

**A STUDY ON COMPARATIVE EFFICACY OF MAIZE, SORGHUM AND  
SUPER NAPIER SILAGE BASED TOTAL MIXED RATIONS ON  
GROWTH PERFORMANCE OF NELLORE LAMBS.**

By

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**I.D.NO: GVM/2019-010**

Thesis submitted to the

**SRI VENKATESWARA VETERINARY UNIVERSITY**

In partial fulfilment of the requirements for the degree of

**MASTER OF VETERINARY SCIENCE**

In the Faculty of Veterinary Science

**(LIVESTOCK PRODUCTION MANAGEMENT)**



**DEPARTMENT OF LIVESTOCK PRODUCTION MANAGEMENT**

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**MARCH-2022**

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

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## ACKNOWLEDGEMENT

*This thesis is the end of my journey in obtaining my M.V.Sc. At the end of my thesis, it is a pleasant task to express my thanks to all those who helped me contributed in many ways to the success of this study and made it an unforgettable experience for me. Here I take space to thank the people who I owe acknowledgements for their scientific, technical, moral and financial support. The support offered by them at various stages of this long journey of research work set me to reach my dream to contribute something to the field of animal sciences.*

*At this moment of accomplishment, first of all, I pay homage and greatly beholden beyond words to express my deep sense of gratitude from inner core of my heart to my major advisor and guide **Dr. Ch. Venkata Seshaiiah**, Professor and Head, Dept. Of Livestock Farm Complex, NTR C.V.Sc, Gannavaram, for his valuable guidance, support scholarly inputs and consistent encouragement, boundless encouragement, keen interest and everlasting patience, I received throughout my studies, course of research work and preparation of thesis can be never be forgotten . This work would not have been possible without his guidance, support and encouragement. Despite of his busy schedule, he has always made himself available to give his valuable directions and used to review my thesis progress and made corrections. His knowledge and commitment towards profession will always inspire me and I hope to continue to work with his noble thoughts for my entire career. I consider myself lucky to have such an excellence perceiving, ever cooperative and helpful personality as my guide. I consider it as a great opportunity to do my master's program under his guidance and to learn from his research expertise.. Thank you for all your help and support, sir.*

*I immensely thank **Dr. M. Kalyana chakravarthi**, Senior Scientist and head, AICRP on Pigs, C.V.Sc, Tirupati, Member of advisory committee for his understanding, encouragement, indefatigable interest, conceptualization of research work, valuable advice, critical super vision, generous help which have provided a good and smooth basis during the course of my research work.*

*I am thankful to **Dr. D. Srinivas Kumar**, Professor and Head Department of ANIMAL NUTRITION, C. V. Sc, Garividi, member of my Advisory committee for his valuable suggestions during proximate analysis, and encouragement*

during the course of my study.

I am thankful to **Dr. K. Sudhakar**, Professor and Head, Department of LPM, NTR C.V.Sc, Gannavaram, for his valuable guidance, concrete suggestions, endless patience, constant encouragement and cooperation throughout my research work.

I express my heart full thanks to **Dr. P. Asha latha**, Professor, **Dr. A. Anitha**, Associate professor and **Dr. T.Sushmitha**, Asst. professor, Dept. of LFC, NTR C.V.Sc, Gannavaram, for their cooperation, good will and encouragement throughout my work.

I am thankful to **Dr. C. Anil Kumar**, Asst. professor, Department of LFC, NTR C.V.Sc, Gannavaram for his valuable guidance.

I owe my effusive thanks to my senior **Dr.G.Kalyani**, **Dr. M. Venkateswarlu**, **Dr. S. Divya** and **Dr. B.Ajay** , **Dr.R.G.Adhethayan** , for his support and encouragement whenever I was in need.

I sincerely thank my colleagues especially for **Dr.V.Keerthi**, and **Dr.Anusha Pydi** for support, care and sincere advice, helps me a lot during the course of my study.

I am very much grateful to my classmates **R.Kalyani** and **Ch. Sumukh** for their timely help in my research work.

I express my profound regards to my seniors and friends **Dr.Amani**, **Dr. Bhanumathi**, **Dr.B.Leela mani**, **Dr.P.Vahini**, **Dr.Ts.Moni Teresa**, **Dr.Kathyayini**, **Dr. Ch.Deepthi**, **Dr.Swapnil**, **Dr.Bala**, **Dr.N.Anjana**, **Dr.P.Tharangani** **Dr.Yashaswi**, **Dr.K.Usha kiran** for their cooperation and encouragement during my study period.

I express my heartfelt thanks for my juniors **Vijya lakshmi**, **Murthy**, and

**Tony,P.Vooha**, **K.Molika** to their good cooperation during my research work.

I extend my thanks to **B.Prakash Rao**, **Srinivas Rao**, **Sarath**, **Vasantha**, **Venkateswarlu** and other non-teaching staff for their cooperation and affectionate help during my study period.

My deepest feeling of love and gratitude to my parents mere words cannot express my profound indebtedness to my beloved father and mother **Mr.P.Venkata Rao** and **Mrs.P.Ramanamma** for their boundless love, pain staking efforts, un compromising sacrifices, needy inspiration for filling my life with laughter and happiness beyond measures and whose moral support and unparalleled affection

*is a constant source of motivation for me in shaping up my career.*

*I would like to thank from the bottom of my heart to my lovely sister **P.Siva Harathi** and my husband **S.Dilleswara rao** and my father-in-law and mother-in-law **K. Prasad rao, K.Bala rama krishnna, S.Asrinaidu** and **S.Komali** who have always been my integral part of life. My love for them is just insatiable.*

*I acknowledge my sincere thanks to university for the financial support extended to me during the study.*

*While travelling on this part of education, many hands pushed me forth, learned hearts put me on the right track. I ever rest thanks to all of them.*

*Finally, I thank all those who have helped me directly or indirectly in the successful completion of my thesis. Any omission in this brief acknowledgement doesn't mean lack of gratitude.*

**P.LAKSHMI PRASANNA...**

## **DECLARATION**

I, **P.LAKSHMI PRASANNA** *hereby declare that the thesis entitled “A STUDY ON COMPARATIVE EFFICACY OF MAIZE, SORGHUM AND SUPER NAPIER SILAGE BASED TOTAL MIXED RATIONS ON GROWTH PERFORMANCE OF NELLORE LAMBS” submitted to Sri Venkateswara Veterinary University, Tirupati for the degree of MASTER OF VETERINARY SCIENCE is the result of original research work done by me. It is further declared that the thesis or any part thereof has not been published earlier in any manner.*

**Date:**

**Place: Gannavaram**

**(P.LAKSHMI PRASANNA)**

## LIST OF SYMBOLS AND ABBREVIATIONS

%	:	Percent
/	:	Per
@	:	At the rate of
°C	:	Degree Centigrade
ADF	:	Acid detergent Fibre
ADG	:	Average daily gain
AF	:	Alfa-Alfa
AIA	:	Acid insoluble ash
AOAC	:	Association of Official Analytical Colloboration
B:C ratio	:	Benefit cost ratio
BCS	:	Body Condition Score
BIS	:	Bureau of Indian Standards
BSLP	:	Bacillus subtilis and Lactobacillus plantarum
Ca	:	Calcium
CF	:	Crude Fibre
CO (CN) <sub>4</sub>	:	Cumbu napier-4
CO (CN) <sub>5</sub>	:	Cumbu napier-5
CO-3	:	Coimbatore-3
CO-4	:	Coimbatore-4
COFS 29	:	Coimbatore Fodder Sorghum
CP	:	Crude Protein
CS	:	Corn Silage
DAS	:	Days after sowing
DCP	:	Digestible Crude Protein
DE	:	Digestible Energy
DM	:	Dry Matter
DMI	:	Dry matter intake
EE	:	Ether extract

ESPP	:	Ensiled Super pressed pulp mixture
FCR	:	Feed Conversion Ratio
Fl	:	Femmtoliters
FS	:	Forage Sorghum
FSS	:	Forage Sorghum Silage
g	:	grams(s)
Hb	:	Haemoglobin
HS	:	High sugar forage sorghum
HSS	:	High Sorghum Silage
ICAR	:	Indian council of Agricultural Research
IVDMD	:	In-Vitro dry matter digestibility
Kg	:	Kilograms
<i>L.buchneri</i>	:	Lactobacillus buchneri
LAB	:	Lactic acid bacteria
LFC	:	Livestock Farm Complex
MCV	:	Mean Corpuscular Volume
ME	:	Metabolizable energy
mg	:	milligram
mis	:	Millet Silage
MiSC	:	Millet Silage and Concentrate
MJ	:	Mega Joules
MSC	:	Maize Silage and Concentrate
MZ	:	Maize
MZS	:	Maize Silage
NDF	:	Neutral Detergent Fibre
NFE	:	Nitrogen Free Extract
NRC	:	National Research Council
OM	:	Organic Matter
P	:	Phosphorus
PCV	:	Packed Cell Volume

PL	:	Pedicoccus and Lactobacillus
q	:	quintal
RBC	:	Red Blood Cell
Rs	:	Rupees
SE	:	Standard error
SNG	:	Super Napier Grass
SS	:	Sweet Sorghum
SSC	:	Sorghum Silage and Concentrate
TA	:	Total ash
TDN	:	Total digestible nutrients
TMR	:	Total mixed ration
VFA	:	Volatile fatty acids
WSC	:	Water Soluble Carbohydrate

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Degree to which it is submitted	:	<b>Master of Veterinary Science</b>
Faculty	:	Veterinary Science
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Year of submission	:	2022

## **ABSTRACT**

The present research was carried to study the physicochemical properties of Maize, Super Napier and Sorghum silages and comparative efficacy of Maize, Super Napier and Sorghum silage based total mixed rations (TMR) on growth performance, body condition score, cost per kg weight gain and hematological profiles in Nellore lambs.

Significant difference was not observed in colour, smell, consistency, sensory score among Maize, Super Napier and Sorghum silages. The pH values observed for Maize, Super Napier, Sorghum silages were 3.86, 4.00 and 3.93, respectively and the

difference was not significant. The mean dry matter, organic matter, crude protein, total ash % was not significantly different among the silages. The ether extract % was significantly ( $P<0.01$ ) high in Sorghum silage, crude fibre, NDF, ADF and calcium % was significantly ( $P<0.01$ ) high in Super Napier silage, while phosphorus content was significantly ( $P<0.01$ ) high and acid insoluble ash content was significantly ( $P<0.01$ ) low in maize silage.

Eighteen Nellore lambs of about 3 months age with uniform body weights were randomly divided into 3 groups of 6 animals in a completely randomized design. Maize, Super Napier and Sorghum silage based TMR were prepared by mixing the silage and concentrate about 90:10 ratio and assigned to T1 (Maize silage based TMR), T2 (Super Napier silage based TMR), T3 (Sorghum silage based TMR) group lambs as per their nutrient requirements.

The mean fortnightly DMI was significantly ( $P<0.01$ ) high ( $6.33\pm 0.12$ ) in T1 group than T2 ( $5.35 \pm 0.09$ ) and T3 ( $5.61 \pm 0.10$ ) groups, while the difference was not significant between T2 and T3 groups. The mean weight gain (kg) during the experiment was  $8.21\pm 1.09$ ,  $7.04\pm 1.34$  and  $7.19\pm 1.49$ , for T1, T2 and T3 groups, respectively. There was no significant difference observed in mean fortnightly body weights as well as overall weight gain in lambs fed with Maize, Super Napier and Sorghum silage based TMR. The average daily weight gains (g) of T1, T2 and T3 group lambs were  $91.22\pm 12.18$ ,  $78.22\pm 14.91$  and  $79.89\pm 20.26$ , respectively and the difference among the groups was not significant. The mean feed conversion ratio of T1, T2 and T3 group lambs were  $4.63\pm 1.19$ ,  $4.60 \pm 1.43$  and  $4.72 \pm 1.24$ , respectively and the difference among the groups was not significant.

Significant difference was not observed in body condition score among T1, T2 and T3 group lambs. The mean RBC count ( $10^6/\mu\text{L}$ ), haemoglobin (g/dL), and MCV (fl) values were not differ significantly among different experimental groups of lambs. The PCV (%) was significantly ( $P<0.05$ ) high in T1 group than T2 and T3 groups, while the difference was not significant between T2 and T3 groups.

The cost per kg production of Maize, Super Napier and Sorghum silages was ₹ 3.22, 2.81 and 3.04, respectively. The cost (₹) per kg weight gain in T1, T2 and T3 groups was 157.76, 146.21 and 151.25, respectively. The present study concluded that feeding of Super Napier silage based TMR is economical compared to the Sorghum and Maize silage based TMR under intensive system of lamb production.



# *Chapter - I*

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## *Introduction*

## CHAPTER I

### INTRODUCTION

Livestock plays an important role in Indian economy. About 20.5 million people depend upon livestock sector for their livelihood. India is a nation with a huge livestock population of 535.78 million of which 192.49 million cattle, 109.85 million buffaloes, 74.26 million sheep, 148.88 million goats, and 9.06 million pigs (20th Livestock Census, GOI, DAHD, 2019). Livestock farming is an important subsidiary and ancillary farming activity that is widespread among small farmers of India, particularly as part of the homestead farming system. The livestock sector plays a significant and essential role in the provision of nutritive food rich in animal protein besides providing livelihoods to two-thirds of the rural population in India.

India's rural economy is greatly supported by sheep farming, especially in the arid/ semi- arid and mountain areas, where crop and dairy farming are not feasible. The production potential and demand for mutton has attracted many progressive farmers and unemployed youth towards the sheep rearing. The major advantages in sheep production includes short generation interval, higher rate of prolificacy and huge market demand for their products.

Sheep population in India is 74.26 million which accounts 13.85% of total livestock population in the country. Andhra Pradesh with sheep population of 17.6 million stands second among the states in India (20th Livestock Census, GOI, DAHD, 2019). In Andhra Pradesh Nellore, Decani, Bellary breeds are commonly reared by the farmers. Nellore is a popular and tallest mutton breed in India distributed predominantly in Nellore, Prakasam, Anantapur, Kadapa and Chittoor districts of Andhra Pradesh.

In Andhra Pradesh, there are 3 types of sheep rearing systems are being practiced viz. extensive, semi-intensive, intensive types. In extensive system the animals are allowed to graze on common lands and without any additional supplementation of nutrients. This system is carried out in low rainfall areas of the state. In semi-intensive rearing system, the sheep are allowed to graze for a period of 4-8 hours depending on the availability of grass and are supplemented with some green / dry fodder and concentrate in order to meet the nutrient requirements. In the intensive rearing the animals are stall fed with cultivated green fodder and concentrate feed. This system is commonly practiced in commercially organized farms. However, shrinking of grass lands and seasonal fluctuations in the availability of feeding resources forcing the sheep producers from low input extensive system to high input intensive system of sheep production in Andhra Pradesh. Continuous supply of green fodder is essential for optimum production, reproduction and growth in sheep.

In view of degraded grazing areas, forage conservation plays an important role in sheep production systems in Andhra Pradesh. Large parts of the state have a low and variable rainfall with periodic droughts effecting the sheep production. It is, therefore, of great importance for farmers to produce enough forage during the rainy season and conserve the surplus fodder for use in scarcity and drought periods. In general hay and silage making are the two ways of forage conservation (McDonald *et al.*, 2002). Silage production is advantageous due to the fact that it is less weather dependent, less field and transportation losses occur and it is more palatable due to the cutting thereof at a younger growth stage (Blaser, 1964). In European countries and Australia, silage commonly being used in sheep production as a drought feed and also for the finishing of lambs in a feedlot (Stanley, 2003; Marley *et al.*, 2007).

Feeding of silage-based rations is becoming popular among the farmers rearing sheep on commercial basis in Andhra Pradesh. There are different varieties of crops used for

silage making. Crops that provide adequate levels of moisture, soluble carbohydrates, and other nutrients (Cullison, 1975) suited for good quality silage making. Thick stemmed fodder crops like maize and sorghum are the popular crops for silage making in Andhra Pradesh. Low biomass production, annual nature of the crop are the major disadvantages in maize and sorghum cultivation. Now, perennial forage crop such as Super Napier (*Pennisetum purpureum* × *Pennisetum glaucum*) variety was recently become popular and are grown by the farmers under irrigated conditions in Andhra Pradesh. The Super Napier is characterized by its profuse tillering ability, high-yield potential, high crude protein (CP) concentration, quick re-growth capacity, high palatability, free from other adverse factors, and resistance to pest and disease attack. However, studies are scanty on the use of Super Napier silage for feeding of sheep as this fodder crop being commonly used on fresh basis

Feeding of total mixed ration (TMR) which is a blend of roughage and concentrate feed ingredients without giving any choice to the animal for the selective eating of any specific feed ingredient, could provide the required amount of nutrients than separate feeding of roughage and concentrates (Wadhwa and Bakshi ,1996). TMR feeding produce more stable and ideal environment in the rumen for the rumen microbes, which in turn can boost the productive performance of ruminants. Feeding of TMR improved feed intake by improving the palatability, efficient utilization of nutrients, improved feed conversion efficiency and higher daily live weight gain were reported in livestock (Singh *et al.*,1998, 2000).

Since there is paucity of information on comparative efficacy of maize, sorghum and Super Napier silage based TMR on growth performance of sheep, the present study is undertaking in weaned Nellore lambs with the following objective

### **Objectives of research work**

1. To prepare Maize, Sorghum and Super Napier silages in the form of bales.
2. To compare organoleptic, physical and chemical properties of Maize, Sorghum and SuperNapier silages.
3. To study the effect of feeding Maize, Sorghum and Super Napier silage based total mixedrations on growth and body condition score in Nellore lambs
4. To work out the cost per kg weight gain in lambs fed with Maize, Sorghum and SuperNapier silage based total mixed rations.

# *Chapter - II*

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## *Review of Literature*

## CHAPTER-II

### REVIEW OF LITERATURE

The review of literature pertaining to physicochemical properties of silages and comparative efficacy of silage based total mixed rations (TMR) on growth performance and body condition scores in small ruminants was described in this chapter.

#### 2.1 PREPARATION OF SILAGE

In the absence of air, the fermentation of soluble carbohydrates in forages results in a variety of end products, ultimately resulting in the preservation of a forage crop as silage. In general, the fermentation phase of the ensiling process is thought to last 7 to 45 d (Pahlow *et al.*, 2003). The silage-making process is divided in 4 phases: (1) the initial aerobic phase in the silo immediately after harvest, (2) the fermentation phase, (3) the stable storage phase in the silo, and (4) the feed-out phase when the silo feed face is open and the material is exposed to air immediately before, during, and after its removal from the silo (Wilkinson and Davies, 2013).

Driehuis *et al.* (2001) reported that inoculation with *Lactobacillus buchneri* inhibits yeast growth and reduces the susceptibility to aerobic spoilage of various ensiled forages and increased ammonia concentration in the silage.

Schmidt *et al.* (2010) reported that inoculation of *L.buchneri* with or without *P.pentosaceus* in silage increases the concentration of acetic acid, lower the no. of fungi and consequently enhanced stability of silage after exposure to air. The addition of *P.pentosaceus* did not reduce the effectiveness of *L.buchneri*.

Khan *et al.* (2011) reported that optimum stage of harvest of maize (*Zea mays*), sorghum (*Sorghum bicolor*) and millet (*Pennisetum americanum*) for silage making was milk stage at which the nutritive value and fermentation characteristics was best for silage

making

Mohd Setapar *et al.* (2012) reported that the temperature and chopped length of forage do not significantly affect the quality of silage produced but the fermentation period must be considered as a crucial parameter.

Assis *et al.* (2014) reported the effect of bacterial inoculants at two inoculation rates on chemical and biological characteristics of maize silage. The treatments influenced LAB populations and filamentous fungi, but no effect was observed on the yeast population.

Erika Lara *et al.* (2015) reported the changes in the nutritive value and aerobic stability of corn silages inoculated with *Bacillus subtilis* alone or combined with *Lactobacillus plantarum*. They concluded that inoculation with both strains increased lactic acid concentration, whereas the use of *B.subtilis* alone or combined *L.plantarum* improved *in vitro* apparent organic matter digestibility. *B.subtilis* combined with *L.plantarum* decreased moulds and yeasts and aerobic stability was improved. Inoculation with *B.subtilis* alone or combined with *L.plantarum* improved the nutritional value and aerobic stability of corn silage.

Ning *et al.* (2017) investigated the association of enzyme-producing microbes and their enzymes with starch and hemi cellulose degradation during fermentation of total mixed ration (TMR) silage. They concluded that the microbial amylase contributes to starch hydrolysis during the ensiling process in both TMR silages, whereas the microbial hemicellulose participates in the hemi cellulose degradation only at the early stage of ensiling.

Parminder Singh *et al.* (2017) conducted study on qualitative assessment of silage prepared from maize varieties alone (P-1844 and PAC-746) and combination of maize varieties (PAC-746 and 31Y45) with sugar graze. The data were recorded with respect to

maize hybrid grown, stage of harvesting (days after sowing), days taken to fill the pit and days of ensiling. They concluded that the silages prepared from maize hybrid P-1844 (S1 and S2) harvested around 70 days after sowing (DAS) with ensiling period of 43 and 63 days, respectively recorded moisture content of 72.6 and 68.3%.

Keles *et al.* (2018) found that application of *L.buchneri* increased the concentration of acetic acid ( $P<0.05$ ) and aerobic stability ( $P<0.01$ ) of baled maize silage and increases the aerobic stability of silage. Elevated acetic acid in the well fermented silages does not depress the dry matter intake.

Silva *et al.* (2018) evaluated the selected strains of *Lactobacillus buchneri* on fermentation and aerobic stability of maize and sugarcane silages. For maize, the inoculated silages had lower pH and higher LAB population, but lower acetic acid concentration in comparison with the untreated control silage.

Da Silva *et al.* (2019) investigated the changes in microbial population, dry matter (DM) recovery and fermentation profile of maize silage with or without inoculation with *L. buchneri* after 45 days of ensiling. They concluded that the selected strains did not affect the DM content, yeast and mould population, DM recovery, WSC, lactic acid bacteria and butyric acid of maize silage after 45 days of ensiling.

Alhaag *et al.* (2019) studied the fermentation characteristics of *Lactobacillus plantarum* and *Pedicoccus spp* isolated from sweet sorghum silage to enhance the fermentation quality of Napier grass and sweet sorghum silage. In both grasses the fermentation characteristics, chemical composition and microbial population were assessed at 5-30 and 90 days of ensiling. They concluded that the addition of inoculants significantly reduced ( $P<0.05$ ) pH, ammonia-N, acetic acid, undesirable microbial population and increased ( $P<0.05$ ) lactic acid and lactic acid bacteria counting. The effect of ensiling days on silage quality through increasing lactic acid, acetic acid, ammonia-N,

propionic acid and butyric acid and decreasing pH, WSC and microbial counts in both sweet sorghum and Napier silage treated with isolated strains.

Brar *et al.* (2021) reported that fodder yield, factor productivity, net return and economic productivity were higher for maize hybrid PMH10 which was found at par with hybrid DKC9108 and significantly better ( $P<0.05$ ) fermentation characteristics, nutritive value and feed values in comparison to silage of composite J1006. They concluded that PMH10 and DKC 9108 hybrids of corn are best suitable for cultivation during spring season for quality silage production. Organoleptic characteristics can be used to assess silage quality because the volatile nature of many fermentation end products produces a variety of distinct odors.

## **2.2 ORGANOLEPTIC, PHYSICAL AND CHEMICAL PROPERTIES OF SILAGE**

Kolver *et al.* (2001) reported that good quality maize silage had a dry matter content of 28-35%, an energy content of 10.8 MJME/ kgDM, a protein content of 7-8%, and a pH of 3.8 to 4.5.

Podkowka *et al.* (2011) reported that dry matter was the lowest (20.88%) in sorghum silage and the highest (37.45%) in maize silage. In sorghum silage, the concentration of crude ash and crude fibre was higher, and crude protein, crude fat and N-free extractives lower compared to maize silage. Neutral detergent fibre and acid detergent fibre were the highest in sorghum silage and the lowest in maize silage. pH of good quality silage was ranged from 4.20 to 4.31.

Khan *et al.* (2011) reported that the DM, NDF, ADF, acid detergent lignin and water soluble carbohydrate contents of maize, sorghum and millet silages were increased ( $P<0.05$ ) and CP, TDN, ME, pH and ammonia nitrogen contents were decreased ( $P<0.05$ ) as the age of the crop increased.

Machado *et al.* (2012) evaluated three sorghum hybrids (BRS 610, BR-700 and BRS 655) harvested at three maturation stages. The dry matter values varied from 22.9% to 41.3% and BR 700 had higher percentage of dry matter than the other hybrids in all ages. The content of CP and fibrous fractions, NDF and ADF presented different behavior between the maturation stages and between hybrids. The lignin values were not modified with the advancement of the cut age. According to the pH, ammonia, nitrogen, organic acids and dry matter values, the silages of the three hybrids were classified as good fermentation quality at all harvest periods.

Assis *et al* (2014) investigated the effect of bacterial inoculants at two inoculation rates on chemical and biological characteristics of maize silage. Samples were taken for the determination of the contents of dry matter, crude protein, neutral detergent fibre, water-soluble carbohydrates, organic acids and alcohols, for the evaluation of the populations of lactic acid bacteria, yeasts, filamentous fungi, and for the determination of pH values during ensilage and after 30 or 90 days of fermentation. The treatments influenced LAB populations and filamentous fungi, but no effect was observed on the yeast population.

Orrico Junior *et al.* (2015) tested the four cultivars of saccharine sorghum (*Sorghum bicolor*) regarding productivity, chemical composition and quality of ensiling process. The tested varieties, BRS 509 and BRS 511 showed the highest total dry matter (DM) production and the BRS 508 variety presented the highest *in vitro* digestibility of the whole plant (70.65% DM). During ensiling, the BRS 509 variety showed the lowest DM loss (8.87%). The highest effluent production was observed for BRS 506 and BRS 508, with yields of 521.87 and 393.16 kg/mg ensiled DM, respectively. The BRS 511 variety was the most recommended because of the best results for plant production and nutritional quality. Regarding the ensiling process, BRS 509 presents the lowest

fermentation losses and highest nutritional value of silage.

Zhang *et al.* (2015) reported that combining sweet sorghum (SS) with alfalfa (AF) for ensiling has the potential to improve the nutritive value and fermentation characteristics of resultant silages. They concluded that as the proportion of SS increased in silage, the content of ash, crude protein, saponins, ammonia, acetic acid, propionic acid and pH decreased, while neutral detergent fibre, acid detergent fibre in organic matter, acid detergent lignin, water soluble carbohydrates, starch, total phenolics and condensed tannins contents were increased.

Rafiuddin *et al.* (2016) reported colour, smell, consistency and sensory scores for maize silages was 3.70, 5.27, 3.90 and 12.87 and for Sorghum silage was 3.36, 4.91, 3.88 and 12.15, respectively. They further observed that maturity had non-significant ( $P>0.05$ ) effect on color of the silages cereals. However, the score for smell and structure positively increased with the increase in maturity for maize, sorghum and oat silages from early bloom to full bloom ( $P>0.05$ )

Zhang Su-jiang *et al.* (2016) studied the chemical composition, mineral profile and *in vitro* fermentation characteristics of maize (MZ), high sugar forage sorghum (HS) and forage sorghum (FS) fodders and silages were measured. The maize (MZ) and maize silage (MZS) had higher crude protein, starch and ether extract contents than both sorghum forages and sorghum silages. High sugar forage sorghum (HS) had higher ash and water soluble carbohydrates concentrations than forage sorghum (FS) and maize (MZ). MZ, MZS, HS, HS silage (HSS) had lower neutral detergent fibre, acid detergent fibre and acid detergent lignin than FS and FS silages (FSS). FSS had higher dry matter (DM) and pH than MZS and HSS. HSS contained higher concentrations of P and K than FSS and MZS. MZS and HSS had higher *in vitro* dry matter and organic matter digestibility, CH<sub>4</sub> production, total volatile fatty acids, acetate and propionate than FSS.

The pH was higher for FSS than for HSS, and ammonia was lower for HSS than for MZS and FSS. HSS had higher gas production than MZS and FSS than for HSS, and ammonia was lower for HSS than for MZS and FSS. They concluded that HS may substitute for MZ to make a good quality silage.

Behling Neto *et al* (2017) estimated the composition and *in vitro* digestibility of different sorghum cultivar silages, at two cropping seasons. The silage of forage sorghum cultivar BRS 655 has higher content of non-fibre carbohydrate and lower level of potentially digestible fibre, at both crop period, with high nutritional value. Therefore, forage sorghum cultivar BRS 655 is the most recommended cultivar for silage production. The silages of sweet sorghum have higher *in vitro* digestibility of dry matter and revealed good quality for ruminant nutrition. However, these cultivars have greater potential if utilized at the second crop and higher *in vitro* dry matter digestibility than the other cultivars. The silages of sweet sorghum cultivars BRS 506 and forage sorghum cultivars BRS 655 presented higher nutritional values.

Parminder Singh *et al.* (2017) carried out comparative study for qualitative assessment of silage prepared from maize varieties alone (P-1844 and PAC-746) and combination of maize varieties (PAC-746 and 31Y45) with sugargraze. The silages prepared from maize hybrid P-1844 (S1 and S2) harvested around 70 days after sowing (DAS) with ensiling period of 43 and 63 days, respectively recorded moisture content of 72.6 and 68.3%, DM content of 27.4 and 31.8% and CP content of 7.9 and 7.5%, respectively. The NDF content in silages S1 and S2 were 45.3 and 43.4%, whereas ADF content values were 32.9 and 28.9%, respectively. The lowest ( $P < 0.05$ ) value of  $\text{NH}_3$ -N (2%) was recorded for silage prepared from P-1844, while the highest (3.3%) total N was recorded in silage from maize hybrid PAC-746. Silage prepared from var. P-1844 (S1 and S2) recorded all the quality parameters in ideal range whereas other silage samples

showed values beyond desirable limits. They concluded that different silages possessed pH in range of 3.8 to 4.0 and buffering capacity values between 3.9-4.2 meq. /g. silage.

Ramya *et al.* (2017) reported chemical composition of hybrid napier and multi-cut sorghum fodder at different stages of cutting. The Proximate analysis (dry matter basis) showed that crude protein content was more in Coimbatore Cumbu Napier-4 {CO(CN)4 (16.88, 17.08, 13.35%) followed by Coimbatore Cumbu Napier-5 CO(BN)5, whereas crude fibre was more in Coimbatore fodder sorghum COFS29 (26.59, 33.33, 37.38%) at 45 , 60 and 75 day of cutting.

Bhagat *et al.* (2017) reported that among the sole varieties of maize significantly higher green biomass yield, dry biomass yield was recorded with African tall followed by Sole J-1006 whereas among intercropping treatments significantly the highest fodder maize green biomass and yield, was recorded with African tall intercropped with cowpea in 2:1 row ratio. Therefore, African tall variety of fodder maize as sole and African tall variety of fodder maize intercropped with cowpea in 2:1 row ratio was found best for increasing yield potential and economics of fodder maize in different intercropping systems.

Da Silva *et al.* (2019) reported that *Lactobacillus buchneri* produces acetic acid slowly and improved aerobic stability in the ensiling process. They concluded that the selected strains affect the pH, lactic acid bacteria population and concentrations of acetic and propionic acids and ethanol.

Alhaag *et al.* (2019) reported that addition of inoculants significantly reduced ( $P < 0.05$ ) pH, ammonia-N, acetic acid and undesirable microbial population and increased ( $P < 0.05$ ) lactic acid and lactic acid bacteria counting.

Seresinhe *et al.* (2020) reported that sorghum silage had a leafy and soft texture with a fruity smell, which proved its desirable character with normal lactic acid

fermentation. The dry matter content at 6 or 8 weeks cutting interval was high, more suitable for ensiling. The crude protein concentration was not modified by the ensiling process, which was proved by the low ammonical nitrogen content. They concluded that Sorghum silage could be considered as the best among the tested silages as compared with Hybrid Napier var. CO-3 and CO-4. The optimum quality of the sorghum silage with highest soluble carbohydrates concentration and lactic acid >3% could be obtained at 6-week cutting interval.

Rodrigues *et al.* (2020) studied the nutritional contents and end products of sorghum silage fermentation as related to the dry-matter composition of fresh plants before ensiling. The water-soluble carbohydrates and hemicellulose not only increased the nutritional value of sorghum forage and sorghum, but also helped to avoid quality decreases during the ensiling fermentation process. They found that 125.4 g/kg DM of water soluble carbohydrates in fresh plant was required for a satisfactory silage pH level and lactic acid content.

Liangco *et al.* (2020) reported that Super Napier grass silage treated with *Lactobacillus buchneri* and *Lactobacillus plantarum* had a higher levels of crude protein, crude fibre, crude fat, ash and nutrient detergent fibre compared to the untreated silage. The dry matter fraction of the SNG treated silages was increased in contrast to untreated.

Bonaldi *et al.* (2021) studied the effects of *Bacillus subtilis* and its enzyme b-glucosidase on the nutritional value and aerobic stability of corn silage after 30 and 60 days of storage. The cellulolytic micro-organisms are potent silage inoculants that decrease the fibrous content and increase the fibre digestibility and nutritional value of silage. No differences were observed in the levels of dry matter, crude protein and neutral detergent fibre due to the different treatments or storage times of the silos.

Sabertanha *et al.* (2021) estimated chemical analysis, total-tract nutrient digestibility, ruminal variables and blood biochemistry metabolites sorghum (ES) from two varieties (first and second cuts) with corn silage (CS) in sheep. Compared to sorghum, CS had lower ( $P < 0.01$ ) concentrations of ash, WSC and CP, but higher starch, lignin (sa), non-structural carbohydrates and apparent nutrient digestibility. The measurements of pH, lactic acid,  $\text{NH}_3\text{-N}$  and volatile fatty acids (VFA) confirmed that all silages were well-preserved. No differences were observed in feed consumption ( $P > 0.05$ ) and total-tract digestibility of DM and nutrients ( $P > 0.05$ ). Rumen pH,  $\text{NH}_3\text{-N}$ , VFA concentrations and acetate to propionate ratio showed no difference among treatments ( $P > 0.05$ ). Sheep fed on sorghum silage showed a decrease ( $P < 0.01$ ) in total protozoa, particularly in the Entodinae population. There were no differences in cellulolytic bacteria counts ( $P > 0.05$ ) among treatments. Urinary N, MNS and blood biochemistry metabolites showed no difference among treatments ( $P > 0.05$ ). Silages from both cuts of sorghum had comparable total-tract nutrient digestibility to CS, therefore, these varieties could be used as a more drought resilient silage source in the feeding of sheep.

### **2.3. EFFECT OF FEEDING SILAGE BASED TOTAL MIXED RATIONS ON DRY MATTER INTAKE**

Doherty *et al.* (1997) studied the performance of pregnant ewes and their progeny when offered grass silage, maize silage or ensiled super pressed pulp mixture during late pregnancy on 60:40 basis. The silage dry matter (DM) intakes (kg/day) were higher on the maize silage/ensiled super pressed pulp mixture (MS/ESPP) diet ( $P < 0.05$ ) than on the grass silage or maize silage diets. When 40% of the maize silage was replaced with ESPP, both DM and total DM intake were increased relative to the MS treatment.

Nascimento (2008) observed that grain sorghum silage promoted greater DM intake (22.98 kg/day) compared to corn silage (21.95 kg/day), and sweet sorghum silage

(19.43 kg/day). Dry matter intake was greater for corn silage than for sweet sorghum silage.

Khan *et al.* (2011) reported that the lambs fed on diet having 100% maize silage (MS) had had higher nutrient intake than those fed on diet having 100% Sorghum silage and 100% millet silage, respectively.

Borba *et al.*, (2012) studied the intake of silage from five different sorghum cultivars: IPA 1011, IPA 2564 (grain sorghum), IPA 2502 (dual purpose sorghum), IFA FS-25 and IPA 467 (forage sorghum). Treatments IPA 1011, IPA 2564 and IPA2502 had high intake of dry matter, total carbohydrate and total digestible nutrients and low intake of neutral detergent fibre.

Babu *et al.* (2014) reported that the dry matter (DM) intake was  $96.53 \pm 6.94$ ,  $98.62 \pm 5.78$  and  $103.12 \pm 8.36$  g/day, respectively for D1 (Sorghum Stover), D2 (maize Stover) and D3 (Sweet sorghum Stover) diets and values were not differed significantly ( $P > 0.05$ ).

Keles *et al.* (2016) reported that lambs fed the diet containing buckwheat silage had 7.6% higher dry matter (DM) intake ( $P < 0.05$ ) than the lambs fed the diets containing maize silage.

Jalajakshi *et al.* (2017) reported that lambs fed on sole sweet sorghum silage had significantly lower DMI, DCP and TDN intake ( $P < 0.01$ ) than those fed on sweet sorghum silage with supplements like top feeds, compound feed and maize grain at 1% of their body weight.

Rabelo *et al.* (2018) studied the effect of lactic acid bacteria and *Bacillus subtilis* as silage additives on feed intake and growth performance of finishing feedlot cattle. The dry matter (DM) intake, average daily gain, and carcass yield of bulls were unaffected by silage inoculation. Conversely, bulls fed the whole maize forage inoculated with

*B.subtilis* and *L.plantarum* (BSLP) silage had lower DM, organic matter, and crude protein digestibility compared with bulls fed untreated silage. Bulls fed both inoculated silages had a reduction of 12% in neutral detergent fibre and acid detergent fibre digestibility compared with that in bulls fed untreated silage.

#### **2.4. EFFECT OF FEEDING SILAGE BASED TOTAL MIXED RATIONS ON GROWTH AND BODY CONDITION SCORE**

Doherty *et al.* (1997) studied the performance of pregnant ewes and their progeny when offered grass silage, maize silage or ensiled super pressed pulp mixture during late pregnancy on 60:40 basis. Overall, there were only minor differences in performance between grass and maize silages but when 40% of the maize silage was replaced with ESPP, the ewes gained more weight and lost least body condition, total colostrum yield was higher and the lambs had a higher growth rate up to weaning.

Kolver *et al.* (2001) observed that recommended levels of feeding, maize silage provides a low cost source of starch and fibre which complements pasture well for much of the year. Balancing dietary deficiencies in protein, minerals, and in some cases fibre, will optimise milk solids production at high levels of maize silage supplementation.

Nascimento (2008) studied the effect of feeding grain sorghum silage, sweet sorghum silage, and corn silage on milk production, milk composition, and nutrient digestibility of lactation dairy cows. Total milk production (28.81; 24.69 and 24.14 kg/day), 4% fat corrected milk (30.65; 25.63 and 26.10 kg/day), and milk chemical composition was greater for cows fed corn silage when compared to the ones receiving grain sorghum silage and sweet sorghum silage. Cows fed sweet sorghum silage, but showed higher milk fat percentage (4.56%) compared to cows fed corn silage (4.39%) or grain sorghum silage (4.31%). Milk protein concentration was higher for cows fed corn silage (3.25%), intermediate for cows fed sweet sorghum silage (3.05%), and lower for

the ones fed grain sorghum silage (2.97%). Nutrient digestibility coefficients were greater for cows fed sweet sorghum silage compared to other silages.

Sezenler *et al.* (2011) reported the relationship between body weights and body condition score in some indigenous sheep breeds. They concluded that the body condition score is a good indicator of changes in body weights.

Khan *et al.* (2011) reported that the lambs fed on diet having 100% maize silage (MS) had 2.79g/day and 4.45g/day higher N retention than those fed on diet having 100% Sorghum silage and 100% millet silage (MiS), respectively. Similarly, lambs fed on diet having maize silage and concentrate at 50:50 (MSC) had 2.24g/day and 5.12g/day higher N retention than those fed on diets having sorghum silage and concentrate at 50:50 (SSC) and diets having millet silage and concentrate at 50:50 (MiSC) diets, respectively. The result showed that lambs fed MSC gained more daily weight gain and showed better feed conversion ratio than those fed MS, SS, SSC, MiS and MiSC diets and the lambs fed MSC diets had higher digestibility and nitrogen balance and weight gain.

Venkateswarlu *et al.* (2012) studied the effect of feeding maize silage supplemented with concentrate and legume hay on nutrient digestibility in Nellore ram lambs. The digestibilities of nutrients were not affected due to supplementation of concentrate or legume hay with maize silage in growing sheep and hence, maize silage can be supplemented with concentrate at 1.5% body weight and or legume hay to meet 25% of dry matter requirement for optimum lamb production. Keles *et al.* (2018) reported that the live weight gain and feed efficiency were similar for in lambs that were fed either buckwheat silage or the maize silage.

Demirel *et al.* (2013) studied the effect of feeding 3 diets viz. 1) hay grass + barley, 2) triticale/barley silage + barley, and 3) barley/triticale silage with inoculants and enzyme mixture + barley on lambs. Significant ( $P < 0.001$ ) difference among groups in

daily live weight gain was observed. Cold carcass weight and dressing percentage based on empty body weight and carcass conformation scores were not significantly different among groups, but fatness scores and proportion of omental and mesenteric fat were significantly affected by diet ( $P < 0.05$ ). It can be concluded that barley/triticale silage offered with concentrate had no unfavorable effect on lamb performance, carcass characteristics, meat quality.

Van de vyver *et al.* (2013) conducted an experiment in Merino lambs to find out the suitability of incorporation of silage in the lamb diets. The diets in the experiment consisted of a control with no silage and three diets containing on a dry matter (DM) basis 20%, 50% or 70% maize silage. All the diets were formulated on isonutrient level except the NDF and ADF. The dry matter intake decreased as the silage inclusion increased. This resulted there was a significant difference between the cumulative intake of the low and high silage diets. The 20% and 50% silage diets resulted in higher dressing percentage than the control and 70% silage diet. They concluded that silage can be successfully incorporated into sheep diets and optimum inclusion levels need to be quantified within high specification feedlot diets.

Babu *et al.* (2014) reported that the digestible crude protein (DCP), total digestible nutrients (TDN), digestible energy (DE) and metabolizable energy (ME) values of D1(Sorghum stover), D2 (maize stover) and D3 (Sweet sorghum stover) based complete diets were differ significantly ( $P > 0.05$ ) by type of stover present in the complete diets. The DCP (g/day) intake of D3 fed lambs was significantly ( $P < 0.05$ ) higher than those fed D1 and D2 diet. The TDN intake (g/day) was significantly ( $P < 0.05$ ) higher in lambs fed D3 diet and the lambs consumed more DM in all groups than requirements stipulated by ICAR (1998).

Zhang *et al.* (2015) reported that combining sweet sorghum (SS) with alfalfa (AF) for ensiling has improved the nutritive value and fermentation characteristics of resultant silages. The *in vitro* rumen degradability of dry matter and organic matter as well as gas production, pH, ammonia, total volatile fatty acids and methane decreased as the proportion of SS increased in the silage mixtures. This study suggests that high quality silages can be made with SS:AF ratios of 20:80 and 40:60. These silage mixtures offer an opportunity to optimize the nutrient supply for ruminant production.

Jalajakshi *et al.* (2017) reported that feeding of sweet sorghum silage with supplements like top feeds, compound feed and maize grain at 1% of their body weight improved performance, nutrient digestibility and met energy/protein requirements in growing lambs and they concluded that supplementation of SS silage with ground maize at 1% of their live weight is considered to be economical for rearing of growing ram lambs.

Rabelo *et al.* (2018) studied the effect of lactic acid bacteria and *bacillus subtilis* as silage additives on feed intake and growth performance of finishing feedlot beef cattle. They concluded that adding *L.plantarum* combined with *L.buchneri* or *B.subtilis* to maize silage do not improve the growth performance of finishing feedlot beef cattle.

Keady *et al.* (2020) reported that increasing grass and maize silage feed value increased food intake ( $P < 0.001$ ) during late pregnancy, ewe body weight and body condition score (BCS) at lambing ( $P < 0.001$ ), lamb body weight at birth ( $P < 0.001$ ) and weaning ( $P < 0.05$ ), and reduced age at slaughter ( $P = 0.06$ ). Increasing concentrate feed level increased metabolizable energy ( $P < 0.01$ ) intake during late pregnancy but had no effect ( $P > 0.05$ ) on ewe or lamb performance. Increasing maize dry matter at harvest and offering soybean meal with maize silage increased food intake ( $P < 0.001$ ) and ewe body weight and BCS at lambing ( $P < 0.05$  or  $P < 0.01$ ). Offering soybean meal with maize silage

increased lamb body weight at birth ( $P < 0.01$ ) and reduced age at slaughter ( $P < 0.05$ ). Replacing grass silage with maize silage did not affect ( $P > 0.05$ ) body weight gain of lambs. They concluded that increasing the feed value of the grass silage offered during pregnancy has the greatest positive impact on ewe and lamb performance.

Liangco *et al.* (2020) observed that SNG silage treated with *Lactobacillus buchneri* and *Lactobacillus plantarum* (T2 and T3) influenced sheep growth rate performance, weight gain, feed intake and days to market. They concluded that addition of beneficial microbes improve the nutritional quality of silage and increased nutrients level resulting to higher growth of sheep.

Geberemariam *et al.* (2021) reported that the growth performance of calves fed the dual purpose green maize stover silage based total mixed ration diet was superior than calves fed natural pasture hay and concentrate mixture following the conventional feeding practice.

## **2.5 EFFECT OF FEEDING SILAGE BASED TOTAL MIXED RATIONS ON FEED CONVERSION RATIO**

Fazaeli *et al.* (2006) compare the performance of sorghum silage with maize silage in feedlot cattle. They substituted the maize silage with sorghum silage in the amount of 0, 33, 66 and 100% of the diets I,II,III and IV, respectively. The ADG was 1037,1068,1010,1157g for the diet and average DMI was 7.50,7.56,7.74 and 8.06kg and feed conversion ratio was 7.23,7.07,7.66 and 6.59, respectively for the diets I,II,III and IV which were not significantly different. They concluded that the feeding performance of the sorghum silage was similar to the maize silage.

Sohail *et al.* (2010) in Sipli lambs reported higher feed efficiency in Maize silage based diets.

## **2.6 EFFECT OF FEEDING SILAGE BASED TOTAL MIXED RATIONS ON HAEMATOLOGICAL PROFILES**

Mahanta. *et al.* (2004) studied the nutritional evaluation of two promising varieties of forage sorghum silage in sheep. They concluded that varieties of sorghum silage did not have any influence on the concentration of the blood metabolites.

Mako *et al.* (2021) reported that feeding of ewes fed with different combinations of guinea grass ensiled with *Alternanthera brasiliana* based diets up to 90% inclusion levels promote body mass growth with no harmful effects on blood parameters

## **2.7 COST OF FODDER FOR SILAGE PRODUCTION**

Wadhwa *et al.* (2010) compared the yield and nutritive value of non-leguminous forages as livestock feed. They found that the cost of cultivation was lowest for bajra, followed by that for maize, which was almost comparable to that of sorghum. In view of lowest yield/acre (harvested at 55, 75 and 45days), cost of production was higher (Rs 35/q) for maize than for sorghum (Rs 26/q) and bajra (Rs 21/q). In spite of higher market rate of maize (Rs 85/q) than sorghum (Rs 75/q) and bajra (Rs 70/q), the net return was considerably higher in sorghum (Rs 11757/acre) than bajra (Rs 11255/acre) and maize (Rs 8535/acre).

Kumar *et al.* (2015) reported the economic analysis of sorghum fodder production. The total working capital was Rs. 14907.03 per hectare and total variable cost is Rs. 15354.24 which is 67.53 per cent of total cost. The average total cost is found as Rs. 22738.20 per hectare. On per hectare basis the average fodder production was 523.89 quintals. The average rate of green fodder is taken as 100 per quintal. The net return is 29650.68 per hectare. The average benefit cost ratio at farm only is found as 2.31.

Ramya *et al.* (2017) found that cost of production per kg of green fodder was higher in COFS29 (Rs. 0.50/kg) followed by CO (CN) 4 (Rs. 0.49/kg) and CO (BN) 5 (Rs. 0.40/kg).

Bhagat *et al.* (2017) reported that among the sole varieties of maize significantly higher net returns and B: C ratio was recorded with African tall followed by Sole J-1006 whereas among intercropping treatments significantly the highest net returns and b: c ratio was recorded with African tall intercropped with cowpea in 2:1 row ratio. Therefore, African tall variety of fodder maize as sole and African tall variety of fodder maize intercropped with cowpea in 2:1 row ratio was found best in different intercropping systems.

Patara *et al.* (2019) reported that the average per hectare cost of cultivation of fodder maize was estimated Rs. 42883.44. The average production of 280.49 quintal per hectare of main produce was obtained from maize fodder. The gross returns obtained Rs. 47701.44 at the overall level with B: C ratio was 1.11.

Brar *et al.* (2021) reported that fodder yield, factor productivity, net return and economic productivity were recorded higher for maize hybrid PMH10 which was found at par with hybrid DKC9108 and significantly better ( $P < 0.05$ ) fermentation characteristics, nutritive value and feed values in comparison to silage of composite J1006.

# *Chapter - III*

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*Materials and Methods*

## CHAPTER III

### MATERIALS AND METHODS

The materials and methods used to study the physicochemical properties of Maize, Super Napier and Sorghum silages and comparative efficacy of Maize, Super Napier and Sorghum silage based total mixed rations (TMR) on hematological profiles, body condition score, growth performance and cost per kg weight gain in Nellore lambs under intensive production system is presented in this chapter.

#### 3.1 LOCATION OF THE STUDY AREA

The present research work was conducted at the sheep unit of Livestock Farm Complex (LFC), NTR College of Veterinary Science, Gannavaram, Krishna District in Andhra Pradesh.

#### 3.2 EXPERIMENTAL DESIGN

A total of 18 weaned lambs of about 3 months age were selected randomly from the sheep unit of LFC and divided into three groups of 6 animals each in a completely randomized design on the basis of body weight. Care was taken that the mean body weight of all the groups was as uniform as possible.

**Table 1: Details of the experimental lambs**

T1		T2		T3	
Animal No	Body weight (kg)	Animal No	Body weight (kg)	Animal No	Body weight (kg)
R-36	12	R-71	10	R-73	10
R-51	10	R-72	11	R-70	12
R-66	11	R-69	12	R-35	13
E-49	12	E-60	10	E-75	10
E-68	13	E-57	12	E-50	11
E-67	14	E-74	13	E-54	12
<b>Mean body weight (kg)</b>	<b>12 ± 0.57</b>	<b>Mean body weight(kg)</b>	<b>11.33 ± 0.49</b>	<b>Mean body weight (kg)</b>	<b>11.33 ± 0.49</b>



**Fig 1. Experimental Lambs of T1 group for Maize silage based TMR feeding**



**Fig 2. Experimental Lambs of T2 group for Super Napier silage based TMR feeding**



**Fig 3. Experimental Lambs of T3 group for Sorghum silage based TMR feeding**

### **3.3 EXPERIMENTAL RATIONS**

#### **3.3.1 Preparation of silage**

The fodder crops of Maize, Super Napier and Sorghum available at fodder production unit of LFC, NTR CVSc, Gannavaram was used for silage preparation. Maize and Sorghum were harvested at milk stage (about 85 days) and Super Napier was harvested at 50 days interval at the height of 2.5 meters. After harvesting, the crops were allowed in the field for 5 hours to reduce the moisture content to about 65%. Each fodder variety was brought to the silage production unit of LFC and chopped into pieces of  $\frac{1}{2}$  to  $\frac{3}{4}$  inches. Only common salt was added to it at the rate of 1% as preservative. The chopped material was loaded into silage bale making machine (MSB 500) and silage bales of 50 kg weight was produced. About 60 bales for each fodder variety was prepared and stored. After 45 days, the bales were used for feeding the lambs

#### **3.3.2 Preparation of concentrate feed:**

The concentrate feed was prepared at the feed mixing plant of Animal Nutrition department located at LFC, NTR college of veterinary science, Gannavaram. The chemical composition of concentrate feed was analysed in the Department of Animal Nutrition, NTR college of veterinary science, Gannavaram. The ingredient and chemical composition of concentrate feed were presented in table 2 and 3 respectively.

**Table 2 : Ingredient composition of concentrate feed**

1	Maize	35
2	Deoiled Rice bran	31
3	Gingly cake	11
4	Soyabean meal	20
5	Mineral mixture	2.0
6	Salt	1.0
Cost of the ration (₹) Per Kg		23

**3.3.3 Chemical composition of the concentrate feed****Table 3. Chemical composition of concentrate mixture (on %DM basis)**

S.No	Nutrient	Concentrate mixture
1	Dry Matter	91.58
2	Organic matter	88.59
3	Crude Protein	21.05
4	Ether Extract	4.33
5	Crude Fibre	10.19
6	Nitrogen Free Extract	51.09
7	Total Ash	11.41
8	Acid Insoluble Ash	1.85



**Fig 4. Chopping of Super Napier fodder for silage bale preparation.**



**Fig 5. Addition of salt to the chopped fodder for silage bale preparation**



**Fig 6. Silage bales making by using Silage bale making Machine MSB(500)**



**Fig 7. Storage of silage bales for 45 days before feeding to experimental lambs**

### **3.3.4 Preparation of TMR**

The TMR was prepared by mixing the silage and concentrate approximately at 90: 10 ratio as per the nutrient requirements (NRC requirements 2016) of the lambs in three different groups i.e. T1 (Maize silage based TMR), T2 (Super Napier silage based TMR), T3 (Sorghum silage based TMR).

## **3.4. MANAGEMENT OF EXPERIMENTAL ANIMALS**

### **3.4.1 Housing management and identification**

All experimental lambs of three groups were housed separately in a well ventilated shed having the provision of individual feeding and watering. All the lambs were identified by ear tagging for proper recording of experimental data. The lambs were allowed 10 days of acclimatization prior to experimental feeding. All the experimental lambs were treated with broad-spectrum anthelmintic (Albomar suspension @ 10mg/kg body weight) before the start of study. The lambs did not show any symptoms of clinical ailment or external injury and were looked quite healthy during whole experimental period.

### **3.4.2 Feeding management**

The experimental lambs in T1, T2 and T3 groups were assigned with experimental rations i.e., Maize, Super Napier and Sorghum silage based TMR respectively. All the experimental animals were offered with TMR diets to meet their nutrient requirements for maintenance and growth as per NRC requirements (2016) for a period of three months. The different experimental rations to the respective groups were offered daily two times in the morning at 9.00AM and in the evening at 3.00PM. The ration schedule was changed every fortnight after recording the body weights of each animal to meet the nutrient requirements for growth (Kearl, 1982). The quantity of TMR offered and leftover was recorded daily in the morning. Fresh clean drinking water was offered free of choice.



**Fig 8. Preparation of Silage based TMR**



**Fig 9. Mixing of Silage with concentrate to form a uniform silage based TMR**



**Fig 10. Offering Silage based TMR to experimental lambs**



**Fig 11. Weighing of experimental animals at fortnight interval using spring balance**

### **3.5 SAMPLE ANALYSIS**

Three different silages i.e. Maize, Super Napier, Sorghum were analyzed for physical and chemical properties in triplicate for colour, smell, consistency, pH and proximate constituents viz., dry matter, crude protein, ether extract, total ash, crude fibre and nitrogen free extracts as per the methods by AOAC (2007). The laboratory analysis for chemical composition was carried out at the Department of Animal Nutrition, NTR college of veterinary Science, Gannavaram.

#### **3.5.1 Estimation of physical properties of silages**

The physical properties of silages were determined by colour, smell, and structure described by Kilic (1986). For colour evaluation the scale 1 to 4 was used on the basis of change in green color from dark brown, dark green to pale yellow. For smell the scale 1 to 7 was used on the basis of repugnant putrid smell to acidic sweet pleasant smell. For structure the scale 1 to 4 was used on the basis of softness of leaves and stem as well as its ability to remain intact after squeezing the silage tightly in hand and then opening from breaking into small pieces to break into two or three pieces. The same person scored the silages for smell, colour and structure to avoid any bias. The overall silage quality was classified into categories as poor, medium, good and very good on the basis of cumulative score obtained from color, smell and structure.

#### **3.5.2 Determination of P<sup>H</sup>**

About 25g sample was randomly taken from Maize, Sorghum and Sorghum silage bales immediately after opening. The sample silage was mixed with 100 ml of distilled water. After hydration for 10 min using blender, the diluted material was then filtered through cheese cloth and then pH was determined by using a digital pH meter (Hart and Horn., 1987).



**Fig 12. Colour of Maize silage**



**Fig 13. Colour of Super Napier silage**



**Fig 14. Colour of Sorghum silage**



**Fig 15. Consistency examination of maize silage**



**Fig 16. Consistency examination of Super Napier silage**



**Fig 17. Consistency examination of Sorghum silage**

### 3.5.3 Estimation of chemical composition

#### 3.5.3.1 Dry matter (DM)

A known quantity of ground samples were taken in pre-weighed moisture cups, and these cups were placed in a hot air oven at  $80 \pm 2^\circ\text{C}$  for 24 hours. The loss in moisture content after drying was estimated and dry matter was calculated as follows. The difference between the fresh and dry weight will be used for calculation of moisture content of the sample. The dry matter percentage was calculated by using following formula:

$$\text{Dry Matter DM (\%)} = \frac{\text{Dry Weight of sample}}{\text{Fresh Weight of sample}} \times 100$$

The air dried foliage samples were oven dried at  $100^\circ\text{C}$  for 24 h for chemical analysis.

#### 3.5.3.2 Organic matter (OM)

It was determined by subtracting the total ash content from 100.

$$\text{OM (\%)} = 100 - \text{Total ash}$$

#### 3.5.3.3 Crude protein (CP)

Crude protein was estimated as per Kjeldahl's method. A known quantity of ground sample was taken in Kjeldahl flask and digested with concentrated  $\text{H}_2\text{SO}_4$  and 2-3 g of digestion mixture ( $\text{K}_2\text{SO}_4$  and  $\text{CuSO}_4$  in the ratio of 9:1) till the solution turns colour less. After digestion, the contents were cooled, transferred to volumetric flask after repeated washings and volume was made to 250 ml. Ten ml of aliquot was transferred into a micro-distillation apparatus and sufficient amount (about 20 ml) of 40 percent NaOH was added to make the content alkaline. About 50 ml of distillate was collected into a conical flask containing 15 ml of 2 percent boric acid solution having Tashiro's indicator (0.1% methyl red and 0.1% bromocresol green in the ratio of 2:1 in absolute alcohol). The distillate was

then titrated against standard sulphuric acid solution (N/100).

$$\text{Percent nitrogen} = \frac{0.014 \times \text{Titter vol.} \times \text{Normality} \times \text{Vol. made}}{\text{Aliquot taken} \times \text{Sample taken (g)}} \times 100$$

The crude protein of sample was calculated by multiplying the N content with factor 6.25

#### **3.5.3.4 Ether extract (EE)**

A known quantity (1-2 g) of ground sample was taken in Whatman's thimble and extracted for 8 h with petroleum ether (BP: 40-60°C) in Soxhlet extraction apparatus having a pre-weighed oil flask. The oil flask was removed after evaporating the excess of ether and dried in oven for overnight. Again, these flasks were cooled in a desiccator and their weights were taken. The difference in two weights gave the amount of ether extract in the sample.

$$\text{Percent ether extract} = \frac{\text{Weight of ether extract}}{\text{Weight of sample}} \times 100$$

#### **3.5.3.5 Total ash (TA)**

A known quantity of sample was taken in pre-weighed silica crucible. After charring the sample till the smoke disappears, the crucibles were kept in muffle furnace for ignition at 550°C for 2-3 hrs. The ash content was calculated as:

$$\text{Percent Total ash} = \frac{\text{Weight of ash}}{\text{Weight of sample}} \times 100$$

### **3.5.3.6 Acid insoluble ash (AIA)**

The dried ash was digested with 5N HCl for 20-30 minutes. Thereafter, it was filtered through whatman filter paper No. 1 and repeatedly washed with hot distilled water. The filter paper with residue was removed, folded, put in crucible, dried in oven and ignited in the muffle furnace at 600°C for 30 minutes. After this, it was cooled in desiccator and weighed. The residue left in crucible after ignition was considered as acid insoluble ash.

### **3.5.3.7 Nitrogen-free extract**

Nitrogen-free extract (NFE) was determined on dry matter basis was calculated by subtracting the sum of CP, EE, CF and ash from sample weight on dry matter basis.

$$\% \text{ NFE} = 100 - (\% \text{ CP} + \% \text{ CF} + \% \text{ EE} + \% \text{ Ash})$$

### **3.5.3.8. Estimation of crude fibre**

Crude fibre (CF) percentage was determined as per the procedure recommended by BIS, IS: 7874(Part)-1975. After determining ether, the oven dried sample was ground 10 g of sample was transferred into a flask and boiled with 1.25% sulphuric acid 1.25% sodium hydroxide for half an hour. Then left residue was dried, weighted and ignited. Loss in weight was taken as fibre contents of the sample.

## **3.6. METHODOLOGY OF THE PARAMETERS STUDIED**

### **3.6.1. Feed intake**

Feed intake (Kg) was obtained at every 24hours by subtracting the quantity of feed left from the quantity of feed offered.

### **3.6.2. Body weight gain**

Body weights (Kg) of the lambs were recorded before the beginning of the experiment and at every fortnight intervals until the end of the experiment using an electronic weighing scale. The body weight gain (Kg) was obtained by subtracting initial

body weight from the final body weight of the experimental lambs.

$$\text{Absolute rate of growth} = (W_2 - W_1 / T_2 - T_1)$$

Where,

$W_2$  = Final body weight,

$W_1$  = Initial body weight, and

$T_2 - T_1$  = the time interval in days.

The feed conversion ratio (kg DM intake/ kg live weight gain) was calculated for all the four groups.

### **3.6.3. Average daily gain**

The average daily gain (ADG) (g/day) was calculated at fortnightly intervals during the experimental period wherein ADG was obtained by subtracting initial body weight from the final body weight and dividing it by number of days.

### **3.6.4. Feed conversion ratio**

The feed conversion ratio was calculated by dividing the total DM intake (Kg) by the body weight gain (Kg) of the experimental animals.

### **3.6.5. Cost per kg weight gain**

The cost per kg weight gain was calculated by dividing the total cost of feeding for the entire experiment in each group by the body weight gain during the same period. The price of the ingredients used in the experiment was obtained from the local market.

## **3.7 HAEMATOLOGICAL STUDIES**

### **3.7.1. Collection of blood**

Blood samples were collected for hematological studies before offering feed and water from the experimental lambs at monthly intervals of the experimental period (3 months). The blood was drawn from the jugular vein with all aseptic precautions, using

a 20 gauge needle, to avoid disruption of erythrocytes, damage of leucocytes and to allow flow of blood smoothly with a minimum vacuum.

### **3.7.2 Analysis of blood sample**

Various hematological parameters viz., White blood cell (WBC) count, Red Blood Cell (RBC) count, hemoglobin, Packed Cell Volume (PCV), Mean Corpuscular Hemoglobin (MCH), Mean Corpuscular Hemoglobin Concentration (MCHC) were determined as per standard methods at Department of Veterinary Pharmacology and Toxicology, NTR College of Veterinary Science, Gannavaram.

For hematological examination, disodium salt of ethylene – di amine- tetra acetic acid (EDTA) was used as an anticoagulant at the rate of 1mg per ml of blood. The whole blood was collected in sterilized test tubes containing adequate amount of anticoagulant, hematological studies viz., RBC count, Hemoglobin, PCV, MCV and MCHC were performed soon after collection of blood with the help of auto hematology analyzer (Mindray, Model No. BC- 2800 Vet).

### **3.8 BODY CONDITION SCORE**

Body condition scoring is a subjective way of measuring the level of muscle and body fat carried on sheep. A BCS scale of 1 to 5 developed by Maurya *et al.* (2010) was used to score the lambs. This method considers the muscle over skeleton and hollow in the flanks below the loin for assessing the fat cover. A score of '1' considered as emaciated condition and a score of '5' considered as obese condition.

Scoring was done by using the hand to feel for the fullness of musculing and fat cover over and around the vertebrae in the loin region. The following skeletal check points were observed by palpation.



**Fig 18. Blood Collection from jugular vein in Nellore lamb**



**Fig 19. Analysis of haematological parameters using Haemoanalyser**



**Fig 20. Estimation of Body Condition score in Nellore lambs**

The spinous processes in the centre of the sheep's back behind the last rib and in front of its hip bone.

1. The tips of the transverse processes.
2. The fullness of muscle and fat cover between spinous and transverse processes.
3. Hollow in the flanks below the loin.

After each check point was observed by palpation the scores were recorded and an average BCS was assigned to the ewe.

### **3.9 COST ECONOMICS**

Comparative economics was calculated at the end of 90 days experimental period. The cost of silage production was calculated based on the cultivation cost of fodder, harvesting and production cost of silage bales at Livestock Farm Complex (LFC), NTR College of Veterinary Science, Gannavaram, Krishna District, Andhra Pradesh. The cost of concentrate feed was calculated based on the cost of ingredients supplied to the feed mixing plant. The total feed cost per lamb during the experimental period was calculated and feed cost per kg live body weight gain was worked out.

### **3.10 STATISTICAL ANALYSIS**

The data obtained with regard to parameters under study was tabulated and this data was statistically analyzed as per Snedecor and Cochran (1989) for interpretation of the results. Analysis of variance was used to test the significance of variance and the treatment means were tested for significance by Turkey's HSD (Honestly Significance Difference) test.

# *Chapter - IV*

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*Results*

## **CHAPTER-IV**

### **RESULTS**

The results on physicochemical properties of Maize, Super Napier and Sorghum silages and comparative efficacy of maize, Super Napier and Sorghum silage based total mixed rations (TMR) on haematological profiles, body condition score, growth performance and cost per kg weight gain in Nellore lambs under intensive production system were tabulated, statistically analyzed and presented in this chapter.

#### **4.1 CHEMICAL COMPOSITION OF EXPERIMENTAL DIETS**

The chemical composition of Maize, Super Napier and Sorghum silages were presented in Table 4. The mean dry matter (DM), organic matter (OM), crude protein (CP), ether extract (EE), crude fibre (CF), nitrogen free extract (NFE), total ash (TA), acid insoluble ash (AIA), calcium (Ca), Phosphorus (P), neutral detergent fibre (NDF), acid detergent fibre (ADF) content of Maize silage was  $31.76\pm 0.58$ ,  $88.16\pm 0.60$ ,  $8.43\pm 0.10$ ,  $1.59\pm 0.02$ ,  $30.70\pm 0.88$ ,  $44.92\pm 0.64$ ,  $11.00\pm 0.01$ ,  $2.56\pm 0.13$ ,  $0.26\pm 0.01$ ,  $0.13\pm 0.04$ ,  $58.08\pm 0.34$  and  $36.96\pm 0.23$ , respectively. The similar values for Super Napier silage was  $31.14\pm 1.11$ ,  $89.28\pm 0.66$ ,  $8.68\pm 0.09$ ,  $1.61\pm 0.04$ ,  $37.81\pm 0.30$ ,  $43.73\pm 0.58$ ,  $10.05\pm 0.01$ ,  $4.21\pm 0.35$ ,  $0.57\pm 0.35$ ,  $0.09\pm 0.01$ ,  $75.8\pm 0.54$  and  $52.10\pm 0.47$  respectively; and for Sorghum silage was  $31.76\pm 0.41$ ,  $87.92\pm 0.13$ ,  $8.64\pm 0.06$ ,  $2.36\pm 0.12$ ,  $35.21\pm 0.44$ ,  $36.49\pm 0.90$ ,  $11.93\pm 0.01$ ,  $4.35\pm 0.83$ ,  $0.40\pm 0.018$ ,  $0.09\pm 0.01$ ,  $69.9\pm 0.60$  and  $51.31\pm 0.43$ , respectively.

**Table 4. Chemical composition of Maize, Super Napier silages,  
Sorghum silages (on %DM basis)**

S.No	Nutrient	Maize silage	Super Napier silage	Sorghum silage
1	Dry Matter	31.76±0.58	31.14±1.11	31.76±0.41
2	Organic matter	88.16±0.60	89.28±0.66	87.92±0.13
3	Crude Protein	8.43±0.10	8.68±0.09	8.64±0.06
4	Ether Extract	1.59±0.02 <sup>b</sup>	1.61±0.04 <sup>b</sup>	2.36±0.12 <sup>a</sup>
5	Crude Fibre	30.70±0.88 <sup>c</sup>	37.81±0.30 <sup>a</sup>	35.21±0.44 <sup>b</sup>
6	Nitrogen Free Extract	44.92±0.64 <sup>a</sup>	43.73±0.58 <sup>a</sup>	36.49±0.90 <sup>b</sup>
7	Total Ash	11.00±0.01	10.05±0.01	11.93±0.01
8	Acid Insoluble Ash	2.56±0.13 <sup>b</sup>	4.21±0.35 <sup>a</sup>	4.35±0.83 <sup>a</sup>
9	Ca (%)	0.26±0.01 <sup>c</sup>	0.57±0.35 <sup>a</sup>	0.40±0.02 <sup>b</sup>
10	P (%)	0.13±0.04 <sup>a</sup>	0.09±0.01 <sup>b</sup>	0.09±0.01 <sup>b</sup>
11	NDF	58.08±0.34 <sup>c</sup>	75.8±0.54 <sup>a</sup>	69.9±0.60 <sup>b</sup>
12	ADF	36.96±0.23 <sup>c</sup>	52.10±0.47 <sup>a</sup>	51.31±0.43 <sup>b</sup>

Means with different superscripts row wise differ significantly (P<0.01)

The results of present study revealed that significant difference was not observed in DM, OM, CP and TA content among Maize, Super Napier and Sorghum silages. The CF, NDF, ADF and NFE content was significantly ( $P<0.01$ ) high in Super Napier silage compared to Maize and Sorghum silages and the difference was also significant ( $P<0.01$ ) between Maize and Sorghum silages. The EE content was significantly ( $P<0.01$ ) high in sorghum silage, while the difference was not significant between Maize and Super Napier silages. The AIA content was significantly ( $P<0.01$ ) low in Maize silage while the difference was not significant between Sorghum and Super Napier silages. The calcium content was significantly ( $P<0.01$ ) high in Super Napier silage compared to Maize and Sorghum silages and the difference was also significant ( $P<0.01$ ) between Maize and Sorghum silages. The phosphorus content was significantly ( $P<0.01$ ) high in Maize, while the difference was not significant between Super Napier and Sorghum silages.

#### **4.2 ORGANOLEPTIC AND PHYSICAL PROPERTIES OF MAIZE, SUPER NAPIER AND SORGHUM SILAGES**

The mean values of colour, smell, consistency, sensory score and  $P^H$  of Maize, Super Napier, Sorghum silages were  $3.63\pm 0.88$ ,  $5.46\pm 0.66$ ,  $3.46\pm 0.33$ ,  $12.56\pm 0.17$  and  $3.86\pm 0.88$ ;  $3.66\pm 0.33$ ,  $5.26\pm 0.12$ ,  $3.43\pm 0.33$ ,  $12.36\pm 0.12$  and  $4.00\pm 0.05$  and  $3.63\pm 0.88$ ,  $5.36\pm 0.33$ ,  $3.53\pm 0.33$ ,  $12.53\pm 0.88$  and  $3.93\pm 0.88$ , respectively (Table.5)

**Table 5. Organoleptic properties of Maize, Super Napier and Sorghum silages**

<b>Physical characters</b>	<b>Maize Silage</b>	<b>Super Napier Silage</b>	<b>Sorghum Silage</b>
<b>Colour</b>	<b>3.63±0.88</b>	<b>3.66±0.33</b>	<b>3.63±0.88</b>
<b>Smell</b>	<b>5.46±0.66</b>	<b>5.26±0.12</b>	<b>5.36±0.33</b>
<b>Consistency</b>	<b>3.46±0.33</b>	<b>3.43±0.33</b>	<b>3.53±0.33</b>
<b>Sensory score</b>	<b>12.56±0.17</b>	<b>12.36±0.12</b>	<b>12.53±0.88</b>
<b>P<sup>H</sup></b>	<b>3.86±0.88</b>	<b>4.00±0.05</b>	<b>3.93±0.88</b>

The results revealed that significant difference was not observed in colour, smell, consistency, sensory score and P<sup>H</sup> among Maize, Super Napier and Sorghum silages.

#### **4.3 DRY MATTER INTAKE (DMI)**

The average DMI in Nellore lambs were measured on fortnightly basis and the observations on avg daily DMI were presented in Table 6. and graphically represented in fig.1

Perusal of the Table 6 revealed that the mean daily dry matter intake of lambs observed at the end of the first fortnight for T1, T2 and T3 groups were 4.20±0.68, 3.89±0.93 and 3.83±0.07 kg respectively with significantly (P<0.01) higher intake in T1group when compared to that of T2 and T3 groups, while DMI of lambs in T2 group did not differ significantly (P<0.01) from T3 group.

The mean daily dry matter intake of lambs observed at the end of the second fortnight for T1, T2 and T3 groups were  $5.74\pm 0.15$ ,  $4.52\pm 0.10$  and  $4.76\pm 0.13$ kg, respectively with significantly ( $P<0.01$ ) higher intake in T1group when compared to that of T2 and T3 groups, while DMI of lambs in T2 group did not differ significantly from T3 group.

The mean daily dry matter intake of lambs observed at the end of the third fortnight for T1, T2 and T3 groups were  $6.51\pm 0.08$ ,  $5.46\pm 0.58$  and  $5.42\pm 0.54$  kg, respectively with significantly ( $P<0.01$ ) higher intake in T1group when compared to that of T2 and T3 groups, while DMI of lambs in T2 group did not differ significantly from T3 group.

During fourth fortnight the mean daily dry matter intake values for T1,T2 and T3 groups were  $7.07\pm 0.13$ ,  $5.85\pm 0.08$  and  $6.35\pm 0.18$  kg, respectively with significantly ( $P<0.01$ ) higher intake in T1group when compared to that of T2 and T3 groups, while DMI of lambs in T2 group differ significantly ( $P<0.01$ ) from T3 group.

During fifth fortnight the mean daily dry matter intake values for T1,T2 and T3 groups were  $7.21\pm 0.19$ ,  $6.16\pm 0.07$  and  $6.44\pm 0.11$ kg, respectively with significantly ( $P<0.01$ ) higher intake in T1group when compared to that of T2 and T3 groups, while DMI of lambs in T2 group did not differ significantly from T3 group.

Similarly, the mean daily dry matter intake of lambs observed at the end of the sixth fortnight for T1, T2 and T3 groups were  $7.26\pm 0.07$ ,  $6.23\pm 0.07$  and  $6.85\pm 0.06$  kg, respectively with significantly ( $P<0.01$ ) higher intake in T1group when compared to that of T2 and T3 groups, while DMI of lambs in T2 group did

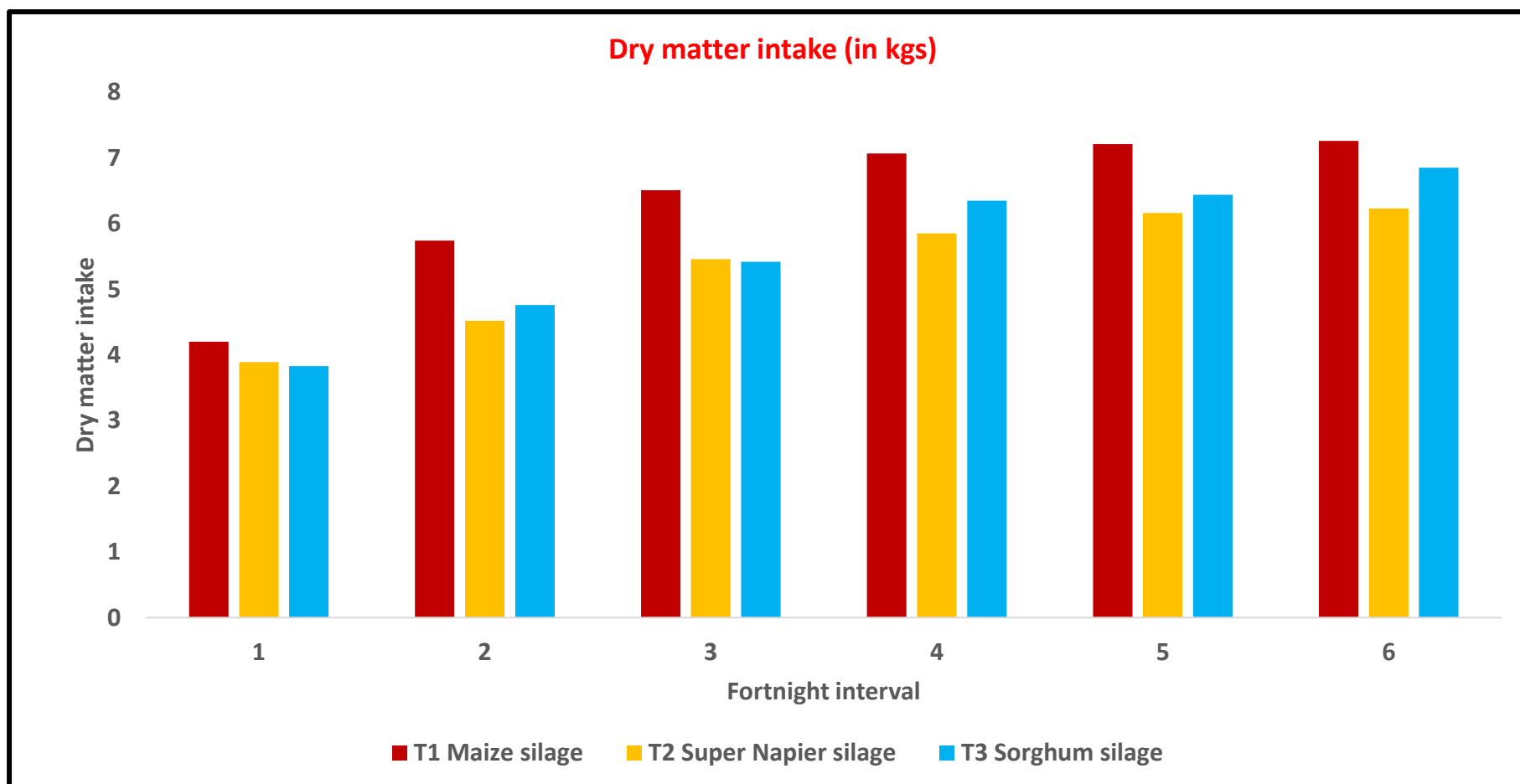
not differ significantly from T3 group.

The overall mean daily DMI of lambs at different fortnights for entire experimental period were  $6.33 \pm 0.12$ ,  $5.35 \pm 0.09$  and  $5.61 \pm 0.10$  for T1, T2 and T3 groups respectively with significantly ( $P < 0.01$ ) higher intake in T1 group when compared to that of T2 and T3 groups, while DMI of lambs in T2 group did not differ significantly from T3 group.

**Table 6. Effect of feeding Maize, Super Napier and Sorghum silage based TMR on dry matter intake (in kg) in Nellore lambs**

Fortnight	T1	T2	T3
1	$4.20 \pm 0.68^a$	$3.89 \pm 0.93^b$	$3.83 \pm 0.07^b$
2	$5.74 \pm 0.15^a$	$4.52 \pm 0.10^b$	$4.76 \pm 0.13^b$
3	$6.51 \pm 0.08^a$	$5.46 \pm 0.58^b$	$5.42 \pm 0.54^b$
4	$7.07 \pm 0.13^a$	$5.85 \pm 0.08^c$	$6.35 \pm 0.18^b$
5	$7.21 \pm 0.19^a$	$6.16 \pm 0.07^b$	$6.44 \pm 0.11^b$
6	$7.26 \pm 0.07^a$	$6.23 \pm 0.07^b$	$6.85 \pm 0.06^b$
Mean $\pm$ SE	$6.33 \pm 0.12^a$	$5.35 \pm 0.09^b$	$5.61 \pm 0.10^b$

Means with different superscripts row wise differ significantly ( $P < 0.01$ )



**Fig 1. Effect of feeding Maize, Super Napier, Sorghum Silage based TMR on DMI (Kgs) in Nellore lambs.**

## 4.4 GROWTH RATES IN LAMBS

### 4.4.1 Average fortnightly body weights (kgs)

The mean body weights (kg) in Nellore lambs were measured on fortnightly basis and the observations were presented in Table.7 and graphically represented in fig.2

The mean body weights observed at starting of the experimental trail for T1, T2 and T3 groups were  $12 \pm 0.57$ ,  $11.33 \pm 0.49$ ,  $11.33 \pm 0.49$  kg respectively, such that average group weights were uniform.

The mean body weights observed at the end of the first fortnight for T1, T2 and T3 groups were  $13.10 \pm 0.96$ ,  $12.72 \pm 1.04$  and  $12.9 \pm 1.20$ kg, respectively. However the differences in average body weight were found to be statistically non-significant during first fortnight.

The mean body weights recorded at the end of the second fortnight were  $14.33 \pm 0.91$ ,  $13.08 \pm 1.15$  and  $13.1 \pm 1.28$  kgs for T1, T2 and T3 groups respectively. However the differences in average body weight were found to be statistically non-significant during second fortnight.

During the third fortnight the mean body weights were recorded as  $15.60 \pm 0.95$ ,  $14.20 \pm 1.33$  and  $14.20 \pm 1.38$  kg for T1, T2 and T3 groups respectively. A comparatively higher gain was observed in T1 group but no significant difference was observed among the three groups.

Similarly at fourth fortnight, the mean body weights recorded for the three groups T1, T2 and T3 were  $16.93 \pm 1.05$ ,  $15.49 \pm 1.44$  and  $15.50 \pm 1.53$ kg respectively. A comparatively higher gain was observed in T1 group but no significant difference was observed among the three groups.

During the fifth fortnight the mean body weights were recorded for the three groups T1, T2 and T3 were as  $18.44 \pm 1.06$ ,  $16.88 \pm 1.54$  and  $16.89 \pm 1.64$  kg respectively. A comparatively higher gain was observed in T1 group than T3 and lowest was recorded in lambs of T2 group but no significant difference was observed among the three groups.

Finally, at the end of the experimental period of 90 days, it was found that the mean body weights were  $20.21 \pm 0.98$ ,  $18.37 \pm 1.33$  and  $18.52 \pm 1.71$  kg for the three groups of T1, T2 and T3 respectively. A comparatively higher gain was observed in T1 group and then T3 and lowest was recorded in lambs of T2 group but no significant difference was observed among the three groups.

#### **4.4.2 Total body weight gain**

The total body weight gains (kg) observed at the end of the experiment were  $8.21 \pm 1.09$ ,  $7.04 \pm 1.34$  and  $7.19 \pm 1.49$  kgs for T1, T2 and T3 groups respectively in Table.7. Statistical analysis of the total weight gain revealed that no significant difference was observed among the three experimental diets.

#### **4.4.3 Average daily body weight gain (ADG)**

The ADG in Nellore lambs were measured on fortnightly basis and the observations on ADG were presented in Table.8 and graphically represented in fig.3. The mean ADG observed at the end of the first fortnight for T1, T2 and T3 groups were  $73.33 \pm 10.12$ ,  $56.00 \pm 5.28$  and  $54.67 \pm 7.14$  g, respectively. A comparatively higher gain was observed in T1 group but no significance difference was observed between T1 and T2 and T3 groups.

The mean ADG observed at the end of the second fortnight for T1, T2 and T3 groups were  $82.00 \pm 10.42$ ,  $60.67 \pm 8.56$  and  $63.33 \pm 8.27$  g respectively. A

comparatively higher gain was observed in T1 group but no significance difference was observed between T1, T2 and T3 groups.

Similarly at third fortnight, the ADG of the three groups T1, T2 and T3 were  $84.67 \pm 10.44$ ,  $74.67 \pm 9.87$  and  $73.33 \pm 9.22$  g, respectively. A comparatively higher gain was observed in T1 group but no significance difference was observed between T1, T2 and T3 groups.

The mean ADG observed at the end of the fourth fortnight for T1, T2 and T3 groups were  $84.67 \pm 10.72$ ,  $86.00 \pm 10.44$  and  $86.67 \pm 10.44$  g respectively. A comparatively higher gain was observed in T1 group but no significance difference was observed between T1, T2 and T3 groups.

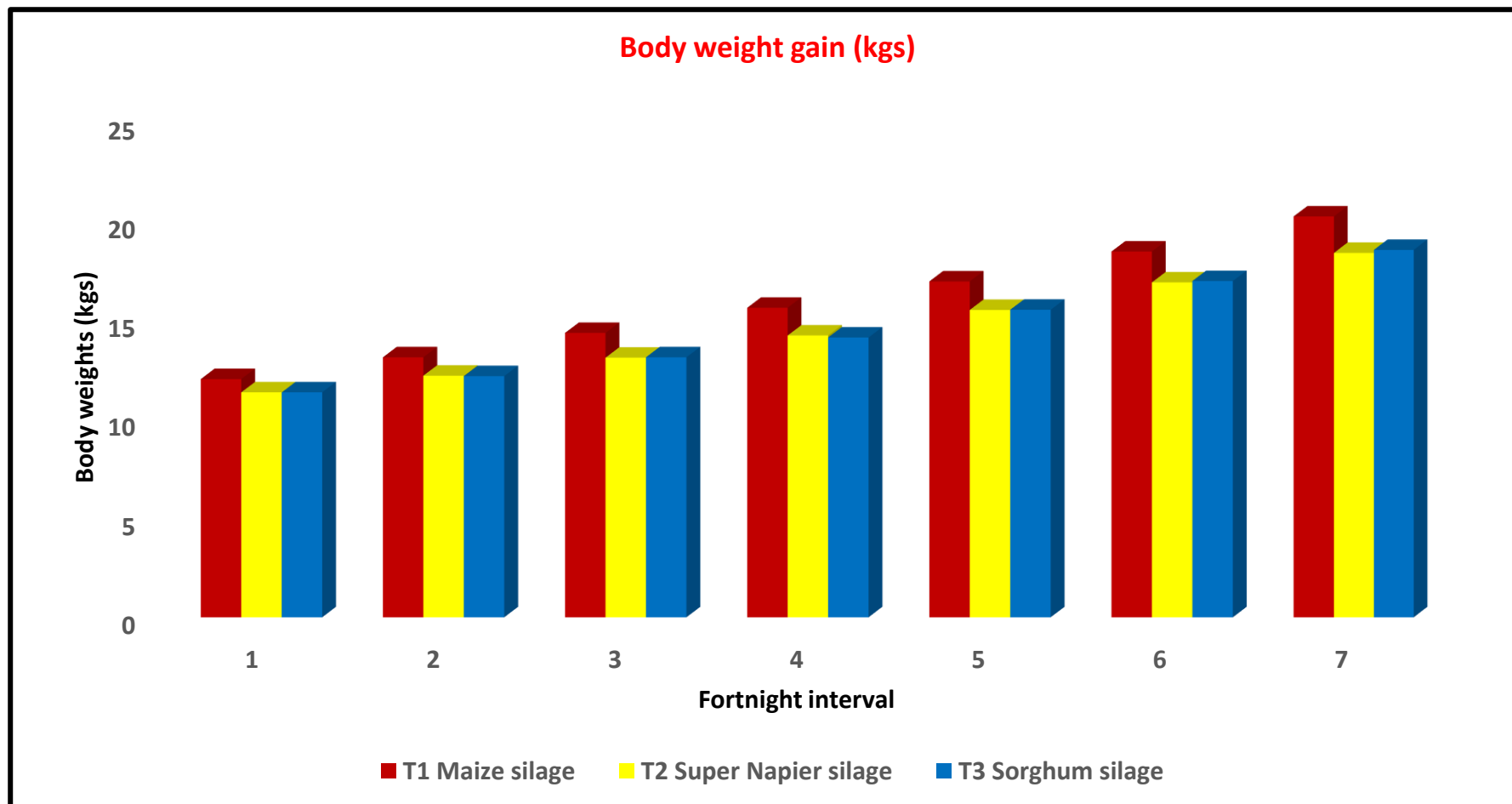
The mean ADG observed at the end of the fifth fortnight for T1, T2 and T3 groups were  $100.67 \pm 20.28$ ,  $92.67 \pm 12.96$  and  $92.67 \pm 12.00$  g, respectively. A comparatively higher gain was observed in T1 group but no significance difference was observed between T1, T2 and T3 groups.

The mean ADG observed at last fortnight for T1, T2 and T3 groups were  $118.00 \pm 22.28$ ,  $99.33 \pm 24.28$  and  $108.67 \pm 20.84$ g respectively. There was no significance difference observed between T1, T2 and T3 groups but higher daily weight gain was observed for T1 group.

The overall mean values of ADG at different fortnights for entire experimental period were  $91.22 \pm 12.18$ ,  $78.22 \pm 14.91$  and  $79.89 \pm 20.26$ g for T1, T2 and T3 groups respectively. A comparatively higher gain was observed in T1 group but no significance difference was observed between T1, T2 and T3 groups.

**Table 7. Effect of feeding Maize, Super Napier and Sorghum silage based TMR on fortnightly body weights in Nellore lambs**

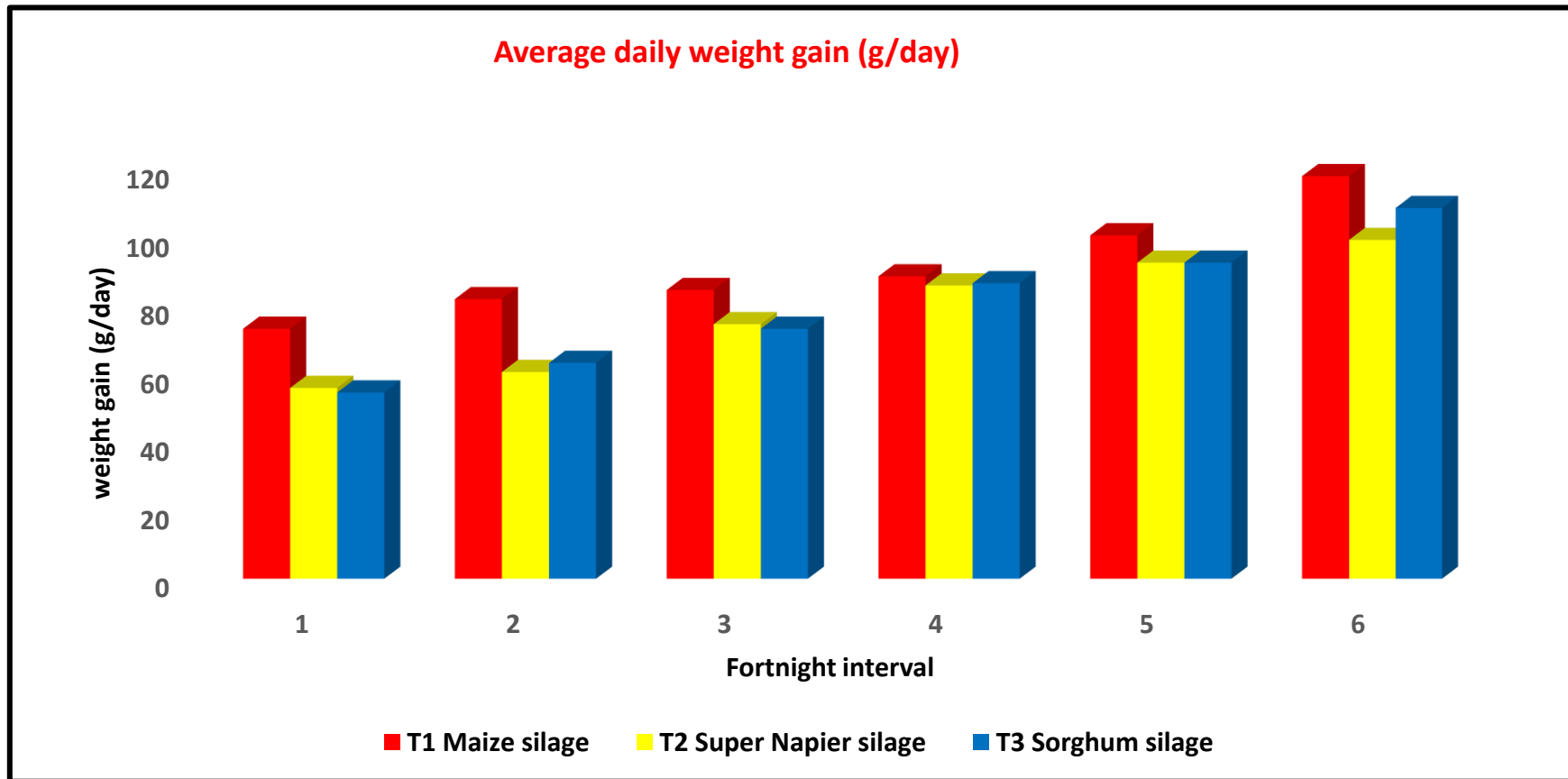
<b>Fortnight</b>	<b>T1 (Maize)</b>	<b>T2 (Super Napier)</b>	<b>T3 (Sorghum)</b>
<b>0</b>	<b>12.00±0.57</b>	<b>11.33± 0.49</b>	<b>11.33 ±0.49</b>
<b>1</b>	<b>13.10 ± 0.96</b>	<b>12.17 ±1.04</b>	<b>12.15 ±1.20</b>
<b>2</b>	<b>14.33 ± 0.91</b>	<b>13.08±1.15</b>	<b>13.10±1.28</b>
<b>3</b>	<b>15.60 ±0.95</b>	<b>14.2 ±1.33</b>	<b>14.20±1.38</b>
<b>4</b>	<b>16.93 ± 1.05</b>	<b>15.49 ±1.44</b>	<b>15.50±1.53</b>
<b>5</b>	<b>18.44 ±1.06</b>	<b>16.88 ±1.54</b>	<b>16.89 ± 1.64</b>
<b>6</b>	<b>20.21±0.98</b>	<b>18.37±1.33</b>	<b>18.52 ±1.71</b>
<b>Total average weight gain</b>	<b>8.21±1.09</b>	<b>7.04±1.34</b>	<b>7.19±1.49</b>



**Fig 2. Effect of feeding Maize, Super Napier, Sorghum Silage based TMR on Body weights (kgs) in Nellore lambs**

**Table 8. Effect of feeding Maize, Super Napier and Sorghum silage based TMR on Average daily gain (g/day) in Nellore lambs**

<b>Fortnight</b>	<b>T1</b>	<b>T2</b>	<b>T3</b>
<b>1</b>	<b>73.33±10.12</b>	<b>56.00±5.28</b>	<b>54.67±7.14</b>
<b>2</b>	<b>82.00±10.42</b>	<b>60.67±8.56</b>	<b>63.33±8.27</b>
<b>3</b>	<b>84.67±10.44</b>	<b>74.67±9.87</b>	<b>73.33±9.22</b>
<b>4</b>	<b>88.67±10.72</b>	<b>86.00±10.44</b>	<b>86.67±10.44</b>
<b>5</b>	<b>100.67±20.28</b>	<b>92.67±12.96</b>	<b>92.67 ± 12.00</b>
<b>6</b>	<b>118.0±22.28</b>	<b>99.33±24.28</b>	<b>108.67 ±20.84</b>
<b>Overall Mean±SE</b>	<b>91.22±12.18</b>	<b>78.22±14.91</b>	<b>79.89±20.26</b>



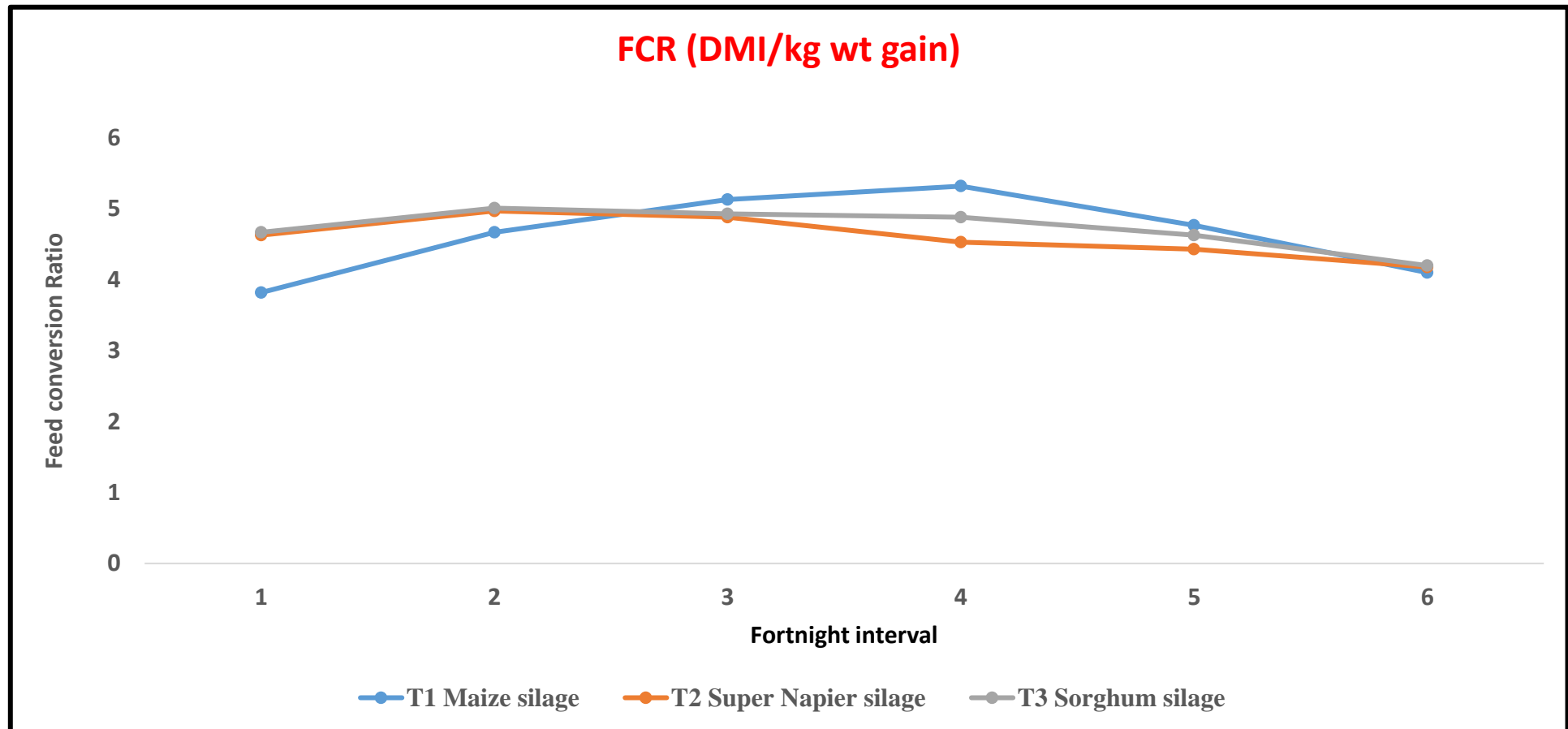
**Fig 3. Effect of feeding Maize, Super Napier, Sorghum Silage based TMR on Average daily weight gain (g/day) in Nellore lambs**

#### 4.5 FEED CONVERSION RATIO (FCR)

The average FCR of lambs fed with different experimental diets i.e Maize, Super Napier and Sorghum TMR based ration for T1, T2 and T3 groups were presented in Table.9 and graphically presented in fig.4. Persual of table. 9 revealed that, the FCR varied from  $3.82 \pm 1.24$  to  $4.10 \pm 1.05$ ,  $4.63 \pm 1.08$  to  $4.18 \pm 1.24$  and  $4.67 \pm 1.30$  to  $4.20 \pm 1.70$  in T1, T2 and T3 groups respectively from beginning to the end of the experimental period. The overall mean FCR values were  $4.63 \pm 1.19$ ,  $4.60 \pm 1.43$  and  $4.72 \pm 1.24$  for T1, T2 and T3 groups respectively. The difference among the groups was not significant.

**Table 9. Effect of feeding Maize, Super Napier and Sorghum silage based TMR on feed conversion ratio in Nellore lambs**

Fortnight	T1	T2	T3
1	$3.82 \pm 1.24$	$4.63 \pm 1.08$	$4.67 \pm 1.30$
2	$4.67 \pm 1.42$	$4.97 \pm 1.34$	$5.01 \pm 1.25$
3	$5.13 \pm 1.44$	$4.88 \pm 1.05$	$4.93 \pm 1.51$
4	$5.32 \pm 1.10$	$4.53 \pm 1.09$	$4.88 \pm 1.12$
5	$4.77 \pm 1.211$	$4.43 \pm 1.14$	$4.63 \pm 1.11$
6	$4.10 \pm 1.05$	$4.18 \pm 1.24$	$4.20 \pm 1.70$
Mean $\pm$ SE	$4.63 \pm 1.19$	$4.60 \pm 1.43$	$4.72 \pm 1.24$



**Fig 4. Effect of feeding Maize, Super Napier and Sorghum Silage based TMR on Feed Conversion Ratio (FCR) in Nellore lambs.**

## 4.6 BODY CONDITION SCORE (BCS)

The effect of feeding silage based TMR on BCS of lambs of different experimental groups were presented in Table.10. The mean BCS values for T1, T2 and T3 at the beginning of the experiment was  $2.18 \pm 0.06$ ,  $2.15 \pm 0.042$  and  $2.18 \pm 0.04$  and at the end of the experiment was  $2.9 \pm 0.05$ ,  $2.96 \pm 0.42$  and  $3 \pm 0.33$ , respectively. The mean BCS of the lambs for all fortnights were  $2.52 \pm 0.04$ ,  $2.51 \pm 0.13$  and  $2.53 \pm 0.12$  respectively. However, significant difference in BCS was not observed among the experimental lambs.

## 4.7 HAEMATOLOGICAL PARAMETERS

Various Haematological parameters viz. RBC, Hb, PCV, MCV values of growing Nellore lambs fed with experimental diets are presented in Table. 11 to 14 and depicted in the picture in the fig.5 to 8.

### 4.7.1 Red blood cells (RBC)

The mean RBC levels ( $10^6/\mu\text{L}$ ) before start of the experiment were  $9.93 \pm 0.21$ ,  $10.06 \pm 0.12$  and  $9.93 \pm 0.21$  in T1, T2 and T3 groups, respectively in (Table.11). The RBC levels ( $10^6/\mu\text{L}$ ) at the end of the experiment were  $10.97 \pm 0.29$ ,  $11.86 \pm 0.25$  and  $11.52 \pm 0.37$  for T1, T2 and T3 groups respectively. Statistical analysis of the data revealed that there was no significant difference in RBC levels among the experimental groups at the end of the experiment. The RBC values are numerically higher in T3 and T2 groups than T1.

### 4.7.2 Haemoglobin

The mean estimated haemoglobin values were  $10.15 \pm 0.22$ ,  $10.01 \pm 0.22$  and  $10.45 \pm 0.34$  (g/dL) before starting of the experiment and at the end of the experiment were  $10.43 \pm 0.23$ ,  $10.73 \pm 0.12$  and  $10.85 \pm 0.18$  (g/dL) in T1, T2 and

T3 groups respectively in (Table.12). No significant difference was observed in haemoglobin values among the experimental groups at the end of the trail.

#### **4.7.3 Packed cell volume (PCV)**

The mean estimated PCV values were  $33.5 \pm 0.88$ ,  $32.5 \pm 0.88$  and  $30.5 \pm 0.86$  (%) before starting of the experiment and at the end of the experiment were  $43.83 \pm 1.4$ ,  $39.83 \pm 0.88$  and  $38.16 \pm 1.04$ (%) in T1,T2 and T3 groups respectively in (Table.13). At the end of the experiment the PCV % was Significantly high in T1,compared to T2 and T3 groups, while the difference was not significant between T2 and T3 groups.

#### **4.7.4 Mean corpuscular volume (MCV)**

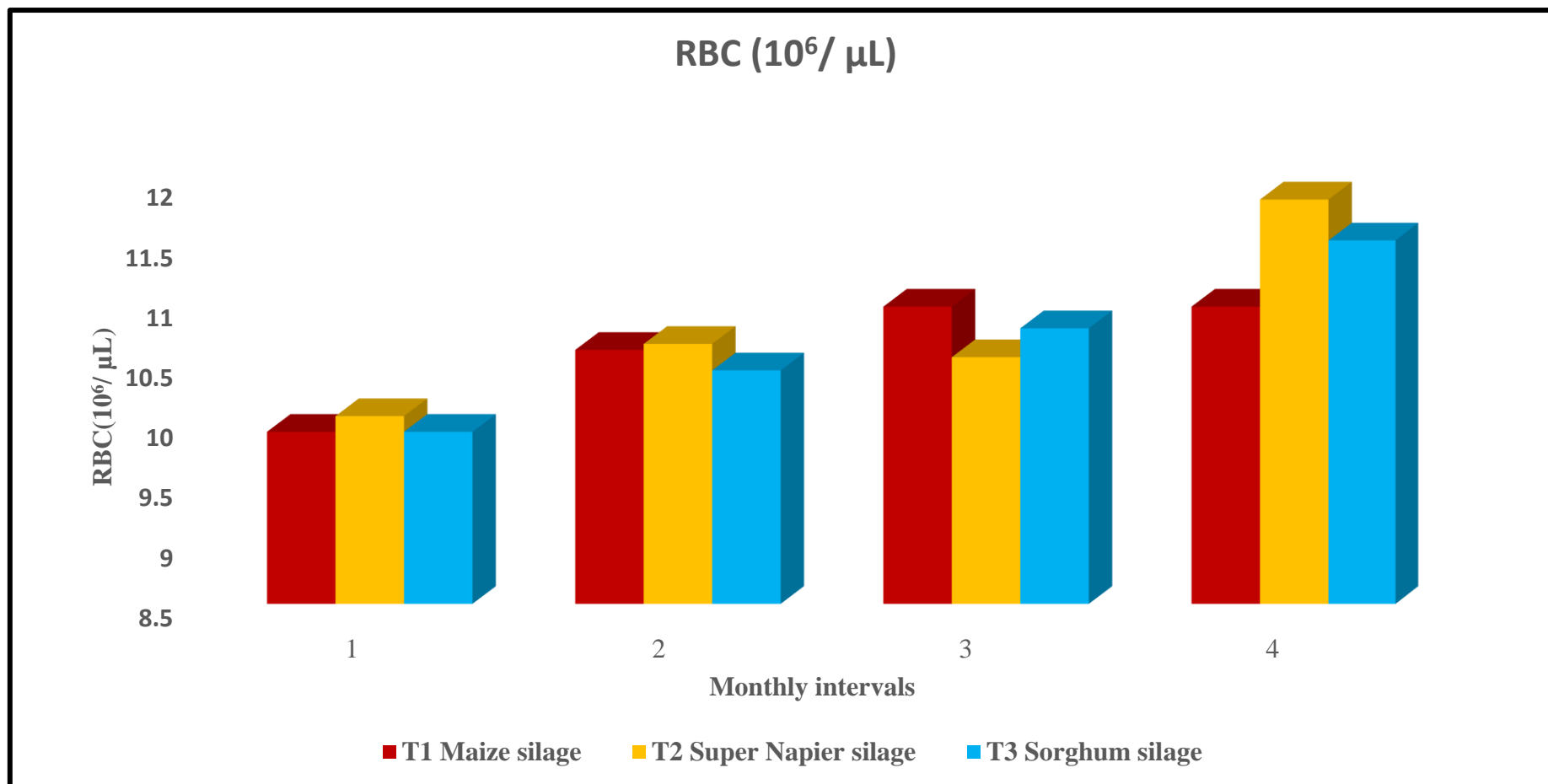
The mean estimated values of MCV were  $26.38 \pm 0.42$ ,  $26.48 \pm 0.42$  and  $26.32 \pm 0.42$  (fl) before starting of the experiment and at the end of the experiment were  $25.75 \pm 0.5$ ,  $27.70 \pm 0.5$  and  $25.20 \pm 0.5$  (fl) in T1, T2 and T3 groups respectively (Table.14). No significant difference was observed in MCV values among the experimental groups at the end of the trail.

**Table. 10 Effect of feeding Maize, Super napier, Sorghum silages on Body condition score in Nellore lambs**

<b>Fortnight interval</b>								
<b>Treatments</b>	<b>Initial BCS</b>	<b>I</b>	<b>II</b>	<b>III</b>	<b>IV</b>	<b>V</b>	<b>VI</b>	<b>Mean ± SE</b>
<b>T1 (Maize)</b>	<b>2.18± 0.06</b>	<b>2.27±0.05</b>	<b>2.37±0.04</b>	<b>2.42±0.03</b>	<b>2.53±0.04</b>	<b>2.65±0.05</b>	<b>2.9±0.05</b>	<b>2.52± 0.04</b>
<b>T2(Super Napier)</b>	<b>2.15±0.04</b>	<b>2.24±0.04</b>	<b>2.32±0.02</b>	<b>2.4±0.01</b>	<b>2.55±0.02</b>	<b>2.70±0.28</b>	<b>2.96±0.42</b>	<b>2.51± 0.13</b>
<b>T3 (Sorghum)</b>	<b>2.18±0.04</b>	<b>2.28±0.03</b>	<b>2.34±0.03</b>	<b>2.39±0.03</b>	<b>2.51±0.03</b>	<b>2.68±0.32</b>	<b>3±0.33</b>	<b>2.53± 0.12</b>

**Table 11. Effect of feeding Maize, Super Napier, Sorghum based TMR on haematological parameter RBC in Nellore lambs**

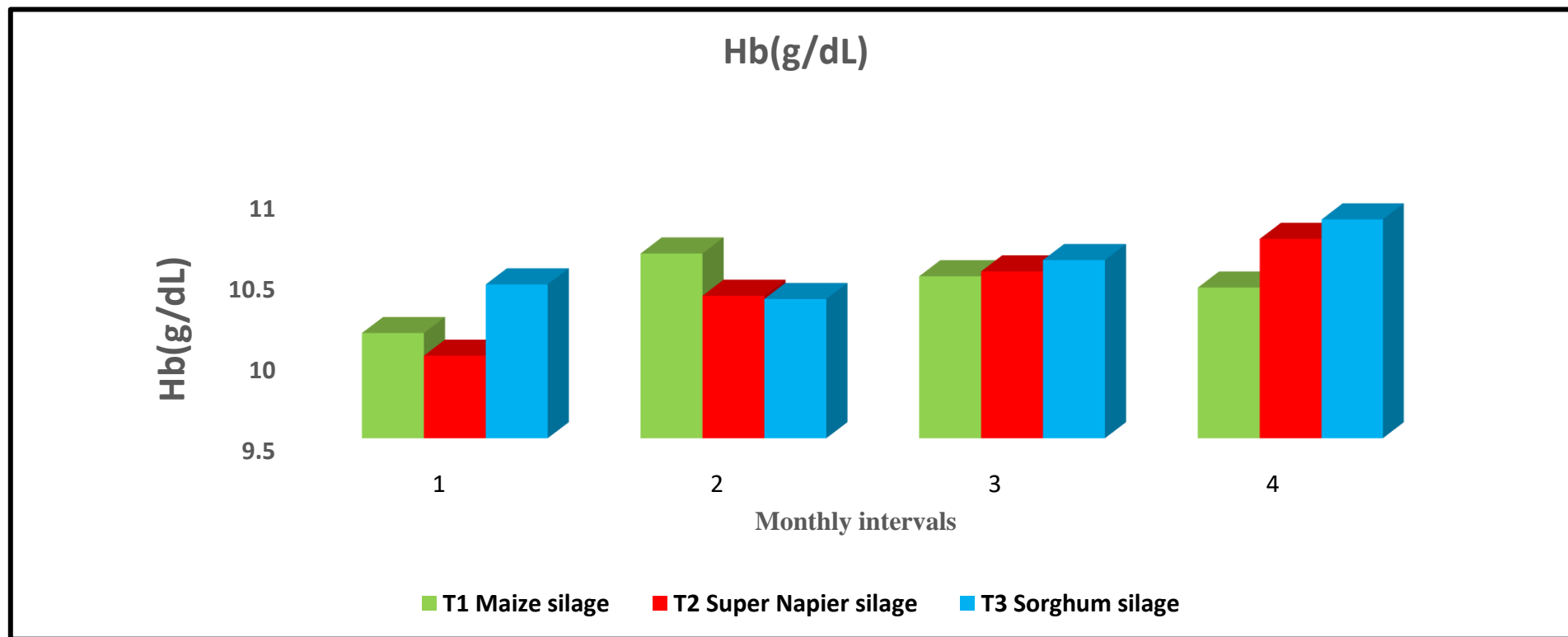
<b>Parameter</b>		<b>T1</b>	<b>T2</b>	<b>T3</b>
<b>RBC (10<sup>6</sup>/μL)</b>	<b>Before experiment</b>	<b>9.93 ± 0.21</b>	<b>10.06±0.12</b>	<b>9.93± 0.21</b>
	<b>1<sup>st</sup> month</b>	<b>10.6 ± 0.35</b>	<b>10.66 ± 0.58</b>	<b>10.44 ± 0.55</b>
	<b>2<sup>nd</sup> month</b>	<b>10.97 ± 0.29</b>	<b>10.55 ±0.49</b>	<b>10.79 ± 0.40</b>
	<b>3<sup>rd</sup> month</b>	<b>10.97 ± 0.29</b>	<b>11.86 ±0.25</b>	<b>11.52 ± 0.37</b>



**Fig 5. Effect of feeding Maize, Super Napier and Sorghum Silage based TMR on RBC (10<sup>6</sup>/ μL) in Nellore lambs**

**Table 12. Effect of feeding Maize, Super Napier, Sorghum silage based TMR on Haemoglobin concentration (g/dl) in Nellore lambs**

<b>Parameter</b>		<b>T1</b>	<b>T2</b>	<b>T3</b>
<b>Hb(g/dL)</b>	<b>Before experiment</b>	<b>10.15 ± 0.22</b>	<b>10.01 ± 0.22</b>	<b>10.45±0.34</b>
	<b>1<sup>st</sup> month</b>	<b>10.64 ± 0.35</b>	<b>10.38 ± 0.21</b>	<b>10.36±0.21</b>
	<b>2<sup>nd</sup> month</b>	<b>10.5 ± 0.18</b>	<b>10.53 ± 0.16</b>	<b>10.6±0.16</b>
	<b>3<sup>rd</sup> month</b>	<b>10.43 ± 0.23</b>	<b>10.73 ± 0.12</b>	<b>10.85±0.18</b>



**Fig 6. Effect of feeding Maize, Super Napier and Sorghum Silage based TMR on Hb (g/dL) in Nellore lambs**

**Table 13. Effect of feeding Maize, Super Napier, Sorghum silage based TMR on Packed Cell Volume (%) in Nellore lambs**

<b>PCV (%)</b>	<b>Before experiment</b>	<b>33.5 ± 0.88</b>	<b>32.5 ± 0.88</b>	<b>30.5 ± 0.86</b>
	<b>1<sup>st</sup> month</b>	<b>39.5 ± 1.08<sup>a</sup></b>	<b>35.66 ± 1.87<sup>ab</sup></b>	<b>32 ± 1.26<sup>b</sup></b>
	<b>2<sup>nd</sup> month</b>	<b>37.5 ± 1.08<sup>a</sup></b>	<b>35.66 ± 1.87<sup>ab</sup></b>	<b>39.83 ± 1.01<sup>b</sup></b>
	<b>3<sup>rd</sup> month</b>	<b>43.83 ± 1.4<sup>a</sup></b>	<b>39.83 ± 0.88<sup>b</sup></b>	<b>38.16 ± 1.04<sup>b</sup></b>

Mean values with different superscripts row wise differ significantly (P<0.05)

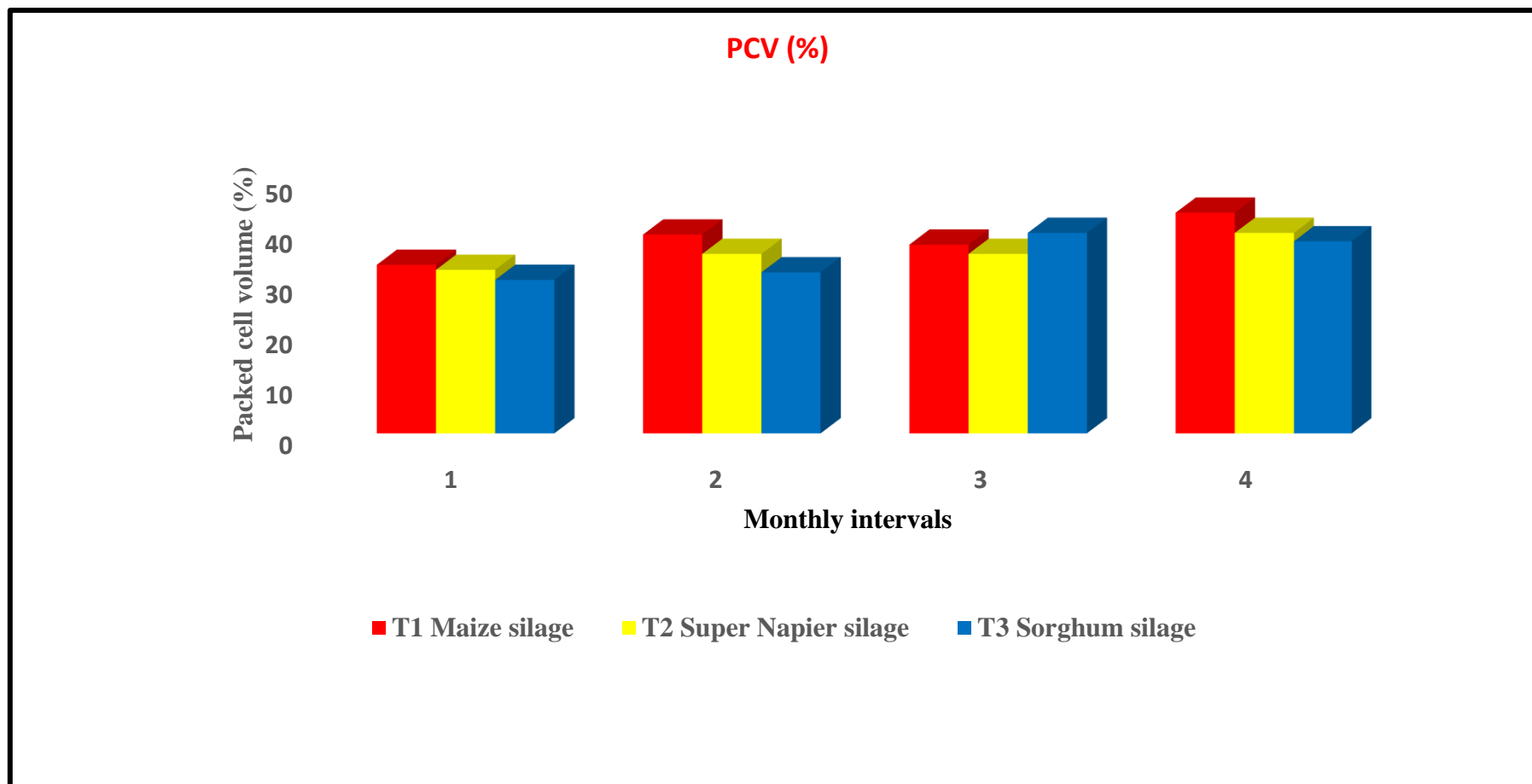


Fig 7. Effect of feeding Maize, Super Napier, Sorghum Silage based TMR on Packed cell volume (%) in Nellore lambs

**Table 14. Effect of feeding Maize, Super Napier, Sorghum silage based TMR on Mean Corpuscular Hemoglobin concentration (fl) in Nellore lambs**

<b>MCV (fl)</b>	<b>Before experiment</b>	<b>26.38±0.42</b>	<b>26.48±0.42</b>	<b>26.32±0.42</b>
	<b>1<sup>st</sup> month</b>	<b>26.75 ±0.50</b>	<b>26.75 ± 0.5</b>	<b>25.6±1.25</b>
	<b>2<sup>nd</sup> month</b>	<b>24.75±0.5</b>	<b>27.7±0.5</b>	<b>26.40±0.5</b>
	<b>3<sup>rd</sup> month</b>	<b>25.75±0.5</b>	<b>27.70±0.5</b>	<b>25.20±0.5</b>

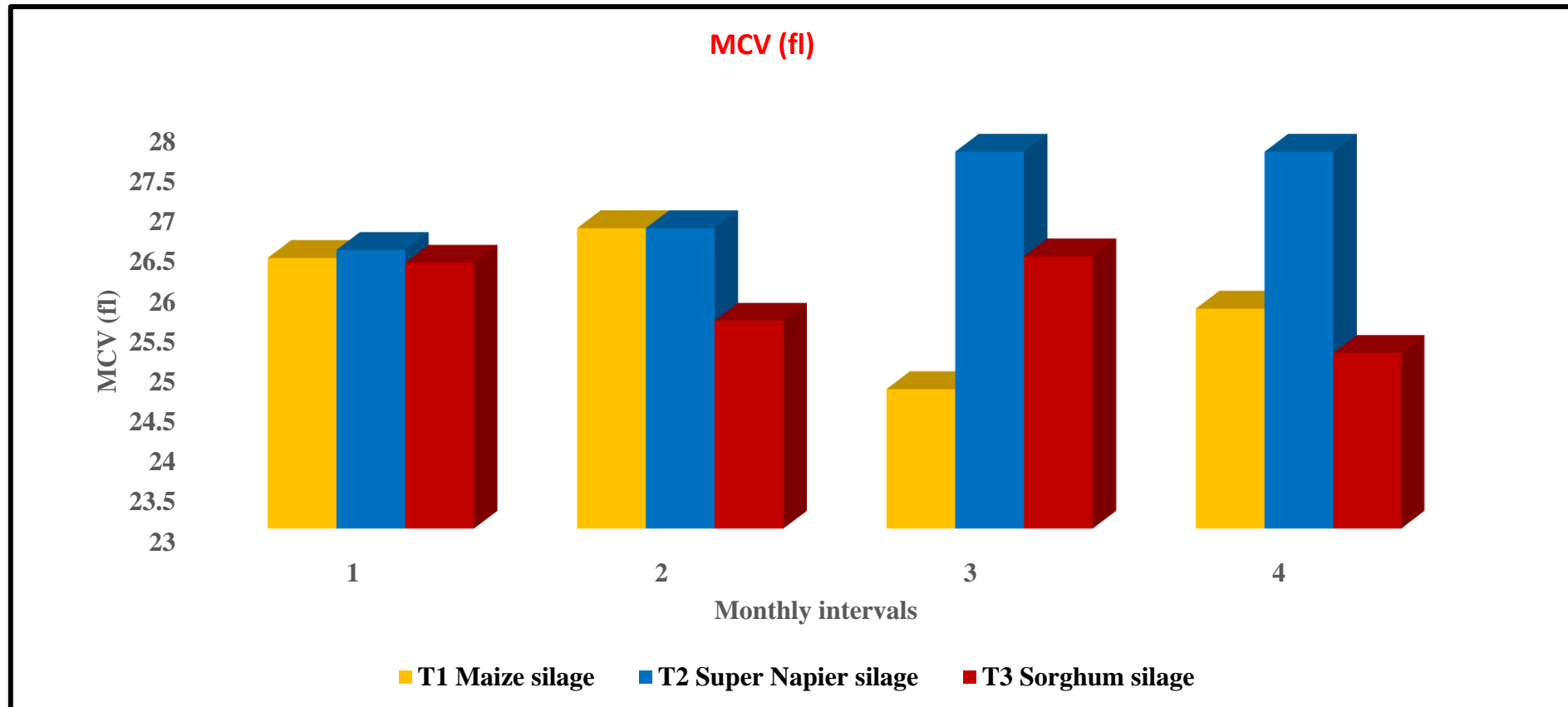


Fig 8. Effect of feeding Maize, Super Napier and Sorghum Silage based TMR on Mean corpuscular Haemoglobin (fl) in Nellore lambs

## 4.8 COST OF THE EXPERIMENTAL RATIIONS

### 4.8.1 Cost of Maize silage production.

The cost /kg production of Maize silage was presented in Table 15. The cost /kg production of maize green fodder was Rs 0.62/-. The cost of fodder harvesting with manual method and silage bale preparation was Rs 0.60/- and Rs 2.00/- respectively. Therefore, the cost /kg Maize silage production for this study was Rs 3.22/-

**Table 15: Cost of Maize silage production**

Parameter	Cultivation of fodder Maize (Per acre)
I. Preparation of land a) Ploughing and Harrowing 4 hours @ 800 per acre	Rs 3200-00
II. Cost of fodder seed @ Rs 50 per kg. Seed rate 25 kg per acre (African Tall)	Rs 1250-00
III. Cost of fertilizers a) Farm yard Manure 3 tons per acre @ 1000/ton b) Chemical fertilizers for basal dose 30:20:10kg N:P:K Urea @Rs 6/kg, Super phosphate @7/kg, Potash @16/kg  Additional 30 kg urea to the crop at 20 days c) Application of FYM and urea require 2 persons @300 per person	Rs 3000-00  Rs 660-00  Rs 600
IV. Cost of irrigation. On an average 4 irrigations required @300/person/day	Rs 1200-00
V. Total Expenditure for cultivation	Rs 9910-00
VI. Yield	16000kg
VII cost per kg production	0.62
VIII. Cost per kg harvest (Manual)	Rs 0.60
IX. Cost of production/kg silage with bale method (Including transport, chapping, processing, salt and packing film and labour cost)	Rs 2.00
X. Total cost of production/kg silage	Rs 3.22

#### 4.8.2 Cost of Super Napier silage production

The cost /kg production of Super Napier silage was presented in Table 16. The cost /kg production of Super Napier green fodder was Rs 0.21/-. The cost of fodder harvesting with manual method was Rs 0.60/- per kg and Rs 2.00/- was incurred to produce one kg silage. Therefore, the cost /kg Super Napier silage production for this study was Rs 2.81/-

**Table 16: Cost of Super Napier silage production**

Parameter	Cultivation of Super Napier (Per acre)
I. Preparation of land	
a) Ploughing, Harrowing. Time required 4 hours @ 800 per hour	Rs 3200-00
b) Furrows, Bund & Bed forming 12-man hours @300/person/day	Rs 3600-00
II. Cost of plantation	
a) Stem cuttings 12000 @ Rs 50np/stem cut	Rs 6000-00
b) Preparation of stem cuttings and plantation 10 persons Rs @300/person/day	Rs 3000-00
III. Cost of fertilizers	
a) Farm yard Manure 5 tons per acre @ 1000/ton	Rs 5000-00
b) Chemical fertilizers for basal dose 30:20:10kg N:P:K Urea @Rs 6/kg, Super phosphate @7/kg, Potash @16/kg, Urea application after each cut @ 30kg. for seven cuts	Rs 1740-00
c) Cost of spreading FYM and fertilizers total 10 persons @300/person/day	Rs 3000-00
IV. Cost of irrigation. on an average 15 irrigations required excluding rainy season. @300/person/day	Rs 4500-00
V Cost of weed management 12 persons @300/person/day	Rs 3600-00
VI. Total Expenditure for cultivation	Rs 33640/-
VII. Yield in 7 cuts	158000kg
VIII. Cost per kg production	Rs 0.21
IX. Cost per kg harvest (Manual)	Rs 0.60
X. Cost of production/kg silage with bale method (Including transport, chapping, processing, salt and packing film and labour cost)	Rs 2.00
XI. Total cost of production/kg silage	Rs 2.81

### 4.8.3 Cost of Sorghum silage production

The cost /kg production of Sorghum silage was presented in Table 17. The cost /kg production of maize Sorghum fodder was Rs 0.44/-. The cost of fodder harvesting with manual method and silage bale preparation was Rs 0.60/- and Rs 2.00/- respectively. Therefore, the cost /kg Sorghum silage production for this study was Rs 3.04/-

**Table 17: Cost of Super Sorghum silage production**

<b>Parameter</b>	<b>Cultivation of Sorghum silage (Per acre)</b>
I. Preparation of land a)Ploughing and Harrowing 4 hours @ 800 per acre	Rs 3200-00
II. Cost of fodder seed @ Rs 50 per kg. Seed rate 20kgper hectare (SSG 59-3)	Rs 1000-00
III. Cost of fertilizers a)Farm yard Manure 3 tons per acre @ 1000/ton b)Chemical fertilizers for basal dose 30:20:10kg N:P:K Urea @Rs 6/kg, Super phosphate @7/kg, Potash @16/kg Urea 30kg per cut c)Application of FYM , urea 3 man hours @300 per person	Rs 3000-00 Rs 1020-00 Rs 900
IV. Cost of irrigation. on an average 8 irrigations required for 3 cuts@300/person/day	Rs 2400-00
V. Total Expenditure for cultivation	Rs 11520.00
VI. Yield in 3 cuts	26000Kg
VII cost per kg production	Rs 0.44
VIII. Cost per kg harvest (Manual)	Rs 0.60
IX. Cost of production/kg silage with bale method (Including transport, chapping, processing, salt and packing film and labour cost)	Rs 2.00
X. Total cost of production/kg silage	Rs 3.04

#### 4.8.4 Cost of concentrate feed

The ingredient composition of the concentrate feed was presented in Table 2. The cost of the concentrate feed used for preparation of experimental TMR was (₹) 23/kg

#### 4.9 COST (₹) PER KG WEIGHT GAIN

The cost of feeding per kg weight gain (₹) in experimental Nellore lambs fed with T1, T2 and T3 diets for 90 days of experimental period is represented in the Table 18. The quantity (kg) of Maize, Super Napier and Sorghum silage based TMR fed to T1, T2 and T3 groups was 1535, 1314 and 1319, respectively. The total cost (₹) of Maize, Super Napier and Sorghum silage based TMR was 77721.44, 6175.71 and 6524.72, respectively. The total weight gain (kg) of the lambs in T1, T2 and T3 groups was 49.26, 42.24, 43.14, respectively. Therefore, the cost (₹) per kg weight gain in T1, T2 and T3 groups was 157.76, 146.21 and 151.25, respectively.

**Table18: Effect of feeding Maize, Super Napier and Sorghum silage based TMR on cost (₹) per kg weight gain in Nellore lambs**

Parameter	T1	T2	T3
Quantity of silage intake (kg)	1392	1191	1193
Quantity of concentrate feed intake (kg)	143	123	126
Total TMR intake (kg)	1535	1314	1319
Total cost of TMR intake (₹)	7721.44	6175.71	6524.72
Total weight gain (kg)	49.26	42.24	43.14
Cost of TMR per kg weight gain (₹)	157.76	146.21	151.25

# *Chapter - V*

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*Discussion*

## CHAPTER V

### DISCUSSION

The results on physicochemical properties of Maize, Super Napier and Sorghum silages and comparative efficacy of Maize, Super Napier and Sorghum silage based total mixed rations (TMR) on haematological profiles, body condition score, growth performance and cost per kg weight gain in Nellore lambs under intensive production system were discussed in this chapter.

#### 5.1 ORGANOLEPTIC AND PHYSICAL PROPERTIES OF MAIZE, SUPER NAPIER AND SORGHUM SILAGES

The colour, smell, consistency, sensory scores of Maize, Super Napier and Sorghum silages were  $3.63\pm 0.88$ ,  $5.46\pm 0.66$ ,  $3.46\pm 0.33$ ,  $12.56\pm 0.17$ ;  $3.86\pm 0.88$ ;  $3.66\pm 0.33$ ,  $5.26\pm 0.12$ ,  $3.43\pm 0.33$ ,  $12.36\pm 0.12$  and  $3.63\pm 0.88$ ,  $5.36\pm 0.33$ ,  $3.53\pm 0.33$ ,  $12.53\pm 0.88$ , respectively. Significant difference was not observed in colour, smell, consistency, sensory score among Maize, Super Napier and Sorghum silages. The organoleptic and physical scores observed for Maize, Super Napier and Sorghum silages in this study indicating that all the silages were properly produced with normal lactic acid fermentation. Rafiuddin *et al.* (2016) reported colour, smell, consistency and sensory scores for maize silages was 3.70, 5.27, 3.90 and 12.87 and for Sorghum silage was 3.36, 4.91, 3.88 and 12.15, respectively corroborated the present findings.

#### 5.2 P<sup>H</sup> OF THE SILAGE

The pH values observed for Maize, Super Napier, Sorghum silages in this study was 3.86, 4.00 and 3.93, respectively which were comparable with the range of pH values of 3.8 to 4.5 and 3.8 to 4.0 for the good quality silages reported by Kolver *et al.* (2001) and Parminder Singh (2017), respectively. Rafiuddin *et al.* (2017) also reported pH values of 3.81 and 3.89 for Maize and Sorghum silages, respectively. Similar to the

present findings, Fazaeli *et al.* (2006) reported pH values of 3.78 and 3.70 for Maize and Sorghum silages, respectively. The pH is an indicator of amount of lactic acid production in the silage. Therefore, all the silages were fermented properly with sufficient amount of lactic acid production. However, Seresinhe *et al.* (2020) reported higher pH values of 5.16 and 5.35 for CO-3 and CO-4 Hybrid Napier varieties. The difference in pH values may be due to difference in time of harvest, ensiling methods, use of different inoculants etc. which may have influence on microbial fermentation and lactic acid production.

### **5.3 CHEMICAL COMPOSITION OF THE SILAGE**

#### **5.3.1 Dry matter**

The mean dry matter per cent of Maize, Super Napier and Sorghum silages were  $31.76 \pm 0.58$ ,  $31.14 \pm 1.11$  and  $31.76 \pm 0.4,1$  respectively (Table 3). The DM content was not significantly different among the silages. The values of DM reported in this study was comparable with the range of values reported by Kolver *et al.* (2001), Parminder Singh (2017), Rodrigues *et al.* (2020) for various silages (27.4 to 31.8%). The range of DM in various silages from 22.9 to 41.3% was also reported by Machado *et al.* (2012), Khan *et al.* (2011), Orrico Junior *et al.* (2015), Behling Neto *et al.* (2017), Seresinhe *et al.* (2020), Su-jiang *et al.*, (2016). Contrary to the present findings, Fazaeli *et al.* (2006) reported lower DM values of 24.0 and 22.7 than the values reported in this study for maize and Sorghum silages.

#### **5.3.2 Organic matter**

The mean organic matter (OM) content of Maize, Super Napier and Sorghum silages were  $88.16 \pm 0.60$ ,  $89.28 \pm 0.66$  and  $87.92 \pm 0.13$ , respectively (Table 3). The OM content was not significantly different among the silages. Similar to the present findings, Jalajakshi *et al.* (2017) reported 89.18% organic matter for sweet Sorghum silage.

### 5.3.3 Crude protein

The mean crude protein (CP) per cent of Maize, Super Napier and Sorghum silages used in the experimental diets was  $8.43\pm 0.10$ ,  $8.68\pm 0.09$  and  $8.64\pm 0.06$ , respectively. The CP content was not significantly different among the silages. Supporting with the present findings, Jalajakshi *et al.* (2017) reported 8.44% CP for sweet Sorghum silage. However, Parminder Singh *et al.* (2017) and Keles *et al.* (2018) observed 7.5 to 7.9% CP for maize silage and Geberemariyam *et al.*, (2021) reported 5.92% CP for Maize stover silage.

### 5.3.4 Ether Extract

The ether extract (EE) per cent of Maize, Super Napier and Sorghum silages used in the experimental diets was  $1.59\pm 0.02$ ,  $1.61\pm 0.04$  and  $2.36\pm 0.12$ , respectively. The EE content was significantly ( $P<0.01$ ) high in Sorghum silage compared to Maize, Super Napier silages, while the difference was not significant between Maize and Super Napier silages. Contrary to the present findings, Mahanta and Pachauri (2004) reported 1.69, 1.78 and 1.53 % EE for three different varieties of sorghum silages. Jalajakshi *et al.* (2017) also reported lower value (1.86%) for EE in sweet Sorghum silage than the value recorded for sorghum silage in this study.

### 5.3.5 Crude fibre

The Crude fibre (CF) content of Maize, Super Napier and Sorghum silages used in the experimental diet was  $30.70\pm 0.88$ ,  $37.81\pm 0.30$  and  $35.21\pm 0.44$ , respectively. The CF content in Super Napier silage was significantly ( $P<0.01$ ) high compared to Maize and Sorghum silages and the difference was also significant ( $P<0.01$ ) between Maize and Sorghum. Consistent with the present findings Jalajakshi *et al.* (2017) reported 36.20% CF for sweet Sorghum silage. Liangco *et al.* (2020) also observed high levels of CF in Super Napier silage.

### 5.3.6 NDF and ADF

The NDF and ADF (%) of Maize, Super Napier and Sorghum silages were  $58.08 \pm 0.34$ ,  $75.8 \pm 0.54$  and  $69.9 \pm 0.60$  and  $36.96 \pm 0.23$ ,  $52.10 \pm 0.47$  and  $51.31 \pm 0.43$ , respectively. The NDF and ADF % was significantly ( $P < 0.01$ ) high in Super Napier silage compared to Maize and Sorghum silages, and the difference was also significant between Maize and Sorghum silages. Similar to the present findings Keles *et al.* (2018) reported 50.9 and 27.3 (%) NDF and ADF for Maize silage. In contrast to the present findings Mahanta and Pachauri (2004) reported higher values of NDF (80.87) and ADF (48.96) content in sorghum silage and Parminder Singh *et al.* (2017) reported lower values for NDF (45.3 and 43.4%) and ADF (32.9 and 28.9%) for the maize silages prepared from two varieties of Maize.

### 5.3.7 Total ash (TA)

The TA per cent of Maize, Super Napier and Sorghum silages used in the experimental diets was  $11.0 \pm 0.01$ ,  $10.05 \pm 0.01$  and  $11.93 \pm 0.01$ , respectively. The TA content was not significantly different among the silages. The TA content reported in the present study was parallel with the findings of Mahanta and Pachauri (2004) who reported the TA ranged from 7.65 to 13.63 in different varieties of sorghum silages. Jalajakshi *et al.* (2017) reported slightly lower values of TA (10.82) in sweet sorghum silage than observed for sorghum silage in the present study.

### 5.3.8 Acid Insoluble ash (AIA)

The AIA per cent of Maize, Super Napier and Sorghum silages used in the experimental diets was  $2.56 \pm 0.13$ ,  $4.21 \pm 0.35$  and  $4.35 \pm 0.83$ , respectively. The AIA content was significantly ( $P < 0.01$ ) low in Maize silage compared to Super Napier and Sorghum silages, while the difference was not significant between Super Napier and Sorghum silages

### **5.3.9 Calcium (Ca)**

The calcium per cent of Maize, Super Napier and Sorghum silages used in the experimental diets was  $0.26\pm 0.01$ ,  $0.57\pm 0.35$  and  $0.40\pm 0.02$ , respectively. The calcium content was significantly ( $P<0.01$ ) high in Super Napier silage compared to Maize, and Sorghum silages and the difference was not significant between Maize, and Sorghum silages

### **5.3.10 Phosphorus (P)**

The calcium per cent of Maize, Super Napier and Sorghum silages used in the experimental diets was  $0.13\pm 0.04$ ,  $0.09\pm 0.01$  and  $0.09\pm 0.01$ , respectively. The phosphorus content was significantly ( $P<0.01$ ) high in Maize silage compared to Super Napier and Sorghum silages, while the difference was not significant between Super Napier and Sorghum silages

The difference in chemical composition the silages reported by different authors might be due to variation in fodder varieties, time of harvest, ensiling methods, use of different inoculants, microbial fermentation and agro- ecological region where the fodder is grown.

## **5.4 DRY MATTER INTAKE**

The mean fortnightly DMI in lambs fed Maize, Super Napier and Sorghum silage based TMR was presented in Table (6). During all the fortnights of the experiment, the DMI was significantly ( $P<0.01$ ) high in Maize silage based TMR compared to Super Napier and Sorghum silage based TMR. The mean fortnightly DMI was also significantly ( $P<0.01$ ) high ( $6.33\pm 0.12$ ) in Maize silage based TMR than Super Napier ( $5.35 \pm 0.09$ ) and Sorghum silage ( $5.61 \pm 0.10$ ) based TMR, while the difference was not significant between Super Napier and Sorghum silage based TMR.

The results of this study were consistent with the findings of Khan *et al.*, (2011) who reported that lambs fed on diets having 100% maize silage has higher nutrient intake than those fed on diets having 100% sorghum silage and 100% millet silage respectively. Doherty *et al.* (1997) also observed increased DM intake in sheep fed with Maize silage based diets than grass silage based diets. Similar to the present findings, Nascimento *et al.* (2008) reported high DMI in dairy cows fed on corn silage than sweet sorghum silage. The increased DMI in T1 group sheep might be due to more palatability of Maize silage based TMR compared to Super Napier and Sorghum silage based TMR.

Contrary to the present findings, Nascimento *et al.* (2008) reported greater DM intake (22.98kg/day) for sorghum silage than corn silage (21.95kg/day) and sweet sorghum silage (19.43kg/day)

## **5.5 GROWTH RATE**

### **5.5.1 Body weight gain**

The mean fortnightly body weights (kg) observed at starting of the experimental trail for T1, T2 and T3 groups were  $12 \pm 0.57$ ,  $11.33 \pm 0.49$ ,  $11.33 \pm 0.49$  kg, respectively and at the end of the experiment was  $20.21 \pm 0.98$ ,  $18.37 \pm 1.33$  and  $18.52 \pm 1.71$ , respectively. Therefore, the mean weight gain during the experiment was for T1, T2 and T3 groups were  $8.21 \pm 1.09$ ,  $7.04 \pm 1.34$  and  $7.19 \pm 1.49$ , respectively. There was no significant difference was observed in mean fortnightly body weights as well as overall weight gain in lambs fed with Maize, Super Napier and Sorghum silage based TMR. Even though the difference was not significant, the lambs received maize silage based TMR recorded 1.17 and 1.02 kg more body weights over the lambs received Super Napier and Sorghum silage based TMR, respectively. The increased growth rates in lambs of T1 group might be due to increased DM intake compared to T2 and T3 groups.

The present observations are in agreement with Doherty *et al.* (1997), Kolver I(2001), Khan *et al.*(2011), Venkateswarlu *et al.* (2012), Jalajakshi *et al.* (2017), Keady *et al.*

(2020), Gebermariyam *et al.*(2021) who reported increased body weight gain in lambs fed with maize silage over other silage based diets.

### **5.5.2 Daily weight gain**

The average daily weight gains (g) of T1, T2 and T3 group lambs were  $91.22 \pm 12.18$ ,  $78.22 \pm 14.91$  and  $79.89 \pm 20.26$ , respectively and the difference among the groups was not significant. However, the lambs received maize silage based TMR recorded 13 and 11.33 g more average daily weight gain over the lambs received Super Napier and Sorghum silage based TMR, respectively. The increased average daily weight gain in lambs of T1 group might be due to increased DM intake compared to T2 and T3 groups. Similar to the present findings, several researchers Doherty *et al.*, 1997; Kolver *et al.*, 2001; Khan *et al.*, 2011; Venkateswarlu *et al.*, 2012; Jalajakshi *et al.*, 2017; Keady *et al.* 2020; Gebermariyam *et al.*, 2021 earlier reported increased daily weight gains in sheep fed with maize silage based diets compared to other silage based diets.

### **5.6 FEED CONVERSION RATIO (FCR)**

The mean feed conversion ratio of T1, T2 and T3 group lambs were  $4.63 \pm 1.19$ ,  $4.60 \pm 1.43$  and  $4.72 \pm 1.24$ , respectively (Table 9) and the difference among the groups was not significant. However, compared to the T1 and T3 groups, the FCR was 0.03 and 0.12 low in T2 group. The lower FCR in T2 group might be due to decreased dry matter intake of Super Napier based TMR compared to Maize and Sorghum based TMR. Contrary to the present findings, Sohail *et al.* (2010) in Sipli lambs reported higher feed efficiency in Maize silage based diets.

### **5.7 BODY CONDITION SCORE (BCS)**

The mean BCS values for T1, T2 and T3 groups at the beginning of the experiment was  $2.18 \pm 0.06$ ,  $2.15 \pm 0.042$  and  $2.18 \pm 0.04$  and at end of the experiment was  $2.9 \pm 0.05$ ,  $2.96 \pm 0.42$  and  $3 \pm 0.33$  (Table 10 ). The BCS was increased in increased in all the experimental groups during the experiment. However, significant difference was not

observed in mean BCS among the experimental groups. Each BCS unit was equivalent to the BW changes of 7.074 kg in sheep (Sezenler *et al.*, 2011). In this study, the body weight change between the fortnights within the group and between the groups was not less than 7 kg. Therefore, significant difference was not observed.

## 5.8 HEMATOLOGICAL PARAMETERS

The mean RBC count ( $10^6/\mu\text{L}$ ) in T1, T2 and T3 groups at the start of the experiment was  $9.93 \pm 0.21$ ,  $10.06 \pm 0.12$  and  $9.93 \pm 0.21$ , respectively and at the end the experiment was  $10.97 \pm 0.29$ ,  $11.86 \pm 0.25$  and  $11.52 \pm 0.37$ , respectively (Table 11) The RBC count was within the normal physiological range in all the experimental groups of lambs. Significant difference was not observed in RBC count among the experimental groups.

The mean haemoglobin (g/dL) values were  $10.15 \pm 0.22$ ,  $10.01 \pm 0.22$  and  $10.45 \pm 0.34$  (g/dL) at day one of the experiment and at the end of the experiment were  $10.43 \pm 0.23$ ,  $10.73 \pm 0.12$  and  $10.85 \pm 0.18$  for T1, T2 and T3 groups, respectively (Table 12). The haemoglobin values were within the normal physiological range in all the experimental groups of lambs. Significant difference was not observed in haemoglobin values among the experimental groups.

The mean PCV (%) values were  $33.5 \pm 0.88$ ,  $32.5 \pm 0.88$  and  $30.5 \pm 0.86$  at the start of the experiment and at the end of the experiment were  $43.83 \pm 1.4$ ,  $39.83 \pm 0.88$  and  $38.16 \pm 1.04$  (%) in T1, T2 and T3 groups, respectively (Table 13). The PCV (%) values were within the normal physiological range in all the experimental groups of lambs. The PCV (%) was significantly ( $P < 0.05$ ) high in T1 group compared to T2 and T3 groups, while the difference was not significant among T2 and T3 groups.

The mean values of MCV (fl) were  $26.38 \pm 0.42$ ,  $26.32 \pm 0.42$  and  $26.32 \pm 0.42$  at day one of the experiment and at the end of the experiment were  $25.75 \pm 0.5$ ,  $27.70 \pm 0.5$  and  $25.20 \pm 0.5$  (fl) in T1, T2 and T3 groups, respectively (Table 14). The MCV values were within the normal physiological range in all the experimental groups of lambs. Significant

difference was not observed in MCV values among the experimental groups.

The above results indicated that Maize, Super Napier and Sorghum silage based TMR does not have any influence on haematological profiles in sheep. The present results were in agreement with the findings of Mahanta and Pachauri (2004) who reported non-significant difference in haematological parameters among the sheep fed with different varieties of sorghum silages.

## **5.9 COST ECONOMICS**

### **5.9.1 Cost of preparation of Maize, Super Napier and Sorghum silages**

The production cost (₹) per kg of Maize, Super Napier and Sorghum green fodder was 0.62, 0.21 and 0.44, respectively (Table 15 -17). The lower production cost reported for Super Napier green fodder in the present study was due to high biomass production per unit area compared to Maize and Sorghum. Ramya *et al.* (2017) reported cost (₹) of production per kg of green COFS29, CO(CN)<sub>4</sub> and CO(CN)<sub>5</sub> was 0.50, 0.49 and 0.40, respectively which was higher compared to the Super Napier and comparable with sorghum fodder production reported in the present study. Wadhwa *et al.* (2010) reported cost (₹) of production of Bajra and Sorghum fodders as 0.20/kg and 0.26/kg, respectively, which was less compared to the cost of green fodder production in this study. This might be due to high labour charges and escalated cost of all inputs for cultivation of fodders as the previous works carried long back compared to the present work.

The cost per kg production of Maize, Super Napier and Sorghum silages was ₹ 3.22, 2.81 and 3.04, respectively (Table 18). Compared to the Maize silage, the cost per kg of Super Napier and Sorghum silages were ₹ 0.41 and 0.18 less, respectively which was due to low production cost of Super Napier and Sorghum green fodder.

### **5.9.2 Cost per kg weight gain**

The quantity (kg) of Maize, Super Napier and Sorghum silage based TMR fed to T1, T2 and T3 groups was 1535, 1314 and 1319, respectively. The total cost (₹) of Maize, Super Napier and Sorghum silage based TMR was 77721.44, 6175.71 and 6524.72, respectively. The total weight gain (kg) of the lambs in T1, T2 and T3 groups was 49.26, 42.24, 43.14, respectively. Therefore, the cost (₹) per kg weight gain in T1, T2 and T3 groups was 157.76, 146.21 and 151.25, respectively. Compared with Maize and Sorghum silage based TMR, feeding of Super Napier silage based TMR saved an amount of (₹) 11.55 and 5.04, respectively per kg weight gain in lambs. Compared to the Maize silage based TMR, feeding of Sorghum silage based TMR saved an amount of (₹) 6.51 per kg weight gain in lambs. Therefore, feeding of Super Napier silage based TMR is economical compared to the Sorghum and Maize silage based TMR under intensive system of lamb production.

### **Conclusions**

1. High biomass producing Hybrid Napier grasses like Super Napier may be popularizes for silage production in place of annual fodders like Maize and Sorghum for economic silage production.
2. Under intensive system of sheep production, Super Napier silage is good alternative to Maize and Sorghum silages for economic meat production.

# *Chapter - VI*

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*Summary*

## CHAPTER VI

### SUMMARY

The present research was carried to study the physicochemical properties of Maize, Super Napier and Sorghum silages and comparative efficacy of Maize, Super Napier and Sorghum silage based total mixed rations (TMR) on haematological profiles, body condition score, growth performance and cost per kg weight gain in Nellore lambs.

Maize, Super Napier and Sorghum silage bales were produced from the available fodder grown at fodder production unit of LFC, NTR CVSc, Gannavaram using silage baler. The physicochemical properties of the silages were measured. The effect of feeding Maize, Super Napier and Sorghum silage based total mixed rations (TMR) on haematological profiles, body condition score, growth performance and cost per kg weight gain was tested in 18 Nellore ram lambs of about 3 months age and body weights were randomly divided into 3 groups in a completely randomized design. The TMR was prepared by mixing the silage and concentrate about 90:10 ratio and assigned to three different groups i.e. T1 (Maize silage based TMR), T2 (Super Napier silage based TMR), T3 (Sorghum silage based TMR) as per their nutrient requirements.

The physical properties like colour, smell, consistency, sensory scores of Maize, Super Napier and Sorghum silages were  $3.63\pm 0.88$ ,  $5.46\pm 0.66$ ,  $3.46\pm 0.33$ ,  $12.56\pm 0.17$  and  $3.66\pm 0.33$ ,  $5.26\pm 0.12$ ,  $3.43\pm 0.33$ ,  $12.36\pm 0.12$  and  $3.63\pm 0.88$ ,  $5.36\pm 0.33$ ,  $3.53\pm 0.33$ ,  $12.53\pm 0.88$ , respectively. Significant difference was not observed in colour, smell, consistency, sensory score among Maize, Super Napier and Sorghum silages. The pH values observed for Maize, Super Napier, Sorghum silages in this study was 3.86, 4.00 and 3.93, respectively.

The mean dry matter (DM), organic matter (OM), crude protein (CP), ether extract (EE), crude fibre (CF), nitrogen free extract (NFE), total ash (TA), acid insoluble ash (AIA), calcium (Ca), Phosphorus (P), neutral detergent fibre (NDF), acid detergent

fibre (ADF) content of Maize silage was  $31.76\pm 0.58$ ,  $88.16\pm 0.60$ ,  $8.43\pm 0.10$ ,  $1.59\pm 0.02$ ,  $30.70\pm 0.88$ ,  $44.92\pm 0.64$ ,  $11.00\pm 0.01$ ,  $2.56\pm 0.13$ ,  $0.26\pm 0.007$ ,  $0.13\pm 0.004$ ,  $58.08\pm 0.34$  and  $36.96\pm 0.23$ , respectively. The similar values for Super Napier silage was  $31.14\pm 1.11$ ,  $89.28\pm 0.66$ ,  $8.68\pm 0.09$ ,  $1.61\pm 0.04$ ,  $37.81\pm 0.30$ ,  $43.73\pm 0.58$ ,  $10.05$ ,  $4.21\pm 0.35$ ,  $0.57\pm 0.35$ ,  $0.09\pm 0.01$ ,  $75.8\pm 0.54$  and  $52.10\pm 0.47$  respectively; and for Sorghum silage was  $31.76\pm 0.41$ ,  $87.92\pm 0.13$ ,  $8.64\pm 0.06$ ,  $2.36\pm 0.12$ ,  $35.21\pm 0.44$ ,  $36.49\pm 0.90$ ,  $11.93$ ,  $4.35\pm 0.83$ ,  $0.40\pm 0.018$ ,  $0.09\pm 0.01$ ,  $69.9\pm 0.60$  and  $51.31\pm 0.43$ , respectively. Significant difference was not observed in DM, OM, CP and TA % among Maize, Super Napier and Sorghum silages. The CF, NDF, ADF and NFE % was significantly ( $P<0.01$ ) high in Super Napier silage compared to Maize and Sorghum silages and the difference was also significant ( $P<0.01$ ) between Maize and Sorghum silages. The EE content was significantly ( $P<0.01$ ) high in sorghum silage, while the difference was not significant between Maize and Super Napier silages. The AIA content was significantly ( $P<0.01$ ) low in Maize silage while the difference was not significant between Sorghum and Super Napier silages. The calcium content was significantly ( $P<0.01$ ) high in Super Napier silage compared to Maize and Sorghum silages and the difference was also significant ( $P<0.01$ ) between Maize and Sorghum silages. The phosphorus content was significantly ( $P<0.01$ ) high in Maize, while the difference was not significant between Super Napier and Sorghum silages.

The mean fortnightly DMI was significantly ( $P<0.01$ ) high ( $6.33\pm 0.12$ ) in Maize silage based TMR than Super Napier ( $5.35\pm 0.09$ ) and Sorghum silage ( $5.61\pm 0.10$ ) based TMR, while the difference was not significant between Super Napier and Sorghum silage based TMR.

The mean fortnightly body weights (kg) observed on 1<sup>st</sup> day of the experiment for T1, T2 and T3 groups were  $12\pm 0.57$ ,  $11.33\pm 0.49$ ,  $11.33\pm 0.49$  kg, respectively and at the end of the experiment on 90<sup>th</sup> day were  $20.21\pm 0.98$ ,  $18.37\pm 1.33$  and  $18.52\pm 1.71$ ,

respectively. Therefore, the mean weight gain during the experiment for T1, T2 and T3 groups were  $8.21 \pm 1.09$ ,  $7.04 \pm 1.34$  and  $7.19 \pm 1.49$ , respectively. There was no significant difference observed in mean fortnightly body weights as well as overall weight gain in lambs fed with Maize, Super Napier and Sorghum silage based TMR. The average daily weight gains (g) of T1, T2 and T3 group lambs were  $91.22 \pm 12.18$ ,  $78.22 \pm 14.91$  and  $79.89 \pm 20.26$ , respectively and the difference among the groups was not significant. The mean feed conversion ratio of T1, T2 and T3 group lambs were  $4.63 \pm 1.19$ ,  $4.60 \pm 1.43$  and  $4.72 \pm 1.24$ , respectively and the difference among the groups was not significant.

The mean BCS values for T1, T2 and T3 groups at the beginning of the experiment was  $2.18 \pm 0.06$ ,  $2.15 \pm 0.042$  and  $2.18 \pm 0.04$  and at end of the experiment was  $2.9 \pm 0.05$ ,  $2.96 \pm 0.42$  and  $3 \pm 0.33$ . Significant difference was not observed in mean BCS among the experimental groups.

The mean RBC count ( $10^6/\mu\text{L}$ ) in T1, T2 and T3 groups at the start of the experiment was  $9.93 \pm 0.21$ ,  $10.06 \pm 0.12$  and  $9.93 \pm 0.21$ , respectively and at the end of the experiment was  $10.97 \pm 0.29$ ,  $11.86 \pm 0.25$  and  $11.52 \pm 0.37$ , respectively. The mean haemoglobin (g/dL) values were  $10.15 \pm 0.22$ ,  $10.01 \pm 0.22$  and  $10.45 \pm 0.34$  (g/dL) at day one of the experiment and at the end of the experiment were  $10.43 \pm 0.23$ ,  $10.73 \pm 0.12$  and  $10.85 \pm 0.18$  for T1, T2 and T3 groups, respectively. The mean PCV (%) values were  $33.5 \pm 0.88$ ,  $32.5 \pm 0.88$  and  $30.5 \pm 0.86$  at the start of the experiment and at the end of the experiment were  $43.83 \pm 1.4$ ,  $39.83 \pm 0.88$  and  $38.16 \pm 1.04$  (%) in T1, T2 and T3 groups, respectively. The mean values of MCV (fl) were  $26.38 \pm 0.42$ ,  $26.32 \pm 0.42$  and  $26.32 \pm 0.42$  at day one of the experiment and at the end of the experiment were  $25.75 \pm 0.5$ ,  $27.70 \pm 0.5$  and  $25.20 \pm 0.5$  (fl) in T1, T2 and T3 groups, respectively. There was no significant difference observed in haematological parameters among the groups except PCV% which was significantly ( $P < 0.01$ ) high in T1 group than T2 and T3 groups, while the difference was not significant between T2 and T3 groups.

The production cost (₹) per kg of Maize, Super Napier and Sorghum green fodder was 0.62, 0.21 and 0.44, respectively. The cost per kg production of Maize, Super Napier and Sorghum silages was ₹ 3.22, 2.81 and 3.04, respectively. Therefore, the cost (₹) per kg weight gain in T1, T2 and T3 groups was 157.76, 146.21 and 151.25, respectively. Compared with Maize and Sorghum silage based TMR, feeding of Super Napier silage based TMR saved an amount of (₹) 11.55 and 5.04, respectively per kg weight gain in lambs. Compared to the Maize silage based TMR, feeding of Sorghum silage based TMR saved an amount of (₹) 6.51 per kg weight gain in lambs. Therefore, feeding of Super Napier silage based TMR is economical compared to the Sorghum and Maize silage based TMR under intensive system of lamb production.

# *Chapter - VII*

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