- Minimum protein requirement of goats for maintenance-endogenous urinary nitrogen and metabolic faecal nitrogen excretion studies. *J.Agri.Sci.***54**: 329-334.

Mandal, A.B., Paul, S.S., Mandal, G.P., Kannan,A. and Pathak, N.N. 2005. Deriving nutrient requirements of growing Indian goats under tropical condition. *Small Rum. Res*.**58**: 201-217.

Mani, A.U., McKelvey, W.A.C., Watson, E.D., 1992. The effects of low level of feeding on response to synchronization of estrus, ovulation rate and embryo loss in goats .*Anim. Reprod.Sci.***38**:1013–1022.

Meyer,A.M., Reed, J.J., Neville, T.L., Taylor, J.B., Hammer, C.J., Reynolds, L.P., Redmer, D.A., Vonnahme, K.A. and Caton, J.S. 2010. Effects of plane of nutrition and selenium supply during gestation on ewe and neonatal offspring performance, body composition, and serum selenium. *J. Anim. Sci.***88**:1786–1800.

Morales, J.U., Meza-Herrera, C.A., Tello-Varela, L., Diaz-Gomez, M.O. and Beltran-Lopez, S. 2012. Effect of nutritional supplementation upon pregnancy rates of goats under semiarid rangelands and exposed to the male effect. *Trop.Anim.Hlth.Prod.***44**: 1473-1477.

Mosaad, G.M. and Derar, D.R. 2009.Effect of dietary energy and phosphorus on nutrients digestibility, blood constituents, and ovarian structures in ewes.*Vet.World.***2:** 456-461.

Murniati, T., Idrus, M. Rahardja, D.P.Toleng.A.and Ako,A. 2013. Effect of maternal nutrition at different stages of pregnancy in goats (Etawa cross and Kacang) on the performance of does and goat kids. *Int.J.Sci.Res.***4**:210-215.

Muturi, K.N., Birnie, L.M., Struthers, J., Wheelhouse, N.M. and Lomax, M.A. 2002. The effect of rumen protected protein on plasma insulin, IGF-1 and glucose in sheep. *S.Afr.J.Anim. Sci.* **34:** 126-132.

Nnadi,P.A., Kamalu,T.N. and Onah, D.N. 2007. Effect of dietary protein supplementation on performance of West African Dwarf does during pregnancy and lactation. *Small Rum. Res.***71**: 200-204.

Nuno, A.R.,Gomez, J.J.U., Hernandez, J.R.O., Hernandez, V.O.F., Occidente, A.D., De, S.A., Morelos, T. and Mexico, J. 2009. The effect of different protein concentrations in the diet of fattening Dorper and Pelibuey lambs. *J. Anim. Vet. Adv.***8**: 1049-2051.

NRC . 1981. *Nutrient Requirements of goats: Angora, dairy and meat goats in temperate and tropical countries*. National Academy of Sci. Washington, D. C., 91p.

NRC. 1985. *Nutrient Requirements of Sheep*. Sixth revised edition.National Academy of Sci., Washington, D. C., 142p.

NRC . 2007. *Nutrient Requirements of Small ruminants*. National Academy of Sci., Washington, D. C., 151p.

Ocak, N., Cam, M.A. and Kuran, M. 2005. The effect of high dietary protein levels during late gestation on colostrum yield and lamb survival rate in singleton-bearing ewes. *Small Rum. Res*. **56**: 89-94.

Rani, K.J. 2006. Effect of restricted milk feeding on blood biochemical profile in cross bred calves.M.V.Sc. thesis, Kerala Agricultural University, Thrissur, 70p.

Ranjhan,S.K. 1998. *Nutrient Requirements of Livestock and Poultry*.Second edition. Indian Council of Agricultural Research, New Delhi. 72p.

Rastogi,A., Dutta,N. and Sharma,K. 2003. Effect of strategic feed supplementation during gestation on intake, blood biochemical profile and reproduction performance of goats. *Asian Aust. J.Anim.Sci*.**16**: 1725-1731.

Rastogi,A., Dutta,N. and Sharma,K. 2006. Effect of strategically supplemented pregnancy allowance on nutrient utilization and reproductive performance of goats.*Livestock Res. for Rural Dev*.**18:** 132-137.

Rejitha,J. 2013. Efficacy of ascorbic acid and chromium to alleviate oxidative stress in peri-partum goats.M.V.Sc thesis, Kerala Veterinary and Animal Sciences University, Pookode, 51p.

Robert, J. and Saun, V. 2005. Need for supplementation of minerals and vitamins for pregnant doe. *J.Anim. Sci*. **70**: 273-279.

Rodriguez, G.F., De Santiago, M.M.A., Scaramuzzi, R.J., Malpaux, B. and Delgadillo, J.A. 2009. Nutritional supplementation improves ovulation and pregnancy rates in female goats managed under natural grazing conditions and exposed to the male effect. *Anim. Reprod. Sci*. **116**: 85-94.

Roshma,T.J. 2014. Effect of dietary incorporation of Ksheerabala residue on growth performance in Malabari kids.M.V.Sc thesis, Kerala Veterinary and Animal Sciences University, Pookode, 42p.

Safari, J., Kifaro, G.C., Mushi, D.E., Mtenga, L.A., Adnøy, T. and Eik, L.O. 2012. Influence of flushing and season of kidding on reproductive characteristics of Small East African goats (does) and growth performance of their kids in a semi arid area of Tanzania. *Afr. J. of Agric. Res.* **7:** 4948-4955.

Saha, N.G., Alam, M.R. and Rahman, M.M. 2012. Effect of feed supplementation on reproduction, lactation and growth performance of Black Bengal goats grazed on native pasture. *Bang. J.Anim.Sci.***41**: 41-46.

Sahlu, T. and Goetsch, A.Feeding the Pregnant and Milking Doe.In : Sahlu,T.(ed.), Proceedings of 13th annual goat field day ; 2nd- 6th August,1998,Langston. Langston University, UK.pp.4-20.

Sahlu, T., Hart,S. P., Le-Trong, Z., Dawson, J.L. and Gipson, T.2000.Influence of prepartum protein and energy concentrations for dairy goats during pregnancy and early lactation.*J. Dairy Sci.***78**:378-87.

Sahluf, T., Hart, S. P., Le- Trong, T., Jia, Z., Dawson, L., Gibson,T. and The, T. H. 1995. Influence of prepartum protein and energy concentrations for dairy goats during pregnancy and early lactation. *J. Dairy Sci*. **78**: 378-387.

Sahu,S., Babu,L.K., Karna,D.K., Behara,K., Kanungo,S., Kaswan,S., Biswas,P. and Patra, J.K. 2013. Effect of different level of concentrate supplementation on the peri parturient growth performance of Ganjam goats in extensive system. *Vet Wld*. **6**:428-432.

Saikia, G., Baruah, K.K., Buragohain, S.C., Saikia, B.N. and Pathak, N.N. 1995. Feed intake, utilization of nutrients and growth of Assamese X Beetal goats fed three levels of energy. *Small Rum. Res.***15:** 279-282.

Satchdeva, K.K., Sengor, Q.P.S., Singh, S.N. and Lindahl, I.L. 1973.Effect of the plane of nutrition on the reproductive performance of does. *J.Agric.Sci.* **80:** 375-379.

Sayed, A.B.N. 2009.Effect of Different Dietary Energy Levels on the Performance and Nutrient Digestibility of goats.*Vet. Wld.***2**: 418-420.

Sengar, O.P.S. 1980.Indian research on protein and energy requirements of goats . *J. dairy Sci.***63**: 1655-1670.

Shahjalal, M., Bishwas ,M.A.A., Tareque,A. M. M. and Dohi,H. 2000. Growth and carcass characteristics of goats given diets varying protein concentration and feeding level. *J. Animal Sci*. **13**: 613-618.

Snedecor, G.W. and Cochran, W.G. 1994. *Statistical Methods*.(8th Ed.). The Iowa State University press, Ames, IA. 314p.

Tanaka, T., Fujiwara, K., Kamomae, H., Kim, S. and Kaneda, Y., 2004. Ovarian and hormonal responses to progesterone – releasing controlled internal drug releasing treatment in dietary restricted goats. *Anim. Reprod. Sci.***84**: 135-146.

Thomas, R.A.C., Back, P. J., Kenyon, P. R., Hickson, R. E., Ridler, A. L., Stafford, K. J. and Morris, S. T. 2015. *Ad libitum* pasture feeding in late pregnancy does not improve the performance of twin-bearing ewes and their lambs. *Asian Aust. J.Anim.Sci*.**28**: 360-368.

Tygesen, M.P.,Nielsen, M.O., Norgaard, P., Ranvig, H., Harrison, A.P. and Tauson, A. 2008. Late gestational nutrient restriction: effects on ewes' metabolic and homeorhetic adaptation, consequences for lamb birth weight and lactation performance. *Arch. Anim. Nutr.***62**: 44- 59.

Viana,R.B., Junior,B., Harry,E., Ayres,M., Caribe, M.C., Benesi, Jose,F., Mirandola, Sakata,R.M. and Harry, B.E. 2003.Influence of pregnancy and puerperium in the erythrogram of Saanen goats raised in the state of Sao Paulo- Brazil. *Brazilian J. of Vet. Res. Anim. Sci.* **40**: 178-184.

Vinu,M.N. 2012.Dietary supplementation of organic selenium in crossbred calves.M.V.Sc thesis, Kerala Veterinary and Animal Sciences University, Pookode, 97p.

Voicu,I, Burlacu,G.H., Criste, R.D. and Voicu, D.1993. Study on the energy and protein requirements in goats. *Br.J. Nutr*.**10:**47-61

Waziri, M.A., Ribadu, A.Y. and Sivachelvan, N. 2010.Changes in the serum proteins, hematological and some serum biochemical profiles in the gestation period in the Sahel goats.*Vet. Arch*.**80**: 215-224.

Yagoub, Y.M. and Babiker, S.A. 2008.Effect of dietary energy level on growth and carcass characteristics of female goats in Sudan.*J. Anim. Sci*. **80**: 100-115.

Zabuli, J., Tanaka, T., Lu, W. and Kamomoae, H. 2010. Intermittent nutritional stimulus by short-term treatment of high-energy diet promotes ovarian performance together with increases in blood levels of glucose and insulin in cycling goats. *Anim. Reprod.Sci.***29:** 116-120.

EFFECT OF NUTRIENT SUPPLEMENTATION ON LITTER SIZE OF MALABARI DOES AND GROWTH RATE OF KIDS

JASITHA JA-AFAR
(13-MVM-25)

ABSTRACT OF THESIS

Submitted in partial fulfillment of the requirement for the degree of

MASTER OF VETERINARY SCIENCE
(Animal Nutrition)
2015

Faculty of Veterinary and Animal Sciences
Kerala Veterinary and Animal Sciences University
Pookode, Wayanad

DEPARTMENT OF ANIMAL NUTRITION
COLLEGE OF VETERINARY AND ANIMAL SCIENCES
MANNUTHY, THRISSUR – 680651
KERALA, INDIA

ABSTRACT

An experiment was carried out in fifty adult crossbred Malabari goats to study the effect of nutrient supplementation on litter size of does and growth rate of kids. Fifty adult female crossbred Malabari goats were selected from University Goat and Sheep farm, Mannuthy for the experiment. The animals were grouped into two groups as control and experimental animals of twenty five animals each uniformly and they were fed with concentrate mixture containing 18 per cent crude protein and 65 per cent total digestible nutrients (farm ration). The animals were offered fresh hybrid napier grass as the sole roughage. Additional 200 g of the same concentrate mixture were fed to all animals in experimental group two weeks prior to breeding. All the animals from control and experimental groups were examined for pregnancy by abdominal palpation. At the 16^{th} week of gestation pregnancy was further confirmed by ultra sound scanning. Eighteen pregnant animals from each group were selected randomly and maintained on the feeding and management conditions prevailing in the farm up to the fourth month of gestation. At last month of gestation both control and experimental group were divided into three subgroups of six animals. Each groups were allotted randomly to one of the dietary treatments T_1 (18 per cent CP and 65 per cent TDN), T_2 (20per cent CP and 65 per cent TDN), T_3 (18per cent CP and 70 per cent TDN).Data on daily dry matter intake, body weight of does during gestation, at kidding and average birth weight of kids and fortnightly body weight of kids for first month were used for evaluation of work.

The results of the study indicated that feeding of does with extra 200g of concentrate mixture (18 per cent CP and 65 per cent TDN) two weeks prior to breeding had no significant effect on the litter size of does and average daily gain of kids but there was a difference in the average birth weight of the kids which was 1.56 kg in the control group and 1.83 kg in the experimental group. In addition, maternal nutrition had a significant effect on the average birth weight, average daily gain and fortnightly body weight of kids. Feeding high energy (70 per cent TDN) and high

protein (20 per cent CP) concentrate mixture to does during last month of gestation resulted in better average birth weight, daily gain and body weight at the end of first month in kids, both in the control and experimental group. Feeding of diet with high energy had a significant effect on the average birth weight, average daily gain and fortnightly body weight of kids compared to the group that was maintained on the farm ration containing 65 per cent TDN and 18 per cent CP (ICAR 1998).The average birth weight and daily gain of the kids in the high energy group was 2.35 and 0.12 kg for the experimental group and 1.95, 0.11 kg for the control group, respectively. The corresponding values in the high protein group were 2.07 and 0.10 kg for experimental and 1.65 and 0.10 kg for the control group, respectively. A significantly lower values of 1.83 and 0.09 kg in the experimental (T_1) and 1.56 and 0.08 kg in the control group (T_1) was observed for the birth weight and average daily gain. By taking into account of the total weight of kids after one month, the returns over expenditure were Rs. 3229.64, 3406.24 and 5715.32, respectively for treatments T_1, T_2 and T_3 of control and Rs.4001.66, 5998.30 and 7199.43 for T_1, T_2 and T_3 of experimental group.

From the above data it can be concluded that even though supplementation of concentrate mixture with 18 per cent CP and 65 per cent TDN to does, two weeks prior to breeding resulted in better birth weight of kids, feeding of a concentrate mixture with 18 per cent CP and 70 per cent TDN to does during last month of gestation improved the birth weight and total gain in kids and better returns over expenditure compared to concentrate mixture with 20 per cent CP and 65 per cent TDN or 18 per cent CP and 65 per cent TDN. Thus even though high protein diet had significant effect on the growth performance of kids compared to control, feeding a diet with 70 per cent TDN and 18 per cent CP to does in last month of gestation is better in having increased average birth weight and growth performance of kids.

Academic Form No.19

KERALA VETERINARY AND ANIMAL SCIENCES UNIVERSITY

FACULTY OF VETERINARY AND ANIMAL SCIENCE

PROGRAMME OF RESEARCH WORK FOR THESIS FOR MASTER'S DEGREE

1. Title of thesis:

Effect of nutrient supplementation on litter size of Malabari does and growth rate of kids

2. (a) Title of the departmental / KVASU Research project of which this form a part:

2. (b) Code No. if any and order by which departmental / KVASU Research project is approved:

-

3. (a) Name of the student:

Jasitha Ja-afar

3. (b) Admission No.:

13-MVM-25

4. (a) Name of the major advisor(Guide):

Dr. K. Ally

4.(b) Designation:

Professor,

Department of Animal Nutrition,

College of Veterinary and Animal Sciences,

Mannuthy, Thrissur-680 651

5. Objective of the study:

Study the effect of energy and protein supplementation in Malabari goats on

1. Conception rate and litter size
2. Birth weight and growth performance of kids

6. Practical / Scientific utility:

The animal production systems in the state are to be viewed separately from the rest of the country because of the limited land availability and very high population density. The rearing of large animals has more or less become an unsuccessful enterprise which is evident from the dwindling cattle population of the state. Goats are easy to manage and their small size makes them suitable for homestead farming of Kerala. Presently, an increasing number of people are attracted

towards goat farming as evidenced by the increase in population of goats during the last ten years (2007 census). In Kerala goats are mainly fed with tree leaves and concentrate feeding is rare. Nutrient supplementation especially protein and energy prior to breeding and last month of gestation is important for increased number of kids, their survivability and better birth weight. Unscientific feeding practices during these periods may lead to huge economic loss resulting from either abortion, or early kid mortality. Moreover twinning rate in Malabari does is very common and work on the nutrient requirement of these does on gestation are scanty. Keeping this in view, the present work is aimed to investigate the effect of nutrient supplementation prior to breeding and during late gestation in goats on kidding rate and growth performance of kids.

7. Important Publications on which the study is based :

Hossain *et al.* (2003) in their work with goats reported that high dietary energy (11.98 mega Joule (MJ) metabolisable energy (ME)/kg dry matter (DM)) increased conception rate in dams and birth weight of kids compared to low energy diet group (10.02 MJ ME / kg DM).

Rastogi *et al.* (2006) reported in their study on local non descriptive adult does that supplementation of 20 gram concentrate mixture / kg $W^{0.75}$to does from 61 days post mating to term increased feed in take of doe, fetal growth rate, birth weight and survivability of kids were better compared to non supplemented group.

Nnadi *et al.* (2007) in their study in pregnant West African Dwarf goats observed that high dietary protein (crude protein 13 percent) had improved livability and weaning weight of kids compared to low protein (CP 9 percent) fed group.

Camelo *et al.* (2008) reported that goats fed high dietary energy (1.8 Mcal / kg ME) during flushing period had more twinning rate compared to low energy diet (0.9 Mcal / kg ME) fed group (60 Vs 30).

He *et al*. (2013) observed that restriction of protein (CP 7.5 per cent) during last month of gestation in Liuyang black goats resulted in lower birth weight of kids compared to group given control feed (12.5 per cent).

Mahboub *et al*. (2013) reported in their study on Egyptian goat, sheep and their offspring that total mixed rations supplying 135 per cent of the NRC requirement during late pregnancy improved the birth weight and

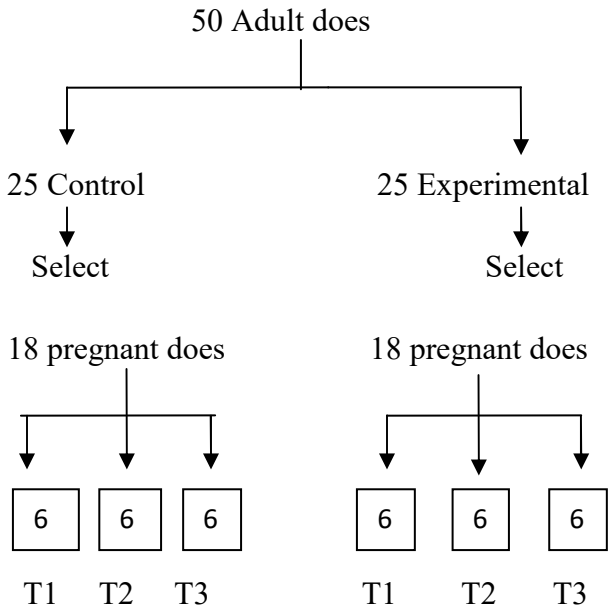
immunity of kids compared to those fed with 100 per cent of the NRC requirement.

Sahu *et al*. (2013) in their study on Ganjam goats reported that the supplementation of 300 g concentrate (CP 22 per cent, total digestible nutrient (TDN) 72 per cent) 60 days prior to expected date of kidding improved both pre partum and post partum body condition of goat compared to those fed 200 g of concentrate mixture.

8. Outline of technical programme:

Fifty adult female Malabari goats will be selected from University goat and sheep farm, Mannuthy. The animals will be grouped into two, as uniform as possible with regard to age, body weight and parity. The animals will be randomly allotted to two groups – control (Group 1) and experimental group (Group 2) of twenty five animals each. Extra 200g of concentrate will be fed to all animals in Group 2, two weeks prior to expected date of mating. Eighteen pregnant does will be selected from each group randomly. All the experimental animals will be fed with standard concentrate mixture with 18 per cent CP and 65 per cent TDN till the last month of gestation. Thereafter both the control and experimental group will be divided into three sub groups of 6 animals each and will be randomly allotted to one of the dietary treatments in each group as below as in a 2 X 3 factorial experiment.

Treatments	Concentrate mixture
T1 (control)	CP- 18 per cent TDN-65 per cent
T2	CP-20 per cent TDN-65 per cent
T3	CP-18 per cent TDN-70 per cent



Standard feeding and management practices will be followed. Animals will be fed as per ICAR standards (Ranjhan, 1998) and will be maintained on their respective feeding regime for a period of six months till

kidding. After kidding all animals will be fed with the regular feed in the farm. Observations on the conception rate, body weight of does before the experiment, at the time of mating and at the time of kidding will be recorded. Blood samples will be collected from the experimental animals during the mating period and with in three days of kidding. The samples will be analyzed for serum glucose level, blood urea nitrogen (BUN) (Kaneko *et al*., 2008), serum calcium (Christian *et al*., 1967) and serum phosphorus (Bernhart and Wreath, 1955). The kidding rate and the birth weight of kids will be monitored. Feed and fodder will be analyzed for proximate principles (AOAC, 2012). Data on various parameters will be analyzed statistically (Snedecor and Cochran, 1994).

9. Main items of observation to be made;

1. Body weight of doe at mating

2. Daily feed intake of does, g

3. Conception rate of doe

4. Monthly body weight of pregnant doe

5. Body weight of doe at kidding

6. Litter size

7. Birth weight of kids

8. Fortnightly body weight of kids for first month

9. Blood parameters-hemoglobin, plasma total protein, blood urea nitrogen, serum calcium, serum phosphorus and serum glucose

Economics of production will be estimated form the data recorded.

10. Facilities

a. Existing: Facilities available in the Department of Animal Nutrition and University goat and sheep farm, College of Veterinary and Animal Sciences, Mannuthy will be utilized for the study.

b. Additional facilities required: Nil

11. Duration of study:

Four semesters

12. Financial estimate:

Cost of reagents, chemicals -- Rs. 10,000

Contingencies -- Rs. 10,000

Total -- Rs. 20,000

Signature of the student:

Signature of the Major Advisor:

Place: Mannuthy

Date: 03.05.2014

Name, designation and signature of

Members of the advisory committee.

Chairperson

Dr. Ally K.,
Professor,
Department of Animal Nutrition,
College of Veterinary and Animal Sciences,
Mannuthy, Thrissur - 680651.

Members

Dr. P. Gangadevi,
Professor and Head,
Department of Animal Nutrition,
College of Veterinary and Animal Sciences,
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Dr. R. Thirupathy Venkatachalapathy,
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Dr. Biju Chacko,
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Pookode, Wayanad.

APPENDIX-I

References:

AOAC. 2012. *Official Methods of Analysis*. (19thEd,). Association of Official Analytical Chemists, Gaithersburg, Meryland, USA.

Bernhart, D.N. and Wreath,A. 1955. Calorimetric determination of phosphorus by modified phosphomolybdate method. *Anal. Chem***. 27**:440-441.

Camelo, A.A., Valencia, E., Rodriguez, A. and Randel,P.F. 2008.Effect of flushing with two energy levels on goat reproductive performance. *Livestock Res. for Rural Dev.* **20**:1-7.

Christian, G., Thin, A.T. and Patricia, A.T. 1967.Estimation of calcium and magnesium in serum and urine by atomic absorption spectrophotometry. *J. Clin. Pathol*.**20** (3): 280-282.

He,Z.X., Wu,D.Q., Sun,Z.H., Tan,Z.L., Qiao,J.Y., Ran,T., Tang,S.X., Zhou,C.S., Han,X.F., Wang,J.H. and Beuchemin,K.A. 2013. Protein or energy restriction during late gestation alters fetal growth and visceral organ mass: An evidence of intrauterine programming in goats. *Anim. Reprod. Sci.* **137**: 177-182.

Hossain,M.E., Shahjalal,M., Khan,M.J. and Hasanat,M.S. 2003. Effect of dietary energy supplementation on feed intake, growth and reproductive performance of goats under grazing condition. *Pakist. J. Nutr*. **2** :159-163.

Jong,H.H. and Vegeter, J.J. 1950. Determination of serum proteins with the biuret test. *Pharm. Weekbl*. **85**: 755-765.

Kaneko, J.J., Harvey, J.W. and Bruss, M.L. 2008.*Clinical Biochemistry of Domestic Animals.*(6thEd.) Academic Press, California, 351p.

Mahboub,H.D.H., Ramadan,S.G.A., Helal, M. A.Y. and Aziz,E.A.K. 2013. Effect of maternal feeding in late pregnancy on behaviour and performance of Egyptian goat and sheep and their off spring. *Global Vet*. **11**: 168-176.

Nnadi,P.A., Kamalu,T.N. and Onah,D.N. 2007. Effect of dietary protein supplementation on performance of West African Dwarf does during pregnancy and lactation. *Small Rum. Res*. **71**:200-204.

Ranjhan,S.K. 1998. *Nutrient Requirements of Livestock and Poultry*.Second edition.Indian Council of Agricultural Research, New Delhi. 72p.

Rastogi,A., Dutta,N. and Sharma,K. 2006. Effect of strategically supplemented pregnancy allowance on nutrient utilization and reproductive performance of goats. *Livestock Res. for Rural Dev.***18.**

Sahu,S., Babu,L.K., Karna,D.K., Behara,K., Kanungo,S., Kaswan,S., Biswas,P. and Patra, J.K. 2013. Effect of different level of concentrate supplementation on the peri parturient growth performance of Ganjam goats in extensive system.*Vet Wld*. **6**:428-432.

Snedecor, G.W. and Cochran, W.G. 1994. *Statistical Methods*.(8th Ed.). The Iowa State University press, Ames, IA. 314p.

Appendix II

Time frame of work

Semester I

1. Collection of literature
2. Planning of programme for research
3.Preparation of synopsis

Semester II

1. Literature collection
2. Formulation of experimental feeds
3. Selection of animals
4. Starting of the experiment

Semester III

1. Conducting the experiment
2. Collection of data

3. Chemical analysis of feed and biological materials

Semester IV

1. Statistical analysis of data
2. Preparation of thesis
3. Submission of thesis

CERTIFICATE

Certified that the research project has been formulated observing the stipulations laid down under the prevention of cruelty to animals act (amendment, 1998)

Mannuthy
O3-05-2014

Dr. Ally K.
Major advisor

CURRICULUM VITAE

1. Name of the candidate	:	JASITHA JA-AFAR
2. Date of birth	:	03-03-1988
3. Place of birth	:	PALAKKAD
4. Marital status	:	Married
5. Permanent address	:	Manimuthu nivas ,yakkara mukku Yakkara post Palakkad – 678701.
6. Major field of specialization	:	Animal Nutrition
7. Educational status	:	B.V.Sc. &A.H, MVSc (doing)
8. Professional experience	:	Nil
9. Publications made	:	"Grooming in Calves"
10. Membership of Indian professional societies	:	1) Kerala State Veterinary Council, Veterinary Association, Indian dairy Association