

STUDIES ON FEEDING VARIOUS LEVELS OF PELTOPHORUM LEAVES ON THE GROWTH PATTERN OF WEANED OSMANABADI KIDS

BY

MASKE DAMODHAR NARAYANRAO
M.Sc.(Agri.)

T 5458

THESIS

Submitted to

the Marathwada Agricultural University

in partial fulfilment of the

requirement for the Degree of



DOCTOR OF PHILOSOPHY
IN
LIVESTOCK PRODUCTION AND MANAGEMENT

DEPARTMENT OF ANIMAL HUSBANDRY AND DAIRYING
MARATHWADA AGRICULTURAL UNIVERSITY
PARBHANI (Maharashtra) INDIA

2004

Affectionately Dedicated

To My

Beloved Parents

CANDIDATE'S DECLARATION

I hereby declare that this thesis or part

thereof, has not been previously

submitted by me to any other

University or Institution for

the award of degree

or diploma.

Place : PARBHANI

Date : 15th JULY, 2004


(D. N. MASKE)

Prof. M.B. Bhosale

M.Sc. (Agri.),

Associate Professor

Department of Animal Husbandry and Dairying

Marathwada Agricultural University


Parbhani - 431 402 (M.S.)

CERTIFICATE-I

This is to certify that the thesis entitled "**STUDIES ON FEEDING VARIOUS LEVELS OF PELTOPHORUM LEAVES ON THE GROWTH PATTERN OF WEANED OSMANABADI KIDS**" submitted by Shri. **MASKE DAMODHAR NARAYANRAO** to the Marathwada Agricultural University, Parbhani in partial fulfilment of the requirement for the degree of **DOCTOR OF PHILOSOPHY** in the subject of **LIVESTOCK PRODUCTION AND MANAGEMENT** is record of original and bonafide research work carried out by him under my guidance and supervision. It is of sufficiently high standard to warrant its presentation for the award of the said degree. I also certify that the thesis or part thereof has not been previously submitted for a degree of any other university.

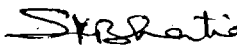
PARBHANI

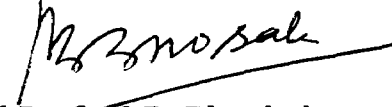
Date : 15th July 2004


(**Prof. M.B. Bhosle**)
Research Guide

CERTIFICATE-II

This is to certify that the thesis entitled "**STUDIES ON FEEDING VARIOUS LEVELS OF PELTOPHORUM LEAVES ON THE GROWTH PATTERN OF WEANED OSMANABADI KIDS**" submitted by Shri. **MASKE DAMODHAR NARAYANRAO** to the Marathwada Agricultural University, Parbhani in partial fulfilment of the requirement for the degree of **DOCTOR OF PHILOSOPHY** in the subject of **ANIMAL HUSBANDRY AND DAIRYING (LIVESTOCK PRODUCTION AND MANAGEMENT)** has been approved by the student's advisory committee after viva-voce examination in collaboration with the external examiner.

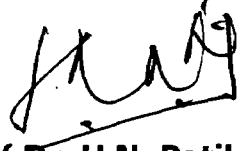

(S.K. Bhatia)
External Examiner


(Prof. M.B. Bhosle)
Research Guide

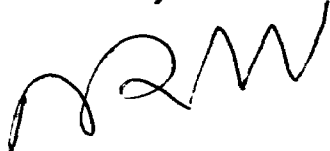
Advisory committee:


Head
Department of of AH & D
MAU, Parbhani.


(Dr. A.T. Sontakke)


(Dr. H.N. Patil)

Associate Dean (P.G.)
College of Agriculture
MAU, Parbhani.


(Dr. P. R. Waghmare)

ACKNOWLEDGEMENT

Formal words cannot carry the fragrance of emotions with them, still those are only available means of expressing emotions in such a formal acknowledgement.

I have immense pleasure in expressing my whole hearted sense of gratitude and indebtedness towards my guide Prof. M.B. Bhosale, Associate Professor, Dept. of Animal Husbandry and Dairying, Marathwada Agricultural University, Parbhani for suggesting need based research project, guidance and for critical review of the manuscript leading to completion of dissertation. I am indebted to him for this achievement.

With profound respect, I acknowledge the indebtedness to Dr. V.M. Pawar, Vice-Chancellor, Marathwada Agricultural University, Parbhani for providing necessary facilities and help during my research.

I am deeply indebted to Dr. M.V. Dhoble, Associate Dean and Principal and Associate Dean (P.G.), College of Agriculture, MAU, Parbhani for his help and inspiration.

Indeed the words at my command are not adequate either in form or in spirit to convey the depth of feeling gratitude to Dr. G.R. Patil, Head, Dairy Technology Division, NDRI, Karnal and Dr. A.T. Sontakke, Associate Professor, (Dairy Microbiology) for their benevolent suggestion in the planning and conduct of this investigation.

I take the privilege of expressing my deepest thanks to Dr. L.M. Karanjkar, Professor and Head, Dept. of Animal Husbandry and Dairy Science, MAU, Parbhani for the and valuable help in completion of this research work.

I record my deep sense of gratitude to the members of my advisory committee, Dr. H.N. Patil, Dept. of Agril. Economics and Dr. P.R. Waghmare, Associate Professor for their valuable suggestions during the conduct of research and preparation of the manuscript.

It is great pleasure to acknowledge the unfailing help rendered by Dr. N.V. Joglekar, Prof. B.R. Deshmukh, Dr. R.P. Barbind, Dr. K.R. Mitkari, Dr. A.A. Shah and Prof. D.D. Joshi for their time to time suggestions.

I do share love with my friends and colleagues who offered their warmer affection throughout my stay in this Institution. In view of this, I place thanks to Shri. Vinayak Dhond, Chandrashekar Dahale and Kuttabadkar H.K. for their much needed and timely help.

Words are not sufficient to express my devotion and gratitude to my uncle Shri. Baliramji Maske, brothers Gangadhar Maske, Prakash Maske, Madhukar Maske and cousin Dilip for their much needed and timely help.

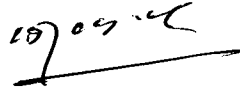
I will be guilty if I forget to thank and love to M.H. Shaikh, Ex-Director Central farm, Dr. R.A. Katare and A.M. Bhosale for their constant help to complete my research work.

Last but not the least I take this opportunity to express my heartfelt gratitude to my ever loving wife Sau. Chandrakala, son Babu and daughter-in-law Sau. Sunanda for their kind co-operation in my odd-even times.

I record my special thanks to Mr. M.A. Khaleque for his cooperation and valuable help in type setting of this dissertation.

PARBHANI

Date : / /2004


(MASKE D. N.)

CONTENTS

Chapter	Title	Pages
1	INTRODUCTION	1-5
2	REVIEW OF LITERATURE	6-51
3	MATERIALS AND METHODS	52-57
4	RESULTS AND DISCUSSION	58-96
5	SUMMARY AND CONCLUSION	97-104
	LITERATURE CITED	i-xvi
	APPENDIX	I-XI

LIST OF TABLES

Table No.	Title	In between pages
1	Tannin content of <i>Peltophorum pterocarpum</i> tree leaves, young shoots, green pods and dry pods (per cent on DM basis).	58-59
2	Per cent chemical composition (on DM basis) of <i>Peltophorum pterocarpum</i> .	59-60
3	Treatment and period effect on nutrient intake of experimental kids (per cent body weight)	61-62
4	Effect of treatment and period on nutrient digestibility coefficients in the experimental kids	65-66
5	Effect of treatment and period on daily nutrient intake balance (g) and per cent retention	75-76
6	Effect of treatment and period on daily body weight gain (g) and monthly linear body measurements (cm) of experimental kids.	84-85
7	Effect of treatments and period on DM, DCP and TDN requirement (kg) for one kg body weight gain in kids	88-89
8	Comparison between sole feeding (T ₅) and all other treatments for various parameters	92-93
8	Correlation coefficient	95-96
10	Multiple linear regression analysis of body weight gain on different growth attributes	95-96

LIST OF FIGURES

Fig No.	Title	In between Pages
1	Tannin content of <i>Peltophorum pterocarpum</i> tree leaves, young shoots, green pods and dry pods (per cent on DM basis).	58-59
2	Treatment and period effect on nutrient intake of experimental kids (per cent body weight)	61-62
3	Effect of treatment and period on nutrient digestibility coefficients in the experimental kids	65-66
4	Effect of treatment on daily nutrient intake balance (g) and per cent retention	75-76
5	Effect of period on daily nutrient intake balance (g) and per cent retention	75-76
6	Effect of treatment and period on monthly linear body measurements (cm) of experimental kids.	88-89
7	Effect of treatments and period on DM, DCP and TDN requirement (kg) for one kg body weight gain in kids	92-93

ABBREVIATIONS

ADF	acid detergent fibre
Ca	Calcium
CF	Crude fibre
Cm	centimeter
CHO	carbohydrate
CP	crude protein
Cv	cultivar
d	day
DM	dry matter
DCP	digestible crude protein
DDMI	digestible dry matter intake
DE	digestible energy
DMD	dry matter digestibility
EE	ether extract
FAO	Food and Agriculture Organization
Ft.	feet
Fig.	Figure
g	gram
kg	kilogram
lb	pound
mm	millimetre
ml	millilitre
Min	minimum
Max	maximum
N	nitrogen
NFE	nitrogen free extract

NDF	neutral detergent fibre
NDFD	neutral detergent fibre digestibility
NRC	National Research Council
NE	Net energy
Na	Sodium
OM	organic matter
OMD	organic matter digestibility
P	Phosphorus
S.E.	Starch equivalent
SPP	species
TCHO	total carbohydrate
TDN	total digestible nutrients
VFI	voluntary feed intake
$W^{0.75}$ kg	metabolic body size weight
wks	weeks
CTs	condensed tannins
HTs	Hydrolyzable tannins



INTRODUCTION

1. INTRODUCTION

The goat population in developing countries accounts for 94 per cent of total world goat population and about 23 per cent of all grazing ruminants. In developing countries they are found across all agro-ecological environments (Devendra, and Lokashwara Rao 1992).

The goat population in India is 126 million (23 per cent of total animal population in the country). They produce about 0.48 million tonnes meat, 1.684 million tonnes of milk, 0.085 million tonnes pashmina and 0.109 million kg skin in addition to 390 thousand tonnes of manure (Annual Report, CIRG, 2002-03).

The goat population increased from about 60 million in 1961 to about 108 million in 1987 which amounts to an increase of 80 per cent. The goat population projected for 2002 was 230 million.

In Maharashtra State, the goat population increased from 5.18 million in 1961 to about 8.09 million in 1987. However, based on the past trend the projected goat population of Maharashtra state for the year 2002 were 11.06 million (Pandey, 1992).

The goat population of Parbhani district as per 15th Livestock Census 1992, was 387235.

India has the world's best dairy buffaloes, draught cattle, carpet wool sheep and prolific goats. Their genetic potential however has not been fully exploited mainly due to various physical, environmental, nutritional and health constraints. Even increasing human population requires enhanced livestock production. This can be achieved by increasing the animal productivity for which both increased amount and better quality of feed will be required.

India is short of feed resources (Nutrition Committee of ICAR, 1954, NCA, 1976, Govt. of India, 1978; Ranjhan, 1994; NDRI, 1996). This shortage is constantly with us. The quantity of feed resources available were increased from 1954 to 1996 by about 70 per cent.

Correspondingly, there was an increase in animal population by 80 per cent. Therefore, the availability of feed for animals remained the same, although in absolute terms there was an increase. The bovine population is increasing at an annual rate of 1.5 per cent. The area under fodder production has decreased to 3.3 per cent (Kelly and Rao, 1994). The crop residues availability has increased by 300 MT. The compound livestock feed production has also increased (8 million tonnes), but still we are not able to meet the requirement. It is estimated that a developing countries like India would be short of 1300 million tonnes of feed and fodder by 2000 (Kelley and Rao, 1994).

It is indeed a fact that feed and fodder resources of the country are scarce and inadequate. The latest among these estimates is the 1993 report of the policy advisory group on integrated grazing policy, Ministry of Environment and Forest, which shows deficit 31 per cent dry fodder, 23 per cent green and 47 per cent concentrates. The total area of the CPRs has shrunk by 30 per cent, 130 million ha between 1950 and 1990 (Kurup 2000). Unconventional feeds such as agricultural wastes / byproducts of top feeds (leaves of trees and shrubs) have been drawing attention of the scientific community for the last two decades. Over the past 10-15 years, interest and research activity in the use of tree legumes has grown exponentially and as a result multipurpose tree legumes are increasingly recognised for their capacity to enhance the productivity and sustainability of tropical agriculture systems both in developed and developing countries of the world.

Tree legumes can provide high quality forage for ruminants, contribute high protein to supplement crop residues and other low quality feeds.

Tree legumes as dietary supplements for ruminants

Leguminous tree leaves have traditionally been fed as supplements to housed and tethered animals in Asia, Africa and the Pacific islands, species such as *leucaena-leocephala* have also been grown with grasses in fodder banks to provide a source of high quality forage for ruminants raised in cut and carry system.

Legume tree leaves maintain higher protein and mineral content during growth, than do grasses which decline rapidly in quality with progress to maturity.

Legume tree foliage is therefore useful as a protein supplement. There is increasing interest in the use of these trees as source of high quality feed for grazing ruminants and as a supplements to improve the productivity of ruminants given low quality feeds.

Although not all forage trees are legumes, more than 200 species of leguminous trees are reported to be used as forage and most species are being tropical or subtropical in origin. The most common species are from the genera, *acacia*, *albizia*, *calliantra*, *deshmanthus*, *desmodium*, *gliricidia*, *leucaena*, *prosopis* and *sesbania*.

The legumes are the third largest group of flowering plants. Comprising over 18000 species in 650 genera, which are well distributed in most environments throughout the world. Taxonomists have divided the legumes into three families.

1. The caesalpiaceae contains about 2800 species most of which are trees of tropical savannas and forests of Africa, South America and Asia (Williams, 1983).

2. Mimosaceae also contains about 2800 species. These are predominantly small trees and shrubs of semi-arid tropical regions of Africa, America and Australia. Acacia species are the best known examples of this family.
3. Fabaceae contains over 12000 species many herbs and small shrubs distributed world wide and includes the well known grain legumes, such as beans and peas.

Peltophorum

The genus is derived from Greek word 'Peltophoros' 'A shield bearer'. The genus comprises about 7 species of trees, all natives of the tropics of which 3 species are grown in India.

1. *Peltophorum pterocarpum* (Syn. *P. Ferrugineum*) Resty Shield bearer, brazillatto Wood.
2. *Peltophorum africanum*
3. *Peltophorum brasiliense*

Peltophorum pterocarpum, the species is a native of Sri Lanka, the Andemans, Malaysia and North Australia. It is grown extensively in India and many other countries for its ornamental value. *Peltophorum pterocarpum* local name (Radhachura) is also called Sonmohar, Bronzepods and 'yellow poinciana' tree. It is a partially deciduous big tree with grey bark, handsome foliage, reaching upto 20 meter in height, leaves fern like, bipinnate, 30.50 cm long, 20.30 cm broad pinnate, 4-13 apposite pairs each one 5-15 cm long, with 8-18 pairs, opposite leaflets, dark shiny green above, whitish below nearly 2 cm long, 6-7 cm broad flowers on 15-20 cm, long terminal panicals about 2-5 cm across sepals 5, petals 5, roundish, crinkled, yellow, stamens 10 free, unequal fruit a flat, elongated shield shaped copper coloured pod, turning

almost black on maturity, 4-6 cm long, 2-3 cm broad, incandescent woody broadly winged containing 1-3 elongated seeds.

Peltophorum pterocarpum trees are planted along the road sides of University campus and in the town as an ornamental plant. It is observed that many Farm workers working in the University campus having goats, carry some foliage daily for feeding goats at their home. Goats consume this foliage but there is no research report of feeding peltophorum to goats and its nutritive value in the literature. Hence, an investigation on "Studies on feeding various levels of peltophorum tree leaves on the growth pattern of weaned Osmanabadi kids" was undertaken to solve the problem of feeding to some extent.

The objectives of the investigation are :

1. To study the chemical composition and quality assessment of peltophorum a forage tree legume for small ruminants (kids).
2. To study the effect of crude protein replacement in the ration of kids by *Peltophorum pterocarpum*.
3. To study the dry matter intake and its effect on growth / production.
4. To study the incriminating factors like phenols, alkaloids, etc. present in peltophorum.



REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

2.1 Toxic principles

The level of toxins depends upon the plant species, plant variety, the season of the year, the geographic and climatic factors, the level of intake and the species variation in the metabolism and disposition (Paterson, 1993).

✓ Thakur *et al.* (1982) reported tannin content as 5.6 per cent in jack (*Abrocarpus integrifolia*) tree leaves on DM basis.

✓ Panda *et al.* (1983) reported pipal leaves contain 0.70 per cent Tannic acid against 6-50 per cent in Jamun leaves on DM basis.

✓ Sehgal (1984) reported tannin content of pala leaves (7.13) per cent and the *Ardu* leaves the least (0.25 per cent). Kekra 2.01 and Zhinji 2.92, Khejri 2.18 and grafted ber leaves 1.46 per cent on dry matter basis.

✓ Kundu *et al.* (1985) reported 3.80 per cent tannin content of mango leaves (*Mangifera indica*) on dry matter basis.

✓ Joshi *et al.* (1985) reported 10.6 to 25.8 per cent tannic acid in *Prosopis cineraria* leaves, trees were 15 to 55 years old and from 6.5 m to 12.5 m height. Newly emerging leaves contained higher percentage than old leaves.

✓ Majgaonkar *et al.* (1987) observed 2.6 per cent tannin content in Gumhar or sesan (*Gmelina arborea*) tree leaves on dry matter basis.

✓ Panda *et al.* (1987) reported tannin content of leaves of *Calliandra calothyrsus* as 5.85 per cent on dry matter basis.

Yadav and Yadav (1988) estimated tannin content of different parts of subabul cultivars. The maximum value of tannin was estimated in dry pods followed by that in leaves, young shoots stems and green pods contained almost equal amount of tannin. However, it was lowest in seeds. The cultivars differed in tannin content of different parts. In general it was observed that K 8 cultivar contained lowest amount of tannin than the other cultivars and the leaves, young shoots and dry pods of Dehradun cultivar contained highest value of tannin.

Bhuyan *et al.* (1989) observed 4.6 per cent tannic acid in banana (*Musa spp.*) leaves on dry matter basis.

Singh *et al.* (1989) reported tannic acid content of Gogum (*Zurauia Napalensis*) as 1.99 per cent on dry matter basis.

Kathiresan and Veera Ravi (1990) reported seasonal changes in tannin content of Mangrove leaves collected from Pichavaram forest as follows.

Species	Tannin content (mg/g) dry weight			
	Pre monsoon	Monsoon	Post monsoon	Summer
<i>Acanthus ilicifolius</i>	3.28	6.96	15.76	16.14
<i>Acgiceras corniculatum</i>	4.52	7.14	8.88	12.52
<i>Avicennia marina</i>	2.62	3.90	5.54	9.28
<i>A. officinalis</i>	3.38	8.22	5.56	11.80
<i>Bruguicra cylindrica</i>	8.38	13.12	13.96	16.40
<i>Ceriops decandra</i>	7.54	11.84	15.88	16.24
<i>Excoechria agallokra</i>	3.64	12.94	17.78	21.44
<i>Lumplizera racemosa</i>	2.14	6.92	8.56	10.28
<i>Rhizophora apiculata</i>	8.80	8.30	15.84	15.84
<i>R. mucronata</i>	7.12	8.72	10.66	13.78
<i>Salicornid brachita</i>	10.88	12.12	11.72	13.56
<i>Sesivium portulacastum</i>	2.94	4.82	5.46	20.02
<i>Suaeda maritima</i>	4.58	4.50	5.64	8.14
<i>S. monoica</i>	3.40	3.52	3.88	6.30

✓ Nag and Matai (1992) determined antinutritional factors of some fodder tree leaves in and around Calcutta. The values observed were as follows.

	Polyphenols	
	Free	Bound
<i>Acacia suma</i>	5.49	0.71
<i>Adenantha pavoniana</i>	5.88	1.41
<i>Ailanthus excelsa</i>	3.08	3.81
<i>Albizia lebbek</i>	1.29	0.56
<i>Albizia procera</i>	6.37	1.96
<i>Anthocephalous cadamba</i>	7.86	0.75
<i>Cassia nodosa</i>	4.25	0.65
<i>Cassia saina</i>	4.54	0.80
<i>Cassia tora</i>	6.09	1.50
<i>Dalbergia latifolia</i>	1.80	1.13
<i>Dalbergia sisso</i>	7.07	1.23
<i>Gliricidia maculata</i>	3.85	1.14
<i>Moringa oleifera</i>	6.62	0.83
<i>Peltophorum pterocarpum</i>	17.65	1.36
<i>Pongamia pinnata</i>	4.63	3.52
<i>Samanea saman</i>	3.61	7.71
<i>Sesbania grandiflora</i>	2.54	6.04
<i>Toona ciliata</i>	7.35	0.66
<i>Trema orientalis</i>	2.21	4.88
<i>Trewia nudiflora</i>	10.54	3.04

There are only six species which contain less than 6 per cent of polyphenols. Plants containing more than 6 per cent polyphenols are considered to be of low digestibility value.

✓ Dharia *et al.* (1993) studied the potential of glyricidia as a fodder. The observed level of tannins in glyricidia leaves was only 1.73 per cent on dry matter basis.

✓ Nag *et al.* (1994) reported that the tannin and associated polyphenols found in *Paraserionthus folacatari*, *Caesalpania coriaria*, *Jacoranda mimosaeifolia*, *Sterculia folida*, *Tecoma stans* and *Thespesia populnea* as 14.93, 5.68, 11.58, 7.47, 14.37 and 9.15 per cent, respectively..

✓ Waghorn *et al.* (1994) reported 55 g/kg condensed tannin 55 g/kg in lotus dry matter (*Lotus pendunculatus*). The condensed tannin accounted for 5.5 per cent of lotus dry matter.

✓ Mondal *et al.* (1994) reported 2.04 ± 0.06 per cent tannin content of Banyan tree (*Ficus bengalensis*) leaves on dry matter basis.

✓ Mandal *et al.* (1995) reported that the average tannin content of pipal tree leaves as 1.05 ± 0.07 per cent on dry matter basis.

✓ Pankaj Biswas *et al.* (1995) reported toxic principles of some common plants. Tannin content ranged from 0.529 per cent to 5.92 per cent being lowest in Mandar seeds (0.529 per cent) and maximum in blue bell leaves (5.92 per cent).

Degan *et al.* (1995) reported tannin content as (Tannic acid equivalent to 11.38 and condensed tannin as leucocyaniden equivalent to 8.3 per cent in dry matter of *Aecacia sulingna* leguminous tree.

Singh *et al.* (1999) reported seasonal variation in chemical composition of important tree leaves of Bundelkhand region. The five tree fodders namely Arjun, Babool, Kardhaie, Mahaneem and Siris were evaluated for summer, rainy and winter seasons. The mean tannin content was highest during summer followed by rainy and winter season.

The average 10.45 per cent tannin content was highest in *H. binata* and 1.77 per cent lowest in *A. lebbek*.

Raghavendra Bhatta *et al.* (1999) reported 14.86, 9.64 and 5.77 per cent tannin content in tamarind seed husk (TSH), gram husk (GH) and salseed meal (SSM), respectively.

Vaithiyanathan *et al.* (1999) reported phenolics contents (gallic acid equivalents) in representative samples under different lopping management as 4.88 ± 0.18 , 4.49 ± 0.14 , 5.26 ± 0.23 and 4.03 ± 0.1 mg/100 g in leaves of fully lopped, samples of young trees, two third lopped samples of young trees, two third lopped samples of adult trees and fully lopped samples of adult trees, respectively of Khejri (*Prosopis cineraria*) tree.

Dehuri *et al.* (2000) studied the nutritive value of Tentulia (*Aeschynomene americana*) in goats and found that the tannin content was 2.09 per cent on dry matter basis.

Sharma *et al.* (2000) reported total phenolics, condensed tannins and the hydrolysable tannins of eleven tree fodders commonly available in Shivalic range (per cent in DM) as follows.

Tree forage	TP	CT	HT
<i>Bauhinia variegata</i>	5.41	4.20	1.21
<i>Butea monosperma</i>	1.01	0.30	0.75
<i>Grewia optica</i>	1.33	0.07	1.26
<i>Ficus religiosa</i>	1.63	0.46	1.17
<i>Morus alba</i>	0.75	0.06	0.69
<i>Quercus dilatata</i>	4.65	0.78	3.87
<i>Q. leucotricophora</i>	2.97	0.98	1.99
<i>Salix alba</i>	0.80	0.09	0.71
<i>Melia azedarach</i>	1.30	0.12	1.18
<i>Olea ferruginea</i>	1.21	0.06	1.15
<i>Carrisa spinarum</i>	4.90	4.53	0.37

Yadav and Bhadoria (2001) assessed the antinutritional factors of *Bauhinia purpurea*, *Leucaena diversifolia* and *Albizia procerra* in terms of total phenolics (TP), condensed tannin (CT) and proanthocyanidins (PA). The investigation revealed that *B. purpurea* contained, TP 154.73 ± 1.28 mg/g (CT/PA 195.05 mg/g) and *L. diversifolia* (TP) 42.53 ± 0.23 mg/g and (CT)/PA) 21.07 mg/g and *Albizia procerra* (TP) 25.053 ± 0.001 (CT) /; PA 16.43 mg/g

Rajendiran and Kadriyal (2002) studied the nutritive value of casuarina leaves (cladode) for goats and reported that casuarina leaves contained 5.26 per cent tannin in sundried samples.

Jain *et al.* (2002) studied chemical and biochemical composition of neem (*Azadirachta indica*) leaves in relation to soils of different agroclimatic zones and observed that polyphenol content of leaves varied between 2.42 per cent (Phulbani) and 7.10 per cent (Shahdo).

2.2 Chemical composition

Jayal and Sahai (1960) reported chemical composition of Gauj (*Millettia auriculata*) leaves as CP 22.68, EE 4.57, CF 32.50, NFE 30.93, TCHO 63.43, Ash 9.32, Ca 1.923 and P 0.28 per cent on DM basis.

Joshi and Thalpatra (1960) reported chemical composition on dry matter basis of Bhimal (*Grewia oppositifolia* Roxb.) tree for July cut as OM 88.66, CP 20.47, True protein 14.12, Amides 6.35, EE 3.56, CF 20.21, NFE 44.42 and Ash 11.34 per cent and for September cut OM 88.09, CP 18.87, True protein 15.50, amides 3.37, EE 3.67, CF 19.54, NFE 46.01 and Ash 11.91 per cent, respectively.

Hussain Mia *et al.* (1960) observed chemical composition of pipal (*Ficus religiosa*) leaves on DM basis as CP 13.99, CF 22.36, EE 2.71, NFE 46.02, Ca 4.61 and P₂O₅ 0.52 per cent.

Pal *et al.* (1979) studied chemical composition of 26 species of fodder trees of Himachal Pradesh during the month of April, August and December. The average seasonal chemical composition of 22 species of fodder tree leaves (per cent in dry matter) as given below.

Month of sampling	CP	EE	CF	NFE	TA	Ca	P
April	16.69	1.56	22.47	48.60	10.68	2.26	0.20
August	14.69	2.77	30.28	40.68	11.58	2.38	0.15
Dec.	14.32	2.86	19.66	50.83	12.33	3.21	0.16

Lohan *et al.* (1980) studied the cell wall constituents of some fodder trees in Himachal Pradesh. The average chemical composition (% DM) of 22 species of fodder trees as per detergent system of feed analysis is given below.

Month of sampling	CP	NDF	Cell content	ADF	Hemi-cellulose	Lignin	Cellulose	Silica
April	16.69	58.4	41.6	40.8	17.6	12.4	25.4	2.09
August	14.69	56.7	43.3	43.5	13.2	12.8	27.6	3.2
Dec.	14.32	54.5	45.5	40.01	14.4	13.1	23.7	3.3

Singh (1981) reported approximate composition (per cent) of top feeds of Ardu, Arjun, Babul pods, Bamboo, bans, bel, biul, dhaman Gular Kankera, Kachhnar, Kharpat, Kharik, Khejri, Kheri, Koo babul, Neem, pala, pipal, sainjana, Timla, Tut and Zinza, tree leaves. The dry matter content varied from 20 to 40, CP 12 to 15 CF 7.7 to 27 per cent in tree leaves.

Deshpande (1981) reported the chemical composition of green Dashrath as CP 15.33, CF 19.46, EE 3.58, NFE 50.55 and ash 9.95 per cent on DM basis containing 26.72 per cent dry matter.

Singh and Patnayak (1981) observed chemical composition of neem (*Azadirachta indica*) per cent on DM basis as 15.8 CP, 3.51 EE, 11.79 CF, 11.2 ash, 2.76 Ca and 0.15 per cent P on DM basis.

Thakur *et al.* (1982) reported chemical composition of jack (*Artocarpus integrifolia*) tree leaves as CP 11.35, EE 2.38, CF 16.19, NFE 58.88, total ash 10.20, Ca 1.41 and P 0.13 per cent on DM basis.

Upase *et al.* (1982) who reported chemical composition (% DM basis) of tree leaves and shrubs available throughout the year, is as given below.

Local name	CP	EE	CF	NFE	TA	Ca	P
Shawari leaves	26.50	0.90	12.20	47.10	13.30	2.78	0.43
Glyricidia	14.50	3.90	14.80	58.30	8.50	1.40	0.52
Tamarind leaves	13.50	6.80	18.00	52.20	9.50	2.28	0.24
Ber leaves	13.00	3.00	18.00	55.00	11.00	2.16	0.18
Anjan elaves	12.60	5.99	21.00	54.28	6.13	1.20	0.46
Banyan leaves	9.7	3.00	23.00	50.30	14.00	2.43	0.18
Pipal leaves	9.30	2.70	17.00	55.20	16.80	2.92	0.21
Jambool leaves	8.40	4.30	17.30	63.40	6.60	1.30	0.17
Babul leaves	7.00	2.50	33.50	51.00	6.00	1.21	0.11
Mange leaves	7.80	3.80	21.10	54.00	13.30	4.24	0.11
Koo babool	27.80	3.20	10.40	55.10	3.50	--	--
Dashrath grass	12.50	2.40	38.30	59.00	5.80	--	--

Kaldate (1982) observed the chemical composition of green Dashrath as CP 15.36, CF 20.24, EE 3.60, NFE 50.51 and ash 10.30 per cent on DM basis containing 26.92 per cent dry matter..

Sehgal and Bhatira (1982) observed percentage chemical composition of pala leaf (*Ziziphus nummularia*) as NDF 67.8, cell soluble 33.2, ADF 62.3 hemicellulose 5.5 lignin 20.20, silica 18.3, cellulose 23.8 CP 13.6 and lignin bounded CP 11.4 per cent on DM basis.

Singh and Gupta (1983) reported chemical composition (% DM basis) of dry Jhanji (*Seripus articulatus*) aquatic plant as OM 83.35, CP 9.05, EE 2.11, CF 30.21, NFE 41.98, TA 16.65, Ca 0.65 and P 0.12 per cent.

Panda *et al.* (1983) observed percentage chemical composition of pipal and Jamun tree leaves as OM 92.95 and 96.17, CP 15.75 and 14.00, EE 5.53 and 5.56, CF 24.56 and 25.70, NFE 47.11 and 50.91, TA 7.05 and 3.83, Ca 1.42 and 1.23 and P 0.36 and 0.14 per cent, respectively.

Kundu *et al.* (1983) observed chemical composition of Ingadulcis (*Pithecellobium dulce*) on per cent DM basis as CP 20.3, EE 7.5, CF 19.8, NFE 43.1, ash 9.3, Ca 2.2, P 0.3 DM was 34.5.

Sehgal (1984) stated chemical composition of dried pala (*Ziziphus nummularia*) leaves as such as DM 92.34 OM 89.8, Ta 10.15, CP 15.36, Cf 14, EE 2.74, NFE 57.15, CE 4.93 and P 0.15 per cent, NDF 41.05, ADF 32.19 cell soluble 58.95, hemicellulose 8.85, cellulose 17.95, lignin 11.37 silica 2.28.

Kundu *et al.* (1985) reported chemical composition of mango (*Mangifera indica*) leaves as DM 40.50, CP 9.63, EE 4.08 CF 6.63, NFE 50.61, TA 9.02, Ca 2.07 and P 0.18 per cent on DM basis.

Mehta and Bhaid (1985) reported chemical composition (*Proximate analysis of Arjun (Terminalla arjuna Roxb) green leaves as DM 39.66, OM 34.06, CP 3.98, EE 0.88, CF 5.17, NFE 24.02, TCHO 29.19, Ash 5.99, ca 1.80 and P 0.015 per cent and for dry leaves DM 100, OM 85.89, CP 10.05, EE 2.22 CF 13.04, NFE 60.58, TCHO 73.62 ash 14.11 Ca 2.73 and P 0.13 and Van Soet's analysis for green leaves. NDF 17.21, cell content 22.44, ADF 11.17, cellulose 7.88, HC 5.44, lignin 4.10 per cent and for dry leaves 43.41 NDF, 56.59 CC, 29.68 ADF, 19.87 cellulose, 13.73 HC and 10.34 lignin per cent on DM basis.*

Saha *et al.* (1985) reported chemical composition of grasses, fodder tree leaves and some conventional fodder crops of Andamans island of India. 75 per cent forages contained CP above 10 per cent out of 44 samples analysed. 12 samples were found to contain above 15 per cent, crude fiber content of the forages ranged from 5.96 to 40.45 per cent. However, out of 44 samples, 20 samples contained CF less than 20 per cent. The calcium and phosphorus contained were 0.99 and 0.17 per cent, respectively.

Joshi *et al.* (1985) reported chemical composition of *Prosopis cineraria* leaves as protein content was from 9.9 to 21.9, NDF 55.8 to 64.3, ADF 32.7 to 49.3 and lignin 14.8 to 30.6 per cent on DM basis.

Marimuthu and Subbarayalu (1986) stated nutritional characters of different tree leaves (per cent on DM basis) as follows.

Local name of fodder tree leaves	CP	EE	CF	NFE	TA	CA	P
Plain region							
Neem - <i>Azadirachta indica</i>	16.12	3.4	20.09	52.06	7.73	1.39	0.24
Mulberry - <i>Morus indica</i>	15	7.43	15.27	47.98	14.32	2.42	0.24
Mahua - <i>Bassia latifolia</i>	9.81	3.8	20.31	50.36	6.72	1.52	0.12
Bargad - <i>Ficus bengalensis</i>	9.63	2.64	26.84	51.59	9.3	1.76	0.17
Beri - <i>Zyzyphus jujuba</i>	8.6	1.7	30.1	48.18	11.42	1.5	0.3
Pakar - <i>Ficus infectoria</i>	12.53	3.52	20.04	49.89	13.05	2.21	0.29
Pipal peepal - <i>Ficus religiosa</i>	9.66	2.66	26.96	45.82	14.9	4.12	0.22
Jamun - <i>Eugenia jamholana</i>	7.26	2.24	15.94	68.44	5.62	1.62	0.2
Tapioca leaf meal	15.35	12.17	22.83	41.16	8.49	1.43	0.25
Subabul - <i>Leucaena leucocephala</i>	21.45	6.54	14.25	49.49	4.28	2.7	0.17
Semi Arid region							
Bamboo - <i>Dendrocalamus strictus</i>	15.09	1.43	23.51	41.64	18.33	1.55	0.17
Bhimal - <i>Grewia oppositifolia</i>	24.86	-	-	-	-	3.55	0.32
Sira - <i>Albizia labbeck</i>	16.8	4	31.5	36.2	11.5	2.57	0.15
Bahera - <i>Terminalia belerica</i>	8.63	4.71	18.59	60.06	8.01	2.08	0.27
Sain - <i>Terminalia tomentosa</i>	8.91	4.88	21.82	54.1	10.29	3.2	0.25
Shissam - <i>Dalbergia sissoo</i>	15	-	-	-	9.8	2	0.17
Hilly region							
Sal - <i>Shorea robusta</i>	10.06	3.22	27.43	55.41	3.88	0.77	0.12
Pula - <i>Klydia calycina</i>	12.47	3.31	23.71	46.1	14.41	3.06	0.35
Bel - <i>Aegle marmelos</i>	15.13	1.54	16.45	52.83	14.05	4.24	0.3
Khair - <i>Acacia catechu</i>	13.03	4.55	22.55	50.96	9.8	2.74	0.17
Kusum - <i>Schleicheratrijuga</i>	10.37	1.93	32.34	49.21	6.15	1.73	0.31
Kanju - <i>Holoptes integrifolia</i>	13.71	3.04	-	-	10.8	2.55	0.3
Khoda - <i>Ehretia leavis</i>	13.5	6	17.98	51.17	11.35	1.49	0.27
Katchnar - <i>Bamhina variegata</i>	15.8	1.98	31.8	41.2	9.22	2.7	0.26

Parthasarthy (1986) while studying effect of feeding varying levels of Khejri (*Prosopis cineraria*) leaves and concentrate on the performance of weaner kids observed tree leaves contained 14.9 per cent CP in dry matter.

Colomer *et al.* (1986) reported chemical composition of *Atriplex nummularia* a shrub of arid land, as CP 17.0, EE 1.5, CF 28.2, NFE 29.7 and ash 23.6 per cent in dry matter.

Chanda and Bhaid (1987) reported percentage chemical composition of hay of Arjun tree leaves (*Terminalia arjuna* Roxb.) (as fed basis) as % DM 92.68, OM 76.85, CP 9.9 EE 3.15, CF 12.51, NFE 51.28, TCHO 63.80, Ash 15.82, Ca 2.87, P 0.09 A.I.A. 4.79 and for dry leaves as DM 100 cm 82.93 CP 10.69, EE 3.40, CF 13.50, NFE 55.34, TCHO 68.84, ash 17.07 Ca 3.10 and AIA 5.17

Shaikh *et al.* (1987) stated chemical composition of Sajna leaves on as fed basis as DM 21.66, CP 4.15, EE 1.48, CF 3.68, NFE 10.28, TA 2.07 and dry leaves as DM 100 CP 13.18, EE 6.84, CF 17.00 NFE 47.44 and TA 9.54.

Majgaonkar *et al.* (1987) reported chemical composition of Gumhar (*Gomelina arborea*) tree leaves as DM 45.26, CP 11.46, EE 2.72, CF 25.50, NFE 55.02, Ash 8.30, Ca 1.70 and P 0.37 per cent on DM basis.

Panda *et al.* (1987) found chemical composition of tree (*Calliandra calothyrsus*) leaves per cent DM basis as DM 43.10, CP 20.00, EE 8.62, CF 14.17, NFE 52.30, TA 4.91, Ca 1.05 and P 0.15.

Chanda and Bhaid (1987) reported chemical composition of hay of Anjan tree leaves (*Hardwickia binata*) as DM 92.5, OM 82.0, CP 9.3, EE 2.8, CF 23.5, NFE 46.4, TCHO 69.9, ash 10.5, Ca 2.9 and P 0.1 per cent on DM basis.

Bhavani Prasad *et al.* (1987) reported that Anjan (*Hardwickia binata*) contained CP 3.5, CF 33.9, EE 3.1, NFE 40.5, ash 8.1, Ca 2.6 and P 0.17 per cent in dry matter.

Saha *et al.* (1987) reported chemical composition of some fodders of Andaman islands ranged from 5.4 to 32.0 CP, 0.6 and 4.2 EE, 6.0 to 40.5 CF, 5.1 to 23.8 ash, 0.14 to 3.82 CA and 0.02 to 0.39 P per cent in dry matter.

Chanda and Bhaid (1987) reported per cent chemical composition of phephor tree (*Ficus tsiela* Roxb) hay (as fed basis) as DM 90.32 OM 72.25, CP 7.27, EE 3.61, CF 13.60, NFE 47.76, TCHO 61.60, ash 18.06, Ca 3.43 and P 0.09.

Thirumalai *et al.* (1989) stated jack tree (*Artocarpus integrifolia*) fresh leaves contained 62.42 moisture, 5.01 CP, 2.38 EE, 6.12 CF, 3.6 TA and 20.10 NFE per cent.

Gupta and Balaraman (1989) reported Navaro (*Ficus hookerii*) leaves chemical composition per cent on DM basis as DM 26.70, OM 82.15, CP 10.94, CF 15.73, EE 3.55, NFE 51.93, TA 17.85, CA 3.38 and P 0.21 of Navaro (*Ficus hookeril*) leaves.

Bhuyan *et al.* (1989) found 13.80 CP, 6.50 EE, 28.25 CF, 39.15 NFE, 12.30 TA, 1.3 Ca and 0.19 P in Banana (*Musa spp.*) leaves on per cent DM basis.

Singh *et al.* (1989) reported chemical composition per cent on DM basis of Gogun tree (*Saurauia napalensis*) leaves as OM 89.35, CP 15.93, EE 1.31, CF 23.14, NFE 48.97, TA 10.65, Ca 2.24, P 0.14 and cell wall constituents as NDF 52.43 ADF 55.70 cellulose 30.55 ADL 18.56, silica 5.40.

Mittal *et al.* (1989) reported chemical composition of the ten important tree leaves, Banj, Moru, Kendu, Burans, Dhudhala, Anyar, Bhimal, Guranu, Khadak and Khadki for different seasons i.e. rainy, winter and summer, in Chakarata (Dehradun) hills. On an average the CP content ranged from 8.60 to 21.20 per cent and calcium from 1.45 to 6.34

per cent during rainy season. During the winter season on account of the seasonal range and maturity of leaves the CP has gone down as compared to rainy season. It ranged from 7.10 to 20.60 per cent on DM basis. During summer season the range of CP increased from 10.60 to 22.65 per cent on DM basis. The calcium contained in leaves during summer season ranged from 1.54 to 5.56 per cent on DM basis.

Sharma and Ogra (1990) reported chemical composition of Khajri (*Prosopis cineraria*) leaves as CP 14.2, EE, 1.6, CF 25.4, NFE 49.5 and ash 9.3 per cent on DM basis.

Thirumalai *et al.* (1990) while studying nutritive value of odi leaves (*Lannea coromandelica*) observed that fresh leaves contained 61 per cent moisture, 5.10 per cent CP, 2.41 per cent EE, 24.38 per cent CF, 65.15 per cent NFE and 2.96 per cent TA.

Nag and Matai (1992) reported chemical composition (per cent on DM basis) of twenty tree leaves in and around Calcutta. *Sesbania grandiflora* leaves contained highest CP contents (33.77 %). Most of the tree leaves contained more than 20 per cent CP. Very high ash content (18.57 %) was in *Trema orientalis* leaves while *Samanea saman* contained very low (5.30 %). Crude fat was highest in *Albizia procera* (25.27 %). Average CF ranged between 5.92 per cent (*Moringa oleifera*) and 25.88 per cent (*Albizia lebek*). Ca contents ranged from 1.63 to 3.90 per cent, while the range of P content was 0.12 to 0.49 per cent. Polyphenols were high in *Peltophorum pterocarpum* and *Trewia nudiflora* 17.65 and 10.54 per cent.

Kibria *et al.* (1993) reported chemical composition (per cent DM basis) of different tree leaves in Bangladesh as follows.

Tree leaves	DM	OM	CP	CF	NFE	EE	Ash
Mander (<i>Erythrina variegata</i>)	13.57	82.71	20.46	36.06	23.66	2.53	17.29
Sal (<i>Shorea robusta</i>)	39.39	95.47	8.11	30.64	53.69	2.53	4.53
Krishnachara (<i>Dolonix regia</i>)	43.88	94.15	14.46	15.96	57.48	6.25	5.85
Jack fruit (<i>Artocarpus heterophyllus</i>)	31.20	88.00	11.22	20.48	53.40	2.90	12.0
Ipil Ipil (<i>Leucana leucocephala</i>)	24.48	92.46	30.62	18.28	38.77	4.97	7.53
Mango (<i>Mangifera indica</i>)	47.02	91.52	8.84	27.46	53.04	1.96	8.48
Guava (<i>Psidium guajava</i>)	40.37	93.21	11.57	16.80	61.66	3.18	6.79

Dharia *et al.* (1993) reported chemical composition per cent on DM basis of glyricidia leaves as 20.73 DM, 21.04 CP, 21.00 CF, 4.2 EE, 38.76 NFE, 15.0 ash, 1.70 Ca and 0.40 P.

Singh, *et al.* (1994) observed Anjan (*Hardwickia binata*) leaves contained OM 89.37, CP 8.36, CF 28.04, EE 3.79, NFE 48.58, TA 10.63, Ca 2.26 and P 0.12 per cent on DM basis.

Nag *et al.* (1994) observed proximate composition (per cent on DM basis) of some tree leaves as follows

Name of species	DM	CP	EE	CF	NFE	TA
<i>Paraserianthes falacataria</i>	28.51	19.78	14.54	48.60	9.77	7.48
<i>Caesalpania coriaria</i>	37.58	16.72	16.26	26.86	34.59	5.56
<i>Jacaronda minosaefolia</i>	17.98	15.85	20.43	13.07	45.52	11.58
<i>Sterculia foetida</i>	35.45	16.03	7.45	22.93	46.64	6.94
<i>Tecoma stans</i>	23.69	17.45	17.82	25.47	33.20	14.34
<i>Thespesia popuenea</i>	23.77	16.85	10.68	13.18	48.45	10.83

Mondal *et al.* (1994) observed proximate composition (per cent on DM basis) of Banyan (*Ficus bengalensis*) tree leaves as 10.21

CP, 3.77 EE, 24.32 CF, 50.50 NFE and 11.20 per cent ash and Van Soet's analysis composition (%) as 50.20 NDF, 49.80 CL, 70.62 hemicellulose, 42.50 ADF, 27.52 cellulose, 10.80 lignin and 5.87 silica. The Ca and P 2.61 and 0.28 per cent, respectively.

Singh *et al.* (1995) stated chemical composition of various tree leaves and range legumes as per cent on DM basis as follows.

Species	CP	NDF	ADF	Lig.	Ash	Ca	P
<i>A. lebbeck</i>	20.50	42.32	35.01	16.63	8.93	1.90	0.12
<i>A. nilotica</i>	19.01	22.72	19.62	10.02	10.02	2.30	0.26
<i>L. leucocephala</i>	18.18	30.12	19.22	8.30	11.10	2.19	0.28
<i>S. aegyptica</i>	20.01	29.01	20.22	8.11	8.10	2.01	0.26
<i>S. hamata</i>	13.02	58.76	37.31	0.89	10.05	2.17	0.25
<i>A. scabroidus</i>	17.21	64.10	44.36	6.44	7.82	1.97	0.23
<i>L. purpureus</i>	22.61	45.43	31.62	5.82	7.61	2.82	0.28

Balaraman (1996) reported chemical composition (% on DM) of fresh Nervo leaves (*Ficus hookerii*) and Nervo hay as DM 88.46 and 88.45, CP 13.65 and 11.90, CF 18.25 and 16.85 NFE, 49.99 and 57.85 EE, 6.59 and 6.85 TA 11.54 and 11.55, Ca 3.28 and 3.32 and P 0.18 and 0.17, respectively.

Palani and Dasthagir (1996) reported chemical composition of (*Gmelina arborea* Linn.) in different seasons on (% DM) basis as follows.

Season	DM	CP	EE	CF	NFE	TA
May	33.76	15.16	3.25	22.60	53.18	5.81
July	33.94	14.71	3.13	24.61	50.84	6.73
September	34.11	14.06	2.63	23.00	52.09	8.24
November	35.06	13.33	2.50	22.22	55.81	6.15
January	34.60	12.45	3.63	21.85	56.84	5.21
March	33.60	14.70	3.50	21.61	54.71	5.48

Tiwari *et al.* (1998) reported chemical composition (% DM) of Reha (*Acacia leucophloca* Wild, L.) tree leaves as DM 54.81, OM 89.18, CP 14.81, EE 1.92, CF 24.48, NFE 47.97, TA 10.82, Ca 2.28 and P 0.15 per cent. The cell wall constituents content were as NDF 62.54, ADF 55.32, lignin 21.10 and silica 2.28.

Khatta *et al.* (1999) studied chemical composition of fifteen species of tree leaves of humid, subtropical region of Himachal Pradesh and found that some of the tree leaves such as biul (*Grewia optica*), dhurra (*Ficus* sp.), magar (*Bambusa arundinacea*), oee (*Albizia stipulata*) and robinia (*Robinia pseudoacacia*) were highly nutritious while Kachnar and Jamun were nutritionally poor.

Chemical composition of tree leaves (per cent on DM basis)

Species	OM	CP	EE	CF	NDF	ADF	HC	Cellulose	Lignin
Biul – <i>Grewia optica</i>	85.00	18.97	3.34	12.75	50.48	38.20	12.28	28.30	8.65
Dhurra – <i>Ficus</i> sp.	85.52	16.28	6.85	10.74	48.42	37.10	11.32	30.00	6.10
Jamun – <i>Engenia jambolana</i>	94.35	10.85	6.77	20.74	67.80	49.90	18.00	34.10	14.40
Kachnar <i>Barhinia variegata</i>	88.30	12.57	1.60	27.37	62.50	42.80	19.70	26.40	13.45
Magar – <i>Bambusa arundinacea</i>	83.69	18.67	3.16	25.24	70.10	46.10	24.00	35.40	7.70
Oee – <i>Albizia stipulata</i>	89.36	18.81	2.65	28.81	70.40	47.10	23.30	34.10	11.60
Robinia – <i>Robinia pseudoacacia</i>	87.80	18.85	3.27	10.32	55.70	46.80	8.90	84.90	10.60

Singh *et al.* (1999) reported seasonal variation in chemical composition (per cent on DM basis) of important tree leaves of Bundelkhand region as follows.

Species	Season	DM	CP	NDF	ADF	ADL	TA	Ca	P
<i>Hardiwickia binata</i>	Summer	40.25	12.30	30.59	16.23	8.31	9.56	1.25	0.22
	Rainy	43.00	16.17	34.21	18.27	12.51	10.26	1.37	0.25
	Winter	46.00	13.08	37.00	20.85	16.44	11.09	2.05	0.19
	Av.	43.08 ^{ab}	13.85	33.93	18.45	12.42	10.30	1.56	0.22
<i>Acacia nilotica</i>	Summer	--	--	--	--	--	--	--	--
	Rainy	46.00	13.84	14.30	13.17	8.35	10.02	1.72	0.14
	Winter	48.00	10.34	17.71	16.14	11.15	7.85	2.46	0.12
	Av.	47.00	12.09	16.01	14.65	9.75	8.93	2.09	0.13
<i>Anogeissus latifolia</i>	Summer	42.69	13.64	27.79	20.51	13.84	7.16	2.85	0.22
	Rainy	45.10	18.20	30.35	22.85	18.49	8.22	3.55	0.27
	Winter	50.00	15.02	32.53	24.31	20.84	9.69	3.69	0.18
	Av.	45.93	15.62	30.22	22.57	17.72	8.36	3.36	0.23
<i>Melia azedarach</i>	Summer	36.00	14.96	21.65	17.73	7.12	10.26	1.93	0.17
	Rainy	44.17	21.90	24.11	18.42	11.91	11.98	2.45	0.25
	Winter	47.00	14.22	27.32	22.41	13.83	12.53	2.55	0.12
	Av.	42.39	17.03	24.36	19.52	10.95	11.59	2.31	0.18
<i>Albizia lebbek</i>	Summer	38.00	19.28	38.91	30.92	11.65	7.93	1.85	0.19
	Rainy	41.50	21.10	42.44	32.24	15.34	8.33	2.67	0.23
	Winter	45.00	16.52	46.65	35.42	18.81	9.18	2.85	0.16
	Av.	41.50	18.97	42.66	32.86	15.27	8.48	2.46	0.19

Shinde *et al.* (2000) reported chemical composition of paragrass and ber leaves (% on DM) basis as DM 17.60 and 37.61, CP 15.20 and 14.95, CF 30.10 and 16.39, EE 1.94 and 2.34, NFE 36.66 and 57.60, Ash 16.10 and 8.49 per cent, respectively.

Mishra *et al.* (2000) stated chemical composition of Pilu (*Salvadora persica*) leaves (% on DM basis) as DM 20.76, OM 73.15, CP 18.90, CF 12.4, EE 2.20, NFE 39.62, AIA 8.80, Ca 8.80 and P 0.20 and cell wall constituents as NDF 36.89, ADF 14.32, HC 22.52, cellulose 12.21, lignin 2.40 AIA 2.51.

Dehuri *et al.* (2000) reported chemical composition (per cent on DM basis) of Tentulia (*Aeschynomene americana*) as 19.26 CP, 4.06 EE, 15.23 CF, 46.38 NFE, 7.38 TA, 1.89 Ca and 0.93 P.

Anandan and Dey (2000) observed chemical composition (Per cent on DM basis) of Oak (*Quercus senecarpifolia*) leaves as DM 53.4, OM 9.52, CP 8.2, EE 5.3, CF 26.7, NFE 54.8, TA 4.8

Das and Ganesh (2001) reported chemical composition (per cent on DM basis) of jack fruit tree leaves as DM 28.20, OM 87.94, CP 12.23, CF 18.42, EE 2.90, NFE 54.40.

Ramana *et al.* (2002) studied chemical composition of ten multipurpose tree and shrub species grown at National Research Centre for Agroforestry, Jhansi and observed the chemical constituents as follows.

Chemical constituents of tree species (g kg⁻¹ DM)

Botanical name	OM	CP	NDF	ADF	Cellulose	HC	Ash	AI
<i>Acacia nilotica</i> subsp. <i>Cupressiformis</i>	951.3	199.2	244.1	166.9	93.2	97.8	48.7	87.7
<i>Anogeissus latifolia</i>	922.06	99.5	389.3	255.5	148.2	133.6	77.4	75.9
<i>Dalbergia sissao</i>	880.2	177.5	361.2	245.2	88.2	116.1	120.0	86.7
<i>Embllica officinalis</i>	381.7	195.6	325.4	163.7	96.7	168.7	118.3	77.3
<i>Ficus religiosa</i>	859.9	76.6	432.1	289.8	92.7	142.3	140.1	85.9
<i>Madhuka latifolia</i>	925.3	150.4	405.6	308.8	180.0	96.8	74.7	70.8
<i>Melia azadarach</i>	912.2	292.5	218.1	154.7	74.6	63.3	87.8	90.7
<i>Morus rubra</i>	842.6	258.9	223.4	156.7	62.1	66.7	157.4	93.8
<i>Siziphus mauritiana</i>	199.9	131.6	343.9	213.5	80.2	137.5	80.1	89.8
<i>Ziziphus nummularia</i>	891.6	144.3	364.2	255.8	128.4	108.3	108.4	83.5

Bhadauria *et al.* (2002) reported chemical constituents of nine browse trees and 12 shrubs leaves and twigs viz., *A. indica*, *A. amara*, *Dalbargia sisso*, *Ficus religiosa*, *Butea monosperma*, *Albizia lebbeck*, *Hardwickia binata*, *Leucaena leucocephala*, *Holoptelza integrifolia* and 12 shrubs, *Acacia catechu*, *Acacia leucophloea*, *Securinega versa*, *Euretia aspera*, *Flacourtia indica*, *Ziziphus xylophyrus*, *Ziziphus nummularia*, *Bauhinia racemsa*, *Carrisa spinarum*, *Dicrostachys cinerea*, *Maytenus emarginata*, *Helicteres isora*. The CP content of the tree leaves varied from 14.03 to 27.16 per cent. The corresponding values for NDF, ADF, lignin, ash, hemicellulose, cellulose and EE varied from 34.66 to 65.42, 20.23 to 48.26, 6.00 to 21.68, 6.80 to 15.34, 9.13 to 19.15, 12.33 to 47.74 and 1.78 to 5.59, respectively. Among the available shrubs, CP content was higher in *S. verosa*, *I. nummularia* and *A. leucocephala*. NDF, ADF, lignin, ash, hemicellulose, cellulose and EE per cent varied from 34.66 to 58.22, 18.33 to 42.90, 3.62 to 23.34, 5.30 to 13.51, 11.40 to 16.07, 10.37 to 24.43 and 1.38 to 6.09, respectively.

Bais *et al.* (2002) observed chemical composition on per cent DM basis of Sares and Neem tree (*Albizia lebbeck* and *Azadirachta indica*) as DM 94.70 and 93.70, CP 21.25 and 17.50, CF 31.34 and 23.03, EE 3.25 and 2.27, NFE 34.92 and 47.25, respectively.

Saikia (2002) reported chemical composition of Thalapadma (*Hibiscus mutabilis* L.) tree leaves as CP 17.5, EE 4.2, CF 16.53, NFE 53.01, Ash 8.76, Ca 3.25 and P 0.53 per cent on DM basis.

Kumar and Sharma (2003) reported that chemical composition of 15 fodder tree species viz., *Embllica officinalis*, *Grewia optiva*, *Melia azedarach*, *Toona cilita*, *Morusalba*, *Browssonitia paprifera*, *Bauhinia variegata*, *Dalbergia sisso*, *Leucaena leucocephala*, *Albizia lebbeck*,

Grevillea robusta, *Tyrsostachys oliveri*, *Bambusa nana*, *Bambusa vulgaris* and *Bambusa nutans*. The average DM, OM, CP, ADF, NDF, hemicellulose, cellulose, lignin, ash, calcium, phosphorus and tannin content in different species of tree leaves ranged from 22.13 to 52.43, 79.40 to 94.47, 8.07 to 27.41, 27.40 to 55.23, 18.87 to 46.30, 4.33 to 19.70, 4.48 to 13.40, 9.30 to 31.57, 5.03 to 20.60, 1.10 to 3.15, 0.087 to 0.355 and 0.2 to 6.7 per cent, respectively.

✓ Barman *et al.* (2003) reported chemical composition (per cent on DM basis) of Ghora neem (*Media azedarach* Linn.) as 18.96 CP, 3.20 EE, 11.60 CF, 55.78 NFE, 10.50 Ash, 2.94 Ca and 0.25 P.

2.3 Nutrient intake and palatability

✓ Jayal and Sahai (1960) reported that the bullocks on an average consumed 362.47 g or 1.9 lb of Gauj leaves on dry basis/100 lb body weight/day. The DM ingestion was quite satisfactory which indicated that Gauj leaves were palatable.

- Joshi and Talapatra (1960) reported Bhimal (*Grewia oppositifolia* Roxb.) fodder is palatable to all classes of livestock. Sheep can consume on an average 3 lb of DM while young growing calves consumed 2.7 lb/100 lb body weight.

- Hussain Mia *et al.* (1960) reported the DM consumption of pipal leaves (*Ficus religiosa*) alone was 929 g/100 lb for bullocks and 2356 g/100 lb for goats is highly palatable.

✓ Deshpande (1981) stated DMI of 3.66, 4.32 and 4.00 per cent on body weight basis in kids while feeding 50 per cent CP through Lucerne + 50 per cent CP through concentrate, 75 % CP through Dashratha + 25 % CP through concentrate mixture and 100 % CP through Dashratha with ad-lib Kadbi respectively.

✓ Kaladate (1982) reported DMI of 3.56, 3.55 and 3.21 per cent on body weight basis in beetal x Osmanabadi kids while feeding 50% CP from lucerne + 50 % CP from concentrate, general grazing 8 hours and Dashrath grazing 8 hours respectively.

✓ Thakur *et al.* (1982) reported that jack (*Artocarpus integrifolia* L.) tree leaves average daily DM consumption by the Kids was 2.94 ± 0.10 kg per 100 kg body weight.

- Kundu *et al.* (1983) reported DM consumption of Ingadulcis leaves (hedge tree) as 4.55 kg/100 kg body weight in goats.

✓ Singh and Gupta (1983) observed that dry Jhanji (*Scirpus articulatus*) aquatic plants average DM consumption by the animals was 1.54 kg/100 kg body weight.

✓ Sehgal (1984) reported tannin rich pala (*Ziziphus nummularia*) total DM consumption/ lamb in 90 days was 71.55 ± 0.36 kg, the average intake / lamb / day being 0.795 ± 0.04 kg equivalent to 4.290 ± 0.46 kg/100 kg body weight.

✓ Bhaskar *et al.* (1985) observed the total DM intake by the bullocks ranged from 4.57 to 5.41 kg/day with an average of 4.77 ± 0.12 kg/day. This is inclusive of 1.82 of DM consumed through subabul leaf meal and 2.89 kg through paddy straw. The DM intake/100 kg body weight varied from 2.01 kg to 2.14 kg with a mean of 2.07 ± 0.02 /day/bullock. The subabul leaf meal was well accepted by the animals and had no adverse effect on the body weight gain as well as on the intake.

✓ Mehta and Bhaid (1985) reported Arjun (*Terminalia arjuna* Roxb.) leaves total DM intake ranged from 3.40 to 5.45 per cent of body

weight with the mean value as 4.62 ± 0.43 per cent body weight for male goats.

Kundu *et al.* (1985) reported mango (*Mangifera indica*) leaves daily average dry matter consumption per 100 kg body weight was 4.09 kg in goats,

Mehta and Bhaid (1986) reported goats fed on phephar tree leaves consumed 4.08 kg DM per 100 kg body weight. The nutritive value worked out to be 0.00, 35.07 and 30.65 per cent for DCP, TDN and SE, respectively. On DM basis phephar leaves were placed in the inferior quality roughage.

Parthasarthy (1986) observed in weaned goats kids fed *Prosopis sineraria* leaves alone or with 25, 50 or 75 % concentrate the dry matter intake of 4.27, 4.24, 3.71 and 2.92 kg/100 kg live weight were significantly higher in the first two groups.

Murugan and Kathaperumal (1987) observed that DMI was 4.03, 2.29 and 2.03 kg/100 kg body weight in crossbred lambs fed basal diet of a concentrate mixture containing 80 % wheat bran, 17 % groundnut cake, 2 % mineral mixture and 1 % salt and supplemented with leaves of *Ficus religosa*, *Azadirachta indica* or *Enterolobium saman* all leaves given to appetite.

Chanda and Bhaid (1987) observed average DM intake of total ration was found to be 3.62 ± 0.09 kg/100 kg body weight and of dry phephar leaves (hay) 2.25 ± 0.09 kg/100 kg body weight on DM basis in local bucks.

Bhuyan *et al.* (1989) reported average DM consumption of kids from banana leaves, when fed as sole feed as 120 g/10 kg body weight. The mean intake of DCP and TDN by kids as 15 g and 118 g,

respectively. The banana leaves cannot meet the requirement of nutrients due to low dry matter consumption by kids and must be fed in combination with other feeds.

Gupta and Balaraman (1989) reported that the goats on an average consumed 3.2 kg DM per 100 kg body weight indicated a high degree of palatability of nevaro leaves. The TDN and DCP intakes per kg metabolic body size were 35.74 and 2.81 g respectively. Their intakes were higher than the minimum recommended levels of 30 g TDN and 2.5 g DCP per day (ICAR, 1985).

Chaudhury and Taparia (1990) reported DMI 3.46 and 1.57 per cent of body weight, DCP intake 182.89 and 54.37 g per day per head and TDN intake of 47.39 and 25.85 g per kg $W^{0.75}$ for goats fed on ad-lib dried leaves of Ingudulcis (*Pithecellobonium dulce*) and Babul (*Acacia milotica*), respectively.

Kedar (1990) while studying the CP replacement at the rate of 0, 25 and 50 per cent by rain tree leaves in the ration of kids, found DMI of 3.767, 3.742, 3.721 DCP of 0.300, 0.267, 0.236 and TDN of 2.405, 2.345, 2.263 % body weight basis, respectively.

Barbind *et al.* (1994) reported DMI as 3.51, 3.04, 2.55, 3.77 and 4.06 kg/100 kg body weight for Babul, ber, papal tree leaves, Lucerne and maize fodder, respectively. The DCP and TDN intake were 0.260 and 1.99 for Babul, 0.13 and 1.63 for ber, 0.13 and 1.28 for papal, 0.48 and 2.29 for Lucerne, 0.16 and 2.56 for maize fodder kg/100 kg live weight in Osmanabadi goats.

Mondal (1994) reported DM intake of 3.5 g kg/100 kg body weight in Black Bengal goats fed on Banyan tree leaves. Average daily

loss in body weight was 19.28 g. So Banyan tree leaves as a sole diet is not sufficient to maintain the goats.

Singh *et al.* (1994) reported average intake of DM, DCP and TDN were 63.3, 2.51 and 33.5 g/kg $W^{0.75}$ respectively of Anjan tree leaves for goats. DM and TDN intake were adequate to meet the maintenance requirement but DCP was 18 per cent less than the recommended values (ICAR, 1985).

Verma *et al.* (1995) reported DM intake of casuarina (*Casuarina equisetifolia*) leaves in goat as 5.34 ± 0.28 kg/100 kg body weight on DM basis. The DCP and TDN consumption was 4.61 and 57.22 g/kg $W^{0.75}$, respectively.

Baruah *et al.* (1995) who reported the mean dry matter intake of paragrass in Mithun as $2.30 + 0.10$ kg was found to be adequate for maintenance of body weight.

Mandal *et al.* (1995) reported goats fed on pipal tree leaves consumed 5.32 kg DM per 100 kg body weight. The DCP and TDN content were found to be 7.05 and 48.22 per cent, respectively.

Jain *et al.* (1998) observed DMI of sola (*Aexhynomene indica* Linn.) grass as 3.88 kg/100 kg body weight in goats.

Ganesh *et al.* (1998) reported as DM consumption as 364 g per day, 2.44 kg/100 kg and 48 g/kg $W^{0.75}$ in Nellore lambs fed Amaranthus whole plant meal.

Tiwari *et al.* (1998) reported DM consumption of Reha (*Acacia leucopholea*) in goats as 1082.49 g or 82.82 g/kg $W^{0.75}$ /day. The DM intake was 3.71 kg/100 kg body weight.

Anandan and Dey (2000) reported 2.50 kg DM intake/100 kg body weight in goats fed on oak tree leaves. The TDN and DCP intake

was 24.36 and 1.36 g/kg $W^{0.75}$, respectively, which were lower than the recommended levels of 30 g TDN and 2.5 g DCP/kg $W^{0.75}$ in goats. The oak leaves fed solely cannot even meet the maintenance requirements of goats. Hence, it needs to be supplemented with good quality feeds.

Dehuri (2000) reported goats fed on tentulia consumed DM 3.2 kg/100 kg body weight.

Shinde *et al.* (2000) reported DM, DCP and TDN intake were 2.641 and 3.18, 0.020 and 0.027 and 1.553 and 1.80 kg/100 kg body weight in goats feed as per feeding standard Group-I and ber leaves group-II.

Das (2001) reported average DM intake was 4.11 per cent of body weight in Black Bengal goats fed Jack fruit leaves. The DCP and TDN intake was 103.85 and 803.48 g/day, respectively. The jack fruit tree leaves when fed solely could support maintenance requirement of goats.

Saikia (2002) reported DMI of Thalapadma (*Hibiscus mutabilis* L.) for goats as 3.60 ± 0.26 kg/100 kg body weight. And 73.02 ± 5.53 g/kg $W^{0.75}$. The Thalapadma tree leaves were palatable to goats. DCP and TDN intake was 55.05 and 323.07 g/day, respectively.

Nageswara Rao *et al.* (2002) observed DMI in group first fed concentrate mixture @ 0.5 % body weight + dry leucaena (*Leucaena leucocethala*) leaves and barley (*Hordeum vulgare*) straw mixture (1:1) ad-lib and group second fed concentrate mixture @ 1 % body weight + dry leucaena and barley straw mixture (1:1) in Marwari goats as 39.12 ± 2.11 and 39.13 ± 4.46 g/kg $W^{0.75}$ though leaf straw mixture and 49.03 ± 2.57 and 58.97 ± 5.48 total DMI g/kg $W^{0.75}$, respectively.

Barman *et al.* (2003) reported goats fed on Ghora neem tree leaves consumed 3.34 kg DM per 100 kg live weight. The nutritive value



in terms of DCP and TDN were 13.09 and 65.37 per cent, respectively. DM, DCP and TDN was found to be adequate to meet the maintenance requirements of bucks. The mean intake of DCP and TDN per 100 kg body weight were 0.44 and 2.13 kg, respectively, which were on higher side in comparison to the recommendation.

2.4 Digestibility and nutritive values

Factors such as ruminant species, microbial type in rumen, grain feeding level, nutritive ratio, season, silica, lignin, mineral content and supplementation affect the digestibility and nutritive value of feeds and fodders.

Jayal and Sahai (1960) reported the average digestibility of DM 45.43, CP 68.50, EE 35.57, CF 32.07, NFE 49.32 per cent and nutritive value as 15.54 per cent DCP and 44.88 per cent TDN for Gauj leaves in Kumaoni bullocks.

Joshi and Talapatra (1960) documented digestibility coefficients of various organic nutrients of Bhimal fodder cut in July and September as DM 61.80 ± 0.32 and 63.80 ± 0.43 , OM 67.45 ± 3.10 and 67.67 ± 0.45 , CP $80.16 \pm .26$ and 78.49 ± 0.88 , TP 71.30 ± 3.40 and 74.77 ± 0.79 , EE 36.30 ± 4.40 and 36.81 ± 6.25 , CF 54.48 ± 6.30 and 46.67 ± 0.86 , NFE 70.05 ± 1.83 and 74.78 ± 1.40 and nutritive value as DCP, 4.84 per cent and 5.44 per cent TDN, 18.14 per cent and 22.56 per cent, respectively

Thakur *et al.* (1982) reported the digestibility coefficients of various organic nutrients as DM 42.29 ± 1.35 , CP 42.48 ± 0.61 , EE 43.47 ± 0.79 , CF 43.45 ± 1.61 , NFE 48.61 ± 2.5 . The nutritive value of jack tree leaves in terms of DCP, TDN and SE were calculated as 4.81, 43.27 and 37.17 per cent, respectively in kids.

Singh and Gupta (1983) studied nutritive value of dried Jhanji leaves in Red Sindhi bullock and observed digestibilities for DM 46.30 ± 2.02 , OM 52.34 ± 1.69 , CP 49.50 ± 2.08 , EE 74.58 ± 2.40 , CF 49.15 ± 1.24 and NFE 47.15 ± 2.04 per cent on DM basis. The DCP and TDN of dried Jhanji was worked out to be 4.82 and 46.12 per cent, respectively on DM basis.

Panda *et al.* (1983) studied the effect of tree leaf tannin on DM intake by goats. The digestibility of nutrients of pipal and jamun leaves were as follows. The digestibility coefficient of OM, EE, CF and NFE was 62.20, 43.86, 44.53 and 76.77 for pipal leaves and 14.16, 25.09, 7.43 and 23.85 for jamun leaves. The digestibility of crude protein of pipal leaves was high whereas it was negative in the case of jamun leaves. The digestible CP content of jamun leaves was nil.

The daily average DCP and TDN consumptions by goats in two trials per 100 kg body weight were 0.658 kg and 3.387 kg respectively in case of pipal leaves, these were nil and 0.147 kg respectively in case of jamun leaves.

Sehgel (1984) reported the digestibility percentage of the nutrients in the whole ration as DM 62.23 ± 1.25 , CP 46.71 ± 2.56 , CF 34.15 ± 3.37 , EE 44.46 ± 3.64 and NFE 79.50 ± 0.77 in growing lambs.

The ration based on pala leaves having 8.56 per cent tannin had better feed conversion ratio. The feed efficiency (percentage) was higher 18.41 ± 0.46

Mehta and Bhaid (1985) observed that the average digestibility coefficients of DM, OM, CP, EE, CF, NFE and total carbohydrates for Arjun leaves by difference method were 58.1, 62.42, 6.34, 18.86, 56.87, 66.59 and 62.25, respectively. The nutritive value of

Arjun leaves was worked out to be 0.63, 49.31 and 43.88 per cent for DCP, TDN and SE, respectively.

Kundu *et al.* (1985) reported the average digestibility coefficient of DM, OM, CP, EE, CF and NFE were 47.00 ± 1.13 , 49.02 ± 1.12 , 44.20 ± 1.33 , 35.54 ± 1.26 , 33.76 ± 1.36 and 58.95 ± 1.02 per cent, respectively in goats. The DCP and TDN contents of mango leaves (*Mangifera indica*) were calculated to be 4.26 and 46.36 per cent, respectively.

Mehta and Bhaid (1986) reported the average digestibility coefficients at DM, OM, CP, EE, CF, NFE and total carbohydrates of pephor leaves by difference method were 45.26, 51.80, 0.00, 31.29, 42.65, 50.52 and 45.76, respectively in young male goats. The nutritive value of phelphar leaves was worked out to be 0.00, 35.07 and 30.65 per cent for DCP, TDN and EE respectively.

Chanda and Bhaid (1987a) reported the average digestibility coefficients of different organic nutrients for dry Arjun leaves to be 49.02, 55.69, 10.34, 19.83, 53.70, 52.59, 53.05 for DM, OM, CP, EE, CF, NFE and TC on DM basis, respectively. The digestibility coefficient for cellulose, hemicellulose and soluble carbohydrates was found to be 43.27, 49.10 and 73.08 per cent, respectively for goats. The nutritive value of dry Arjun leaves in terms of DCP, TDN and SE was worked out to be 1.10, 38.76 and 33.15 per cent respectively.

Chanda and Bhaid (1987b) reported the average digestibility coefficient of dry pephor leaves (*Ficus tsiela*) for DM, OM, CP, EE, CF, NFE and TCHO determined by difference method were to be 50.07, 54.88, 0.00, 40.79, 36.44, 57.25 and 52.69 per cent, respectively.

The nutritive value of dry pheapor leaves which was evaluated in terms of DCP, TDN and SE and were 0.00, 39.41 and 34.46 per cent, respectively.

Shaikh *et al.* (1987) observed average digestibility coefficient of DM, CP, EE, CF and NFE of Sajna leaves in goats as 69.49 ± 0.73 , 72.25 ± 1.74 , 56.04 ± 1.46 , 50.30 ± 1.71 and 75.94 ± 0.65 per cent, respectively. Nutritive value of Sajna leaves were studied with Black Bengal goats. DCP and TDN values was 40.82 and 68.03, respectively.

Majgoankar *et al.* (1987) reported the average digestibility coefficient of DM, CP, EE, CF, NFE of Gumhar (*Gemelina arborea*), maize-sorghum were 57.19, 0.00, 0.00; 55.27, 61.00, 44.00; 51.95, 65.00, 44.00; 53.5, 70.00, 59.00 and 60.11, 76.00, 60.00, respectively. The nutritive values were 6.33, 4.18 and 3.45 DCP and 58.02, 67.77 and 54.03 per cent TDN, respectively.

Panda *et al.* (1987) reported digestibility coefficient for DM, OM, CP, EE, CF and NFE of *Caliandra calothyrsus* leaves were 48.84 ± 2.84 , 50.41 ± 2.78 , 38.11 ± 3.26 , 39.03 ± 2.95 , 27.11 ± 5.02 and 64.01 ± 2.55 , respectively, nutritive value 7.62 % DCP and 52.50 % TDN, respectively.

Gupta and Balaraman (1989) reported digestibility coefficients as 54.25 ± 1.85 , 58.86 ± 1.44 , 35.71 ± 1.23 , 54.04 ± 2.20 , 33.26 ± 2.53 and 66.47 ± 1.77 for DM, OM, CP, CF, EE and NFE respectively of Nevara (*Ficus hadeeri*) leaves. Nutritive value 3.91 ± 0.13 % DCP and 49.47 ± 1.41 % TDN, respectively.

Thirumalai *et al.* (1989) reported digestibility coefficient as 64.4, 74.82, 71.06, 70.97 and 69.01 for DM, CP, CF, EE and NFE,

respectively of Jack leaf (*Artocarpus intignafolia*) in goat. The TDN and DCP values were 25.99 and 3.75 per cent, respectively.

Bhuyan *et al.* (1989) observed the mean digestibility coefficients of different organic nutrients as 65.13 ± 0.27 , 60.23 ± 0.58 , 63.20 ± 0.38 , 67.50 ± 0.75 and 68.30 ± 0.93 for DM, CP, EE, Cf and NFE, respectively of banana (*Musa spp.*) for kids. The nutritive values of banana leaves for kids was DCP 8.31 and TDN 63.37 per cent.

Singh *et al.* (1989) reported the digestibility coefficient as 55.72 ± 1.49 , 63.05 ± 0.96 , 57.98 ± 1.32 , 55.21 ± 1.81 and 54.76 ± 3.16 for DM, OM, CF, EE and NFE, respectively of Gogun (*Saurauia napalensis*) tree leaves. Nutritive value were 1.19 % DCP and 34.01 % TDN.

Thirumalai *et al.* (1990) observed digestibility coefficient as 70.38 ± 1.19 , 56.22 ± 2.24 , 72.02 ± 0.61 , 60.18 ± 1.60 and 71.61 ± 0.98 for DM, CP, CF, EE and NFE, respectively basis for odi leaves (*Lannes coromandelie*) for goats.

The dry matter disappearance for 24 and 48 hours were 34.61 and 41.25 per cent, respectively.

Thirumalai *et al.* (1993) observed digestibility coefficients of different organic nutrients DM, CP, CF, EE were 73.06, 70.20, 67.45 and 67.76 per cent, respectively for vagi leaves (*Albizia lebbele*) for goats.

Mondal *et al.* (1994) reported digestibility coefficient for DM 50.52 ± 0.81 , OM 55.08 ± 0.96 , CP 37.35 ± 2.02 , EE 35.37 ± 1.81 , CF 36.66 ± 1.81 , NFE 67.42 ± 1.04 , NDF 42.83 ± 1.52 , total cell contents 58.27 ± 2.79 , ADF 39.54 ± 1.75 , cellulose 39.92 ± 1.31 and hemicellulose 61.18 ± 2.54 , DCP and TDN contents were found 3.81 ± 0.21 and $49.78 \pm$

1.03 per cent, respectively of Banyan (*Ficus bengalensis*) tree leaves in male Black Bengal goats.

Singh *et al.* (1994) reported the digestibility coefficient as 52.41 ± 2.45 , 56.46 ± 2.08 , 44.53 ± 1.76 , 48.96 ± 1.67 , 50.21 ± 2.86 and 62.66 ± 2.19 for DM, OM, CP, SE, NFE, respectively of Anjan tree leaves (*Hardwickia binata*) for goats. The nutritive values observed were 3.99 ± 0.16 and 53.19 ± 1.92 per cent DCP and TDN respectively.

Barbind *et al.* (1994) observed the digestibility coefficient of various organic nutrients DM, CP, CF, EE and NFE for babul, ber, pipal, lucern and maize were 55.21 ± 1.67 , 52.39 ± 1.88 , 43.86 ± 2.04 , 64.11 ± 2.33 , 66.41 ± 1.66 ; 65.05 ± 2.93 , 41.87 ± 2.06 , 46.34 ± 1.81 , 69.90 ± 1.66 , 68.09 ± 2.11 ; 34.29 ± 1.88 , 43.55 ± 2.99 , 44.72 ± 2.09 , 57.28 ± 1.81 , 66.90 ± 1.96 ; 42.90 ± 3.06 , 87.53 ± 1.33 , 36.41 ± 1.91 , 53.31 ± 1.26 , 51.21 ± 1.33 and 62.24 ± 2.04 , 66.40 ± 1.88 , 61.62 ± 1.16 , 71.68 ± 20.89 , 71.62 ± 2.92 per cent, respectively for Osmanabadi goats.

The nutritive value in the form of DCP was 7.32 ± 0.08 , 4.29 ± 0.09 , 5.24 ± 0.08 , 13.82 ± 0.19 , 4.15 ± 0.09 and TDN 56.01 ± 1.03 , 53.62 ± 1.19 , 50.81 ± 1.73 , 62.57 ± 0.73 , 63.07 ± 1.47 per cent for babul, ber, pipal, lucern and maize respectively for goats.

Verma *et al.* (1995) reported digestibility coefficient as 50.64 ± 1.06 , 39.92 ± 1.30 , 52.72 ± 1.02 , 50.05 ± 1.08 , 56.00 ± 0.95 , 55.08 ± 0.97 , for DM, CP, CF, EE, NFE and TECHO, respectively and 53.03 ± 1.02 , 38.84 ± 1.33 , 31.97 ± 1.47 , 21.27 ± 1.70 , 49.25 ± 1.09 and 74.24 ± 0.56 for OM, NDF, ADF, cellulose and hemi-cellulose respectively of casuarina (*Casuarina equisetifolia*). Nutritive value as 4.41 % DCP and 54.80 % TDN, respectively.

Mandal *et al.* (1995) reported the digestibility coefficient for DM, OM, CP, EE, CF and NFE as 58.57 ± 1.46 , 52.04 ± 0.53 , 50.81 ± 1.63 , 29.32 ± 0.78 , 42.05 ± 1.09 and 63.50 ± 2.18 , respectively of pipal tree leaves (*Ficus religiosa*) in male Black Bengal goats. Nutritive value as DCP and TDN were found to be 7.05 ± 0.23 and 48.22 ± 0.95 per cent, respectively.

Balaraman (1996) observed the digestibility coefficients of various organic nutrients for DM, OM, CP, CF, NFE and EE were 54.75 ± 3.35 , 58.02 ± 3.35 , 22.64 ± 6.87 , 71.29 ± 6.90 , 61.13 ± 1.61 and 57.17 ± 14.07 , respectively on DM basis for Nevaro hay (*Ficus haokerii*) for goats. The nutritive value as DCP, TDN and SE were found to be 2.69, 55.82 and 49.40 respectively.

Nageswara Rao *et al.* (1996) reported digestibility coefficient as 61.20 ± 1.46 and 63.61 ± 1.09 , 66.70 ± 1.20 and 69.14 ± 0.96 , 65.59 ± 2.24 and 64.83 ± 3.61 , 78.33 ± 2.15 and 46.12 ± 2.49 , 71.03 ± 2.02 and 75.02 ± 0.88 , 54.84 ± 3.23 and 65.15 ± 1.29 , respectively for DM, OM, CP, EE, NFE and CF of neem and mulberry leaves pelated feeds. The nutritive value were 8.88 and 9.65 % DCP, 58.86 % and 64.51 TDN, respectively.

Ganesh *et al.* (1998) reported digestibility coefficients of various organic nutrients of *Amaranthus* plant meal (*Amaranthus sruentus*) for DM, OM, CP, EE, CF, NFE were 62.82, 64.71, 73.49, 61.91, 48.11 and 67.78 per cent, respectively for goats. The nutritive value as DCP 12.71 and TDN 52.83 per cent.

Tiwari *et al.* (1998) reported digestibility coefficients of organic nutrients in Reha (*Acacia leucophloea* Wild. L.) tree leaves in goats as 46.68 ± 1.79 , 49.65 ± 1.65 , 49.66 ± 2.53 , 54.05 ± 8.02 , $43.78 \pm$

5.57 and 51.07 ± 3.07 for DM, OM, CP, EE, CF and NFE. The nutritive value were $7.35 \% \pm 0.37$ DCP and $44.90 \% \pm 1.94$ TDN.

Shinde *et al.* (2000) studied the digestibility coefficients of paragrass and ber leaves for goats. The digestibility coefficient of various organic nutrients were observed to be 48.57 and 51.37, 49.11 and 54.06, 50.12 and 53.27, 59.91 and 52.45, 56.45 and 62.61 for DM, OM, CP, CF, EE and NFE, respectively. The nutritive values as were 7.45 and 8.01 DCP and 55.54 and 57.90 per cent TDN.

Dehuri *et al.* (2000) reported the digestibility coefficients of various organic nutrient for DM, CP, EE, CF and NFE were 71.80 ± 3.51 , 72.12 ± 3.29 , 50.34 ± 2.00 , 39.89 ± 1.56 and 70.23 ± 3.25 per cent, respectively for of tentulia (*Aeschynomene americana*) in goats. The nutritive value was estimated to contain 30.89 DCP and 61.35 TDN.

Anandan and Dey (2000) reported digestibility coefficients for various organic nutrients for DM, OM, CP, EE, CF, NFE as 43.93 ± 2.47 , 46.40 ± 2.44 , 42.40 ± 2.44 , 44.83 ± 3.74 , 35.41 ± 1.54 and 52.65 ± 2.40 per cent, respectively for oak tree (*Quercus semecarpifolia*) leaves for goats. The nutritive values of oak leaves as DCP and TDN were 3.65 and 47.17 per cent, respectively.

Rajendiran and Kadirvel (2002) reported digestibility coefficients as 51.7 ± 1.31 and 53.0 ± 1.30 , 34.9 ± 2.8 and 25.7 ± 3.9 , 37.0 ± 2.0 and 68.40 ± 0.7 , 43.9 ± 1.6 and 40.5 ± 3.6 , 60.8 ± 4.3 and 58.1 ± 7.3 for DM, OM, CP, EE, CF, NFE, NDF, ADF, cellulose, hemicellulose and legnin for casuarinas leaves, respectively. The nutritive value was 3.5 % DCP and 51.4 % TDN.

Bais *et al.* (2002) reported digestibility coefficient of sares and neem leaves in Marwari goats. Digestibility coefficient of various

organic nutrient for sares leaves and neem leaves for DM, CP, CF, EE and NFE were 57.54 ± 1.32 and 51.30 ± 1.43 , 56.51 ± 1.13 and 53.91 ± 2.32 , 58.12 ± 1.54 and 33.25 ± 1.18 , 58.41 ± 1.16 and 28.28 ± 2.15 , 71.70 ± 2.34 and 65.81 ± 0.63 , respectively. The nutritive value in terms of DCP and TDN was 12.01 and 59.60 for sares leaves and 9.43 and 48.74 for neem leaves, respectively.

Saikia (2002) observed the digestibility coefficient values were as DM 57.68, OM 58.65, CP 51.66, EE 63.78, CF 49.07 and NFE 56.34 per cent of Thalapadma (*Hibiscus mectabilis* L.) tree leaves for goat. Nutritive value of Thalapadma leaves was 9.14 per cent DCP and 53.04 per cent TDN.

Barman *et al.* (2003) reported digestibility coefficient for DM 69.71 ± 1.20 , OM 70.28 ± 1.29 , CP 69.03 ± 1.28 , EE 61.73 ± 1.43 , CF 60.98 ± 1.4 , NFE 73.13 ± 1.3 for Ghora neem (*Melia azedarch* Linn.). The nutritive value was $13.09 \% \pm 0.24$ DCP and $65.37 \% \pm 1.12$ TDN.

2.5 Nutrient balances

Jayal and Sahai (1960) reported that the experimental animals maintained healthy condition throughout the feeding period of 63 days and recorded positive balances for nitrogen $+25.42 \pm 4.77$, calcium $+7.10 \pm 0.97$ and phosphorus $+0.74 \pm 0.14$ respectively g/day/animal on gunj leaves feeding.

Jayal and Kehar (1962) reported that sheep and goats fed on fresh and green mulberry leaves ad-lib showed positive balances for N +1.511, Ca +1.757 and P +0.327 g/day/animal indicates mulberry leaves are nutritious.

Bhatia *et al.* (1977) revealed from the balances study in sheep and goat fed with Khejri leaves. The balances of N, Ca and P were + 0.57 and + 7.47, + 0.75 and + 7.43 and - 0.30 and + 0.36 g/day respectively.

Thakur *et al.* (1982) reported balances of, nitrogen -0.59 ± 0.95 , calcium 0.70 ± 0.13 and phosphorus 0.03 ± 0.02 g/day/animal when jack tree leaves were fed ad-lib. Feeding of jack tree leaves alone to growing kids under stall fed conditions will not be adequate to meet the requirements for growth.

Singh and Gupta (1983) reported positive nitrogen balance $+10.34 \text{ g} \pm 3.08$, calcium $+0.35 \pm 1.21$ and phosphorus -1.51 ± 1.43 g/day/animal, when dried Jhanji leaves were fed to the Red Sindhi bullocks.

Panda *et al.* (1983) found that all the goats eating pipal leaves showed positive balance of nitrogen +3.50, calcium +1.07 and phosphorus +0.75 g/day on the other hand goats that were fed jamun leaves could not consume much dry matter showed negative balances of nitrogen -1.45 , calcium -0.07 and phosphorus -0.094 g/day/goat.

Mehta and Bhaid (1985) balance studies for N, Ca and P were conducted in order to find the availability of N and minerals from Arjun tree leaves to the bucks when given with wheat bran. The results obtained were as N $+3.56 \pm 1.03$, Ca $+2.41 \pm 0.37$ and P $+0.65 \pm 0.22$ g/day/animal. All the animals on mixed ration showed positive balances.

Kundu *et al.* (1985) reported balances of nutrients in Black bengal goats, when mango (*Mangifera indica*) leaves were fed *ad-libitum*. All the animals showed positive balances for N $+1.72 \pm 0.15$, Ca $+1.99 \pm 0.15$ and P $+0.093 \pm 0.03$ g/day.

Mehta and Bhaid (1986) observed positive balances of N $+1.10 \pm 0.16$, Ca $+4.78 \pm 0.61$ and P $+0.52 \pm 0.09$ g/day/animal, when fed pipal leaves supplemented with wheat bran during the collection period.

Chanda and Bhaid (1987) observed positive balances of N $+5.43 \pm 0.56$, Ca $+1.06 \pm 0.24$ and P 0.15 ± 0.21 g/day when fed dry Arjun leaves (hay) supplemented with wheat bran.

Chanda and Bhaid (1987) reported all animals (goats) showed positive balances of N $+2.28 \pm 0.45$, Ca $+6.39 \pm 0.66$ and P $+0.353 \pm 0.18$ g/day, when offered dry phephar leaves ad-lib supplemented with 300 g wheat bran.

Shaikh *et al.* (1987) reported positive balances of N $+1.67 \pm 0.16$ g/day, when goats fed fresh Sajna leaves.

Majgaonkar *et al.* (1987) observed positive balances of N $+9.99 \pm 1.61$, Ca $+14.21 \pm 2.34$ and P $+1.06 \pm 0.33$ g/day in animals fed *Gmelina arborea* leaves.

Panda *et al.* (1987) reported that all the animals showed positive balances for N $+5.24 \pm 0.20$, Ca $+0.78 \pm 0.11$ and P $+0.19 \pm 0.01$ g/day in animals fed *Calliandra calothyrsus* tree leaves ad-lib without concentrate mixture to Black Bengal goats.

Gupta and Balaraman (1989) reported that positive balances of N $+2.03 \pm 0.32$, Ca $+5.36 \pm 1.28$ and P -0.28 ± 0.08 g/day. The study indicated Nevaro leaves could meet the maintenance needs of goats when fed the sole roughage and would need only a little P supplement.

Singh *et al.* (1989) found positive balances for N $+13.04 \pm 2.62$, Ca $+6.00 \pm 1.08$, P $+0.31 \pm 0.21$ g/day in adult Siri x Jersey bullocks when fresh Gogun (*Saurania napalensis*) leaves were fed as sole feed.

Mondal *et al.* (1994) reported goats fed fresh Banyan (*Ficus bengalensis*) tree leaves were on positive N $+0.91 \pm 0.11$, Ca $+3.33 \pm 0.22$ and P $+0.42 \pm 0.05$ g/day/animal balances during collection period.

Singh *et al.* (1994) observed negative nitrogen balance -0.86 ± 0.36 g/day in Barbari bucks when solely fed on anjan tree (*Hardwickia binate*) leaves.

Verma *et al.* (1995) stated that the average daily balance of N, Ca and P were $+1.33 \pm 0.19$, $-2.61 \pm .97$ and P $+0.30 \pm 0.07$ g/day in Barbari kids fed ad-lib casuarina leaves, respectively. The results indicated that casuarina fodder is palatable and nutritious for goats but must be supplemented with appropriate amount of minerals to meet their maintenance requirements.

Balaraman (1995) found that the local goats fed hybrid Napier grass (*Pennisetum purpureum*) exhibited negative nitrogen balance (-0.12 ± 0.78) and marginally positive Ca $+0.26 \pm 0.4$ and P 0.176 ± 0.072 g/day/goat.

Mandal *et al.* (1995) reported goats fed fresh pipal leaves as sole feed were on positive balance for N $+3.21 \pm 0.13$, Ca $+5.03 \pm 0.54$ and P $+1.06 \pm 0.12$ g/day/goat.

Balaraman (1996) reported balances of nutrients in goats fed on nevro hay as sole feed as N $+1.26 \pm 1.03$, Ca $+5.51 \pm 1.47$ and P $+0.58 \pm 0.14$ g/day. The balance study thus showed adequacy of N, Ca and P for purpose of maintenance of adult goats.

Nageshwara Rao *et al.* (1996) studied two iso-nitrogenous complete feeds having same proportions (40 %) of dry leaves of either neem (Feed-1) or mulberry (feed-2) and evaluated in two metabolism trials using Sirohi and barbari breeds, respectively. They observed positive

nitrogen balance $+6.74 \pm 1.51$ and 6.25 ± 1.44 g/day during metabolism trial period.

Ganesh *et al.* (1998) observed the daily positive N $+3.4$ g, Ca $+1.35$ g and P $+0.54$ g balances in Nellore lambs fed the Amaranths (*Amaranthus cruentus*) ad-lib for a period of 21 days.

Dehuri *et al.* (2000) observed positive balances of N $+11.16 \pm 0.48$, Ca $+2.60 \pm 0.19$ and P $+1.00 \pm 0.11$ g/day in castrated Ganjam x Black Bengal goats, which were fed fresh tentulia (*Aeschynomene americana*) for a period of one month.

Rajendiran and Kadirvel (2002) studied nutritive value of casuarina leaves for goats. Two metabolism trials were conducted on adult bucks and young bucks to compare the in situ degradability to that of *in vivo* digestibility under two different locations in two different seasons. The balance studies showed that the animals were in positive balance of N $+2.1 \pm 0.4$ and $+4.7 \pm 0.5$, Ca $+5.7 \pm 0.8$ and $+0.4 \pm 0.2$ and P $+0.03 \pm 0.05$ and $+0.06 \pm 0.02$ g/day in both the trials.

Bais *et al.* (2002) studied nutritive value of sares and neem leaves in Marwari goats and found that all animals were in positive N balances $+0.59 \pm 0.93$ g/day and $+0.94 \pm 0.39$ g/day for sares and neem fed groups. The balances for Ca and P for Sares leaves were highest $+3.93 \pm 0.76$ and $+0.43 \pm 0.23$ than neem leaves $+1.05 \pm 0.1$ and $+1.35 \pm 0.16$ g/day.

2.6 Growth rate

Different species have characteristic growth rate governed by respective genetic potential in an optimum plane of nutrition. Highest the growth rate the receipt of profit will be earlier. Animals relatively smaller in size take much less time to attain maturity and consequently

start giving profit at an early age. The growth of young animals is generally attributed to increase in bone and muscle tissues.

Newale (1979) reported the effect of feeding different levels of protein on the growth of Osmanabadi kids during the age of 60 to 180 days period. The daily body weight gain ranged from 33 to 56, 42 to 68, 33 to 51 and monthly gain in height from 1.625 to 2.625, 1.125 to 2.875, 1.125 to 2.375 and chest girth : 1.625 to 2.500, 1.875 to 2.875, 1.625 to 2.375 cm for T₁ (100 per cent), T₂ (120 per cent) and T₃ (80 per cent) DCP of NRC respectively.

Mairal (1980) reported the effect of feeding different levels of protein on the growth of Osmanabadi goats during 12 to 13 months age. The average daily body weight gain : 36.65, 29.04, 21.9 g and average monthly gain in height : 2.29, 1.14, 1.14; length : 2.29, 2.29, 2.86 and girth : 2.14, 2.29, 2.14 cm were for T₁ (100 per cent), T₂ (120 per cent) and T₃ (80 per cent) DCP of NRC, respectively.

Kaldate (1982) observed daily body weight gain as 67.82 g and monthly linear body measurements as length : 2.50, height : 2.62 and chest girth : 2.92 cm in *Beetal x Osmanabadi* kids while browsing.

Thakur *et al.* (1982) reported that kids progressively lost their body weight which was found to be 18.5 ± 2.8 g/kg/day during a period of 90 days. This might be due to negative nitrogen balance and marginal positive balances of calcium and phosphorus when jack tree laves were fed ad-lib.

Singh and Gupta (1983) indicated that low consumption has resulted into the loss of average body weights of animals from the initial 30.15 to 29.17 kg during metabolism trial of 30 days of feeding dried Jhanji leaves.

Panda *et al.* (1983) found some gain in body weight (0.10 g/day/animal) in goats fed papal leaves, whereas the goats fed jamun leaves has lost (-0.75 g) their body weight during the 8 days feeding trial. The tannin content of jamun leaves has acted as a deterrent to intake.

Sarode (1984) studied the effect of different levels of protein: energy on growth of Osmanabadi kids of 3 to 15 months age. The average daily body weight gain : 37.40, 35.0, 33.20, 33.70 g and average monthly gain in height : 1.46, 1.38, 1.26, 1.13 ; length 1.17, 1.15, 0.97, 1.12 and chest girth : 1.28, 1.37, 1.11, 0.98 cm were observed in 100 : 100, 100 : 80, 80 : 100 and 80 : 80 of protein : energy combination diets (NRC), respectively.

Sharma and Ogra (1990) studied growth rate of Barbari kids fed Khejri (*Prosopis cineraria*) leaves, 1, 2 and 3 per cent levels of concentrate + Khejri leaves ad-lib Growth rate was 18.2, 41.1, 51.1 and 56.1 g/day. The supplementation of concentrate significantly improved ($P < 0.05$) the growth rate.

Yadav *et al.* (1990) reported that the average growth rate of Barbari kids was 34.8 ± 5.5 g/day when kids were fed 200 g of concentrate mixture daily and were allowed to graze for 6 hours.

Thirumalai *et al.* (1993) reported average body weight gain as 56, 69 and 57 g/day in weaned goats fed concentrate and fresh Vagai (*Albizia lebbek*) tree leaves ad-lib.

Mondal *et al.* (1994) reported that Black Bengal goats lossed their body weight when fresh Banyan (*Ficus bengalensis*) tree leaves were fed solely. Average daily loss in weight observed was 19.28 g/day during metabolism trial period of 7 days.

Sehgal (1994) observed the average daily gain of 145 g in lambs fed the composite ration containing 50% of pala leaves having 3.56 per cent tannin.

Varma *et al.* (1995) observed the average gain of 34.83 ± 0.98 g/day in body weight when casuarina (*Casuarina equisetifolia*) leaves were fed *ad-libitum* without any supplementation of concentrate mixture during the feeding period of 30 days.

Mandal *et al.* (1995) studied nutritive value of pipal tree leaves (*Ficus religiosa*) in male Black Bengal goats. The fresh pipal tree leaves were fed *ad-lib* for a period of 27 days including balance trial period of 7 days. The goats recorded gain in body weight of 38.57 ± 2.63 g/day during 7 days experiment period.

Balaraman (1996) noticed no significant change in the body weight of animals when Nevaro (*Ficus hookerii*) hay was fed to Sikkim local female goats.

Tiwari *et al.* (1996) reported that when fresh guinea (*Panicum maximum*) grass harvested at matured stage was fed to goats for 26 days as a sole feed resulted in loss in body weight @ 138.46 g/day.

Tiwari *et al.* (1998) reported a daily weight gain of 57.69 g/day in Jamunapari goats fed sole Reha (*Acacia leucophloea* Willd L.) tree leaves for 30 days.

Shinde *et al.* (2000) reported 3.59 and 5.11 kg weight gain in two groups of Osmanabadi kids in 90 days. Kids were fed paragrass, dry kadbi concentrate in group-I and ber leaves *ad-lib* in group-II.

Anandan and Dey (2000) reported bucks fed solely on fresh oak (*Querces semecarpifolia*) leaves during monsoon season lost body weight of the animals during the study -1.20 ± 0.30 kg.

Tomar *et al.* (2001) reported average daily growth rate of 82.5 ± 6.77 , 87.8 ± 1.38 , 91.60 and 77.86 g per day in four groups of Sirohi goat kids fed on different plains of concentrate supplementation in addition to normal browsing. These groups were no concentrate supplementation (FG-I), 1 % (FG-II), 2 % (FG-III) and 3 % (FG-IV).

Sen *et al.* (2002) reported average daily gain of 85.5 ± 6.77 g/day in group I, 87.8 ± 1.36 g/day in group II. The goats in group I fed ad-lib Khejri leaves and concentrate and second group was given pala and concentrate in cafeteria system of feeding management.

Saikia (2002) reported daily average body weight gain of 35.00 ± 5.14 g/day, when Thalapadama (*Hibiscus mutabilis* L.) tree leaves were fed to Marwari goats for a period of 21 days during the month of September and October and their after a 5 days metabolism trial was conducted.

Nageshwara Rao *et al.* (2002) reported average daily growth of 46 and 44 g/day in Marwari goats fed concentrate mixture @ 0.5 % and @ 1 % body weight + dry *Leucanea leucephal* leaves and barley straw mixture (1:1) ad-lib.

Barman *et al.* (2003) reported that crossbred goats fed Ghora neem ad-lib maintained their body weight during the experimental period.

2.7 Feed efficiency

Feed efficiency always depends on genetic potentiality of breed or species, biological value of feed and environmental factors.

Mudgal *et al.* (1979) reported that 11.76 kg feed (ration of 16.86 DCP and 66.93 TDN) is needed for one kg body weight gain of kids.

Nawale (1979) indicated nutrient requirement as dry matter 7.953, 7.079, 9.103 kg and DCP 0.987, 0.936, 0.837 kg for 1 kg body weight gain in Osmanabadi kids fed with 100, 120 and 80 per cent DCP of NRC, respectively.

Mairal (1980) indicated the consumption of dry matter 41.29, 39.67, 41.56 kg, DCP 1.685, 1.710, 1.440 and TDN 47.11, 45.15 and 47.69 kg for one kg body weight gain of Osmanabadi goats fed with 100, 120, 80 per cent DCP of NRC respectively.

Sarode (1984) found feed conversion efficiency for DM 16.86, 13.23, 16.97, 30.28 kg DCP, 1.93, 1.92, 1.65, 1.80 kg and TDN 10.98, 8.19, 11.12, 8.97 kg for one kg body weight gain in Osmanabadi goats.

Deshmukh (1988) observed feed efficiency for three groups of the kids as 20.88, 27.44 and 25.04 kg/kg body weight gain when fed with 50% CP through concentrate +50% CP through lucerne, 25% CP through concentrate +75% through green *Styloseathus hamata* and 100 % CP through green *Stylosanthus hemata* with ad-lib Kadbi, respectively.

Sarode (1988) indicated nutrient requirements of DCP as 1.208, 1.257, 1.292, 1.404, 1.507 and TDN as 7.323, 7.193, 8.581, 10.199, 11.822 kg/kg body weight gain in kids fed with 0, 25, 50, 75 and 100 per cent CP through *Stylosonthes hamata* hay respectively.

Kedar (1990) found that the feed efficiency for three groups of the kids were 10.14 kg for control group, 10.41 kg for group fed with 25 % CP through rain tree leaves and 10.2 kg per kg body weight gain for group fed with 50% CP through rain tree leaves.

Hembade (1994) reported the average nutrient requirement for 1 kg body weight gain was 20.387, 22.068 and 21.985 kg DM; 1.490, 1.565 and 1.617 kg DCP and 11.586, 12.380, 12.529 kg TDN for T1, T2 and T3, respectively when fed banana green leaves as partial replacement of roughage, in the ruminants.

2.8 Correlation and regression

The body weight gain variable is correlated with most of the nutrient intakes, balances and their digestibility coefficients. They are also intercorrelated with each other.

Gholap (1984) observed correlation amongst various variables while feeding shevra hay upto 50 per cent CP replacement to crossbred heifers. The body weight gain has significant and positive correlation with DM, CP, EE and CF digestibility, while DCP and TDN intake have positive but non-significant correlation. However, negative but non-significant correlation was found with DM intake and NFE digestibility.

Deshmukh (1988) indicated correlation amongst variables while feeding green *Stylosanthes hamata* to crossbred kids. DM, CP, CF and NFE digestibility has positive correlation with body weight gain and EE digestibility has negative correlation with body weight gain.

Hembade (1988) reported correlation amongst various variables while feeding shevra (*Alysicarpus rugosus*) hay upto 80 per cent CP replacement to half breed growing calves. The body weight gain has positive correlation with DM, DCP and TDN intakes and DM, CP, CF and NFE digestibility while EE digestibility have negative correlation with body weight gain.

Mandava *et al.* (1988) observed correlation amongst DM, DCP and TDN intake and DM, CP, EE, CF and NFE digestibility with body

weight gain while feeding rain tree leaves in buffalo calves. The body weight gain has positive but non significant correlation with DM, CP, EE and NFE digestibility but negative correlation with DM, DCP and TDN intake and CF digestibility with body weight gain.

Sarode (1988) reported correlation amongst various variables while feeding *Stylosanthes hamata* hay to Osmanabadi x Beetal kids. Body weight gain has positively significant correlation with DCP and P intakes, OM digestibility and N and P balance. On the contrary the correlation of other attributes could not achieve significance at 5 per cent level. The balances of Ca and EE digestibility have recorded significantly negative correlation with body weight gain. Coefficient of multiple determination was non-significant implying thereby the linear function was not a better fit.

Hembade (1994) observed that intakes of DM and TDN, digestibility of DM and CP and daily balances of N and P were significantly positively correlated with body weight gain. While intake of DCP and digestibility of OM, CF and NFE have shown non significant but positive correlation with body weight gain. While intake of Ca, digestibility of EE and daily balance of Ca have recorded significant negative correlation with body weight gain. Intake of N and digestibility of TCHO have shown non significant negative correlation with body weight gain.



MATERIALS AND METHODS



**Plate 1. *Peltophorum pterocarpum* leguminous tree
(Ornamental plant)**

3. MATERIALS AND METHODS

Present investigation was undertaken at Department of Animal Husbandry and Dairying, College of Agriculture, Marathwada Agricultural University, Parbhani (Maharashtra). The place is located at an elevation of 489 metres with 97.40 S longitude and 19.16 N latitude. The rainfall ranges from 605 to 990 with average of 767 mm, temperature from 13.4°C to 41.1°C and humidity from 16.5 to 91 per cent. The herd strength of goat unit was 160 heads.

3.1 Growth trial

3.1.1 Selection of kids

Twenty four kids of Osmanabadi, 12 males and 12 females between the age of 77 to 221 days and 5 to 12 kg body weights were selected for this experiment. Four groups of six each were formed, which were tested statistically and found homogenous for sex, body weight and age (Appendix-I).

3.1.2 Details of experiment

Treatment	Feed	Total kids
T ₁ (control)	50 per cent CP from concentrate mixture + 50 per cent CP from paragrass (<i>Bracharia mutica</i>) + dry jowar kadbi ad-lib.	6
T ₂	50 per cent CP from concentrate mixture + 35 per cent CP from paragrass (<i>Bracharia mutica</i>) + 15 per cent CP from <i>Peltophorum pterocarpum</i> tree leaves + dry jowar kadbi ad-lib.	6
T ₃	50 per cent CP from concentrate mixture + 20 per cent CP from paragrass (<i>Bracharia mutica</i>) + 30 per cent CP from <i>Peltophorum pterocarpum</i> tree leaves + dry jowar kadbi ad-lib.	6
T ₄	50 per cent CP from concentrate mixture + 5 per cent CP from paragrass (<i>Bracharia mutica</i>) + 45 per cent CP from <i>Peltophorum pterocarpum</i> tree leaves + dry jowar kadbi ad-lib.	6
	Total	24

3.1.3 Experimental period

The experiment with four trials each of 28 days was conducted, prefixing 8 days as pre experimental period was given. In the same experimental trials the metabolism studies of four days were conducted in the metabolic cages during the last 20 days of each experimental period to involve all the kids. All kids fed simultaneously. The experiment was started on 13th August 2003 and lasted for 157 days upto 16th January 2004.

3.1.4 Housing and management

The kids were housed, in the well ventilated shed. Every kid was tied at proper distance and provided with separate feeding box through out the experimental period. The kids were let loose outside in the sun for 1 to 2 hours daily in the morning, except during the metabolism trial throughout the experimental period. Healthy and hygienic condition was maintained in the experimental shed.

3.1.5 Feeding and watering

The requirements of DM, DCP and TDN of the experimental kids for growth, were calculated weekly on the basis of body weights as per the recommendations of Ranjhan (1998). Jowar kadbi (*Sorghum vulgare*), green paragrass and *Peltophorum pterocarpum* tree green leaves as roughage and concentrates (sugras) compounded feed (kid fed containing 16.34 % DCP and 77.19 % TDN) manufactured by Maharashtra Agro Industries Development Corporation Ltd., Bombay, as concentrate were used in experiment. The kids were fed daily with *Peltophorum pterocarpum* tree green leaves, paragrass at 9.00 hours and concentrate at 14.00 hours to fulfil DCP requirement of each kid. The deficient DM and TDN were made up through kadbi at 17.00 hours ad-lib

(weighed), clean, fresh, cold drinking water was offered four times a day at 7.30, 10, 14.30 and 18.00 hours.

3.1.6 Feeding practices

Peltophorum pterocarpum tree green leaves were looped from trees available in the campus and fed to the kids at 9.00 a.m. as per treatment and also as per requirement. Tree leaves were taken from the same plant till available and after complete defoliation other tree leaves were taken.

3.1.7 Health and hygiene

The kids were dewormed before experiment. The shed and kids were sprayed weekly and fortnightly with 0.1 and 0.05 per cent malathion solution, respectively to control ectoparasites during experiment. Health care was taken as and when required.

3.1.8 Growth of kids

Weekly record of body weights and linear measurements such as height, length and chest girth were recorded. All the observations as detailed below were recorded in the morning before feeding and watering.

a) Weights

Body weights were taken on a standard dial type weighing machine (Apex) upto the 100 g fraction.

b) Height

The height was measured from ground level to wither point.

c) Length

The length was measured from the point of shoulder to pin bone.

d) Chest girth

The chest girth was measured as the circumference of the chest at the wither and behind the fore legs. All the linear measurements were taken by using standard tape upto the 0.5 cm fraction.

3.2 Metabolism trial

During the four experimental periods, four days metabolism trials were conducted involving all the experimental kids.

3.2.1 Collection of faeces

Total faeces perged out during previous 24 hours were quantitatively collected in good quality polythene bags, placed in plastic bucket and tied just beneath the faecal outlet of metabolic crate, collected at 8.30 a.m., weighed and labelled for each animal separately. Strict vigilance was kept during the metabolism trial to ensure the total collection and preservation of excreta.

3.2.2 Collection of urine

Urine was collected in leak proof good quality polythene bags placed in plastic bucket and tied just beneath the urine outlet of metabolic crate. The collections were measured and labelled for each animal separately in the morning at 8.30 a.m. It was acidified with dilute hydrochloric acid to keep down the pH, strict vigilance was kept during the metabolism trial to ensure the total urine collection and preservation.

3.2.3 Sampling of faeces

Faeces were mixed thoroughly and then a homogenous 125 g sample was taken in a numbered and labelled polythene bag separately for each animal. For N determination fresh 5 g sample in duplicate was taken, remaining sample was subjected to oven drying for DM and other proximate analysis.

3.2.4 Sampling of urine

A homogenous 30 ml sample of urine was collected in well stoppered bottle and labeled. For N determination five ml fresh sample in duplicate was pipetted, remaining sample was preserved for Ca and P determination.

3.2.5 Chemical analysis

The chemical analysis of feed offered, left over feed and fodders, faeces, urine samples during metabolism, and palatability trials was carried out for their proximate principles and minerals (Ca and P) with standard method of ISI 1975. The chemical analysis of *Peltophorum pterocarpum* tree leaves was carried out at preflowering, flowering and pod formation stages during August, September, October, November and December. 20 samples each in duplicate was analysed for proximate principles, toxic principles and minerals. Similarly, thirty samples of every offered and 25 samples of left over feed and fodder as a representative sample were analysed for proximate principles

3.2.6 Balance studies

The balance of N, Ca and P were estimated during the metabolism trials.

3.2.7 Feed efficiency

Feed efficiency was worked out in terms of DM, DCP and TDN requirement per kg body weight gain.

3.3 Palatability cum metabolism trial (T₅)

Six male kids from treatment T₃ and T₄ were selected for 13 days palatability trial. During trial, *Peltophorum pterocarpum* tree green leaves was fed ad-lib. DM consumption and acceptability were estimated. All the kids was subject to 4 days metabolic study. This sole feeding trial

was treated as T₅, which was statistically compared with rest of the treatments T1 to T4 by Students 't' Test.

3.4 Statistical analysis

The data on growth and various parameters were subjected to standard statistical analysis by following factorial completely randomized design using analysis of variance (Federer, 1967). Comparison between T₅ and other treatments was carried by calculating student 't' test for all parameters. Correlations and regressions were estimated amongst all variables.



RESULTS AND DISCUSSION



4. RESULTS AND DISCUSSION

The results obtained during the present investigation are presented and discussed under the following heads.

1. Toxic principles of *Peltophorum pterocarpum* tree leaves
2. Chemical composition
3. Nutrient intake
4. Nutrient digestibility
5. Nutrient balances
6. Growth rate
7. Feed efficiency
8. Sole feeding or palatability trial (T₅) with all other treatments
9. Correlation and regression amongst all variables

4.1 Toxic principles

Peltophorum pterocarpum tree leaves tender shoots, green pods and dry pods were analysed for the presence of toxic principles viz., alkaloids and polyphenols.

4.1.1 Alkaloids

Qualitative test for *Peltophorum pterocarpum* tree leaves were found to be positive for alkaloid.

4.1.2 Polyphenols

Qualitative test for *Peltophorum pterocarpum* tree leaves was found to be positive for polyphenols (Tannin) with Folin Cicalteu reagent. Therefore, quantitative estimation of polyphenols was carried

Table. 1. Tannin content of *Peltophorum pterocarpum* tree leaves, young shoots, green pods and dry pods (per cent on DM basis).

Plant parts	Aug. 2003	Sept. 2003	Oct. 2003	Nov. 2003	Dec. 2003	Jan. 2004	Mean
Tree leaves	12.00	12.50	13.00	14.00	15.00	15.00	13.58
Young shoots	14.00	14.50	14.00	14.50	16.00	16.00	14.83
Green pods	--	12.00	12.00	12.50	13.00	14.00	12.70
Dry pods	--	--	--	--	15.00	15.00	15.00
Av.	13.00	13.00	13.00	13.66	14.75	15.00	14.02

out. The data regarding polyphenols (tannin) content of *Peltophorum pterocarpum* tree leaves, young shoots, green pods and dry pods are presented in Table 1 and depicted in Fig. 1.

It is evident from the data in Table 1 that the average tannin content varied with seasonal changes. The average tannin content ranged from 13.00 to 15.00 per cent from the month of August to January. The tannin content of *Peltophorum pterocarpum* tree leaves (old) ranged from 12.00 to 15.00 per cent with a mean of 13.58 per cent.

The young shoot contained more tannin (14.00 to 16.00 per cent) than old leaves, green pods and dry pods.

The green pods contained 12.00 to 14.00 per cent tannin. It can be concluded that the tannin content of green leaves, young shoots, green pods and dry pods increased with passage of time / month.

The presented values of tannin are slightly lower than those reported by Nag and Matai (1992) for *Peltophorum pterocarpum* tree leaves. The presented values are in agreement with the reported values by Nag *et al.* (1994) in *Paraserianthus falacateria*, *Jacaranda*, *Mimosefolia* and *Tecoma foetida*. The presented values of tannin for leaves, tender shoots green pods and dry pods were similar to those reported by Degan *et al.* (1995) from eighteen plants and different parts and various stages of growth.

4.2 Chemical composition of *Peltophorum pterocarpum* tree leaves

The values regarding chemical composition of tree leaves, young shoots, green pods and dry pods are presented in Table 2 and depicted in Fig. 2.

Table 2. Per cent chemical composition (on DM basis) of *Peltophorum pterocarpum*.

	August	November	January	Mean
DM	27.00	29.33	32.66	29.66
OM	92.16	91.32	89.82	91.10
CP	20.04	18.50	16.00	18.18
EE	8.50	9.00	9.16	8.88
CF	10.83	11.66	12.33	11.60
NFE	52.77	52.16	52.33	52.42
TCHO	63.28	63.83	64.66	63.92
Total ash	7.86	8.68	10.68	8.90
Acid insoluble ash	1.41	1.50	1.70	1.53
Ca	1.75	1.75	1.80	1.76
P	0.59	0.49	0.55	0.54
Polyphenols				
H.T.	11.50	12.0	13.50	12.33
C.T.	1.50	1.66	1.50	1.55
Alkaloids				
A	+	+	+	+
B	+	+	+	+

Cell wall composition percentage (on DM basis)

DM	CP	NDF	ADF	Hemicellulos	Cellulose	Lignin	Silica
29.66	18.18	30.12	19.22	10.9	10.42	8.3	1.52

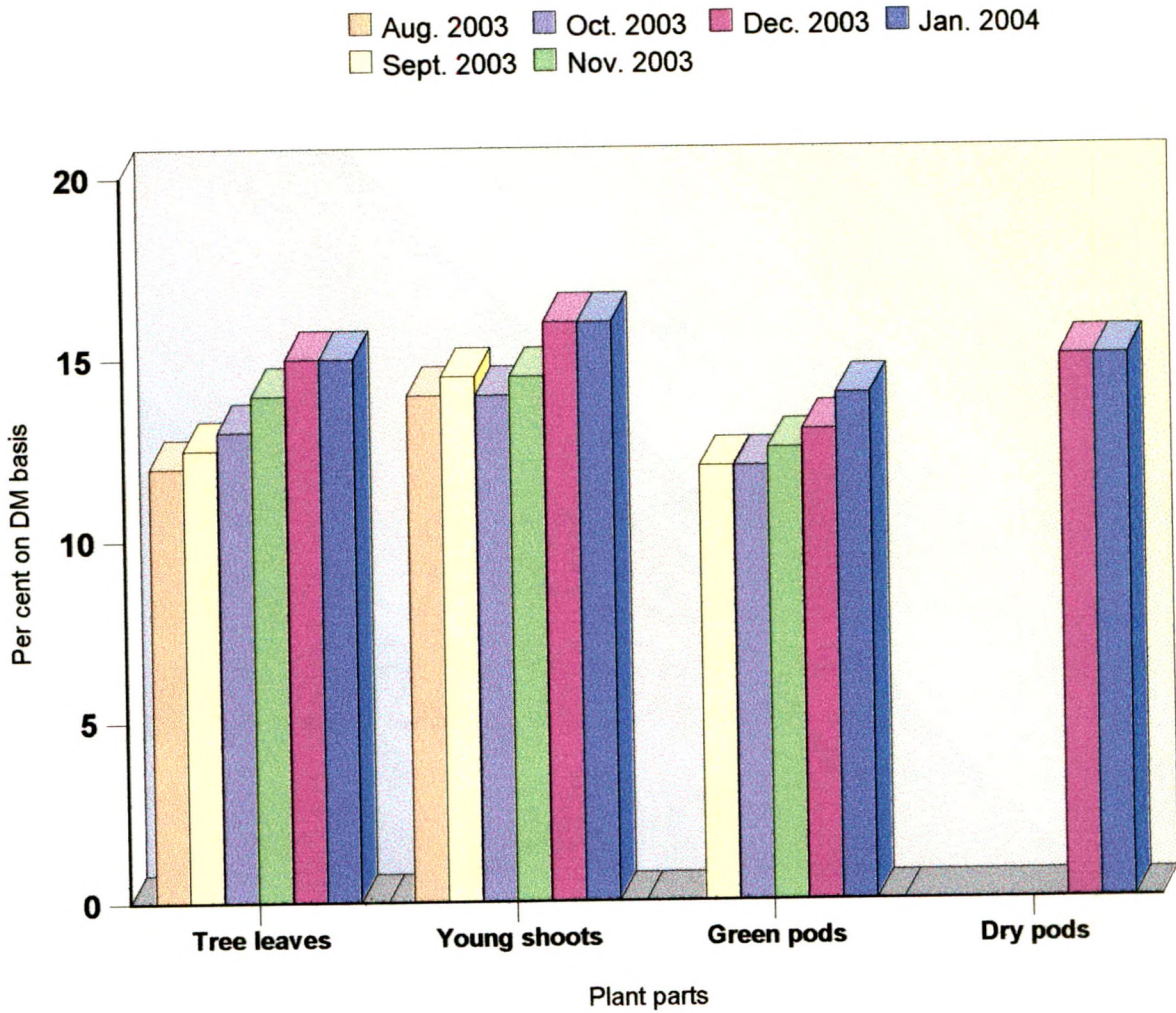


Fig. 1. Tannin content of *Peltophorum pterocarpum* tree leaves, young shoots, green pods and dry pods (per cent on DM basis).

4.2.1 Chemical composition of leaves

The mean dry matter content of *Peltophorum pterocarpum* tree leaves was 29.66 per cent. The average chemical composition on dry matter basis was OM 91.10, CP 18.18, EE 8.88, CF 11.60, NFE 52.42, TCHO 63.92, TA 8.90, AIA 1.53, Ca 1.76 and P 0.54 per cent.

The presented values are in agreement with the reported values of Nag and Matai (1992) for *Peltophorum pterocarpum* tree leaves.

The composition determined by the detergent system of feed analysis (Van Soest's method) on dry matter basis was 29.66, CP 18.18, NDF 30.12, ADF 19.12, HC 10.9, cellulose 10.42, lignin 8.3 and silica 1.52 per cent.

The chemical composition of *Peltophorum pterocarpum* tree leaves varied during the period of investigation. Dry matter content increased from 27.00 per cent to 32.66 per cent from August to January. The OM content showed reverse trend i.e. it decreased from 92.16 per cent to 89.82 per cent. The CP contents also showed decreased trend. It was decreased from 20.04 per cent from August to 16.00 per cent in January, whereas, EE, CF, TCHO and Ash content were found to be increased from 8.5 - 9.16, 10.83 - 12.33, 63.28 to 64.66 and 7.86 - 10.18 per cent, respectively.

The presented various nutrients are comparable with the reported values by Palani and Dastagir (1996) for *Gmelina arborea*; Joshi and Thalpatra (1960) for bhimal (*Grewia oppositifolia*).

The cell wall constituents of *Peltophorum pterocarpum* tree leaves are comparable to those reported by Ramana *et al.* (2002) for ten

multipurpose tree and shrub species. Lohan *et al.* (1980) also reported seasonal chemical composition of 22 species of fodder trees as per the detergent system of feed analysis. The values reported by Nag *et al.* (1994) were somewhat higher than obtained. The values obtained for cell wall constituents are lower than the values reported by Yadav and Bhaduria (2001) for *Baudlimia purpurea*, *Leucana diversifolia* and *Albizia procerra*.

4.3 Nutrient intake

Results regarding treatment, period and its interaction effects on DM, DCP and TDN intake on per cent live weight basis are presented in Table 3 and depicted in Fig. 3.

Dry matter

Treatments	T ₃	T ₂	T ₄	T ₁
DM intake kg/100 kg live weight	3.794	3.718	3.717	3.684

Values revealed that there was non significant differences amongst the treatments in respect of dry matter intake.

Kids received 30 per cent CP through *Peltophorum pterocarpum* (T₃) consumed slightly higher dry matter than all other treatments followed by T₂, T₄ and lowest dry matter intake was recorded in T₁. However, T₃, T₂, T₄ and T₁ were at par.

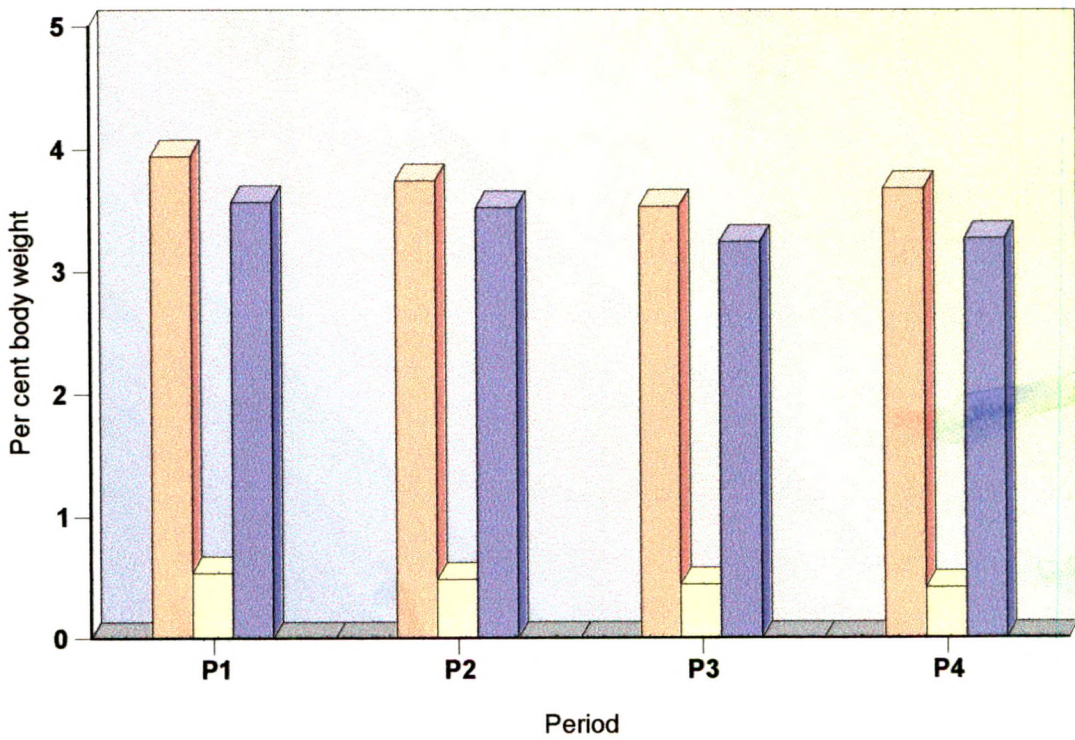
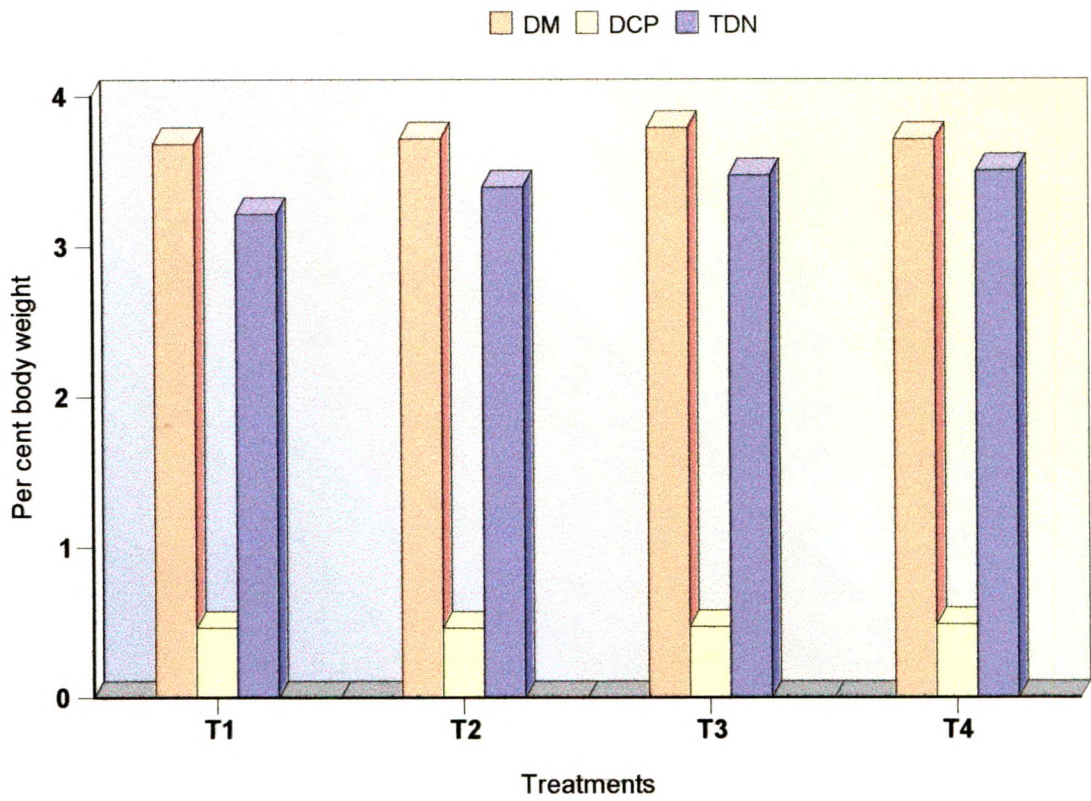
Period	P ₁	P ₂	P ₄	P ₃
DM intake kg/100 kg live weight	<u>3.953</u>	<u>3.743</u>	<u>3.682</u>	<u>3.535</u>

Data revealed that there was significant ($P < 0.01$) differences among the values of dry matter intake during different periods.

Table 3. Treatment and period effect on nutrient intake of experimental kids (per cent body weight)

	DM	DCP	TDN
Treatments			
T ₁	3.684	0.468	3.222 ^b
T ₂	3.718	0.467	3.400 ^b
T ₃	3.794	0.477	3.478 ^a
T ₄	3.717	0.492	3.505 ^a
SE +	0.134	0.134	0.071
CD at 5%	NS	NS	0.197
Period			
P ₁	3.953 ^a	0.544 ^a	3.568 ^a
P ₂	3.743 ^b	0.489 ^b	3.521 ^a
P ₃	3.535 ^b	0.449 ^c	3.246 ^b
P ₄	3.682 ^b	0.422 ^c	3.269 ^b
SE	0.134	0.134	0.071
CD at 5%	0.371	0.371	0.197
Period x treatment			
P ₁ T ₁	3.749	0.5306	3.341
P ₁ T ₂	3.783	0.5371	3.424
P ₁ T ₃	4.009	0.5385	3.580
P ₁ T ₄	4.272	0.571	3.927
P ₂ T ₁	3.720	0.566	3.350
P ₂ T ₂	3.760	0.455	3.475
P ₂ T ₃	3.817	0.483	3.768
P ₂ T ₄	3.673	0.511	3.491
P ₃ T ₁	3.641	0.453	3.144
P ₃ T ₂	3.521	0.459	3.274
P ₃ T ₃	3.652	0.443	3.265
P ₃ T ₄	3.325	0.441	3.302
P ₄ T ₁	3.627	0.384	3.051
P ₄ T ₂	3.809	0.416	3.426
P ₄ T ₃	3.696	0.445	3.298
P ₄ T ₄	3.598	0.445	3.301
SE ±	0.145	0.026	0.142
CD at 5%	NS	NS	NS

Note : Treatment / period / P x T effects carrying similar letters are at par and those carrying different letters are significantly differed from each other at 5% level.



3
 Fig. 2. Treatment and period effect on nutrient intake of experimental kids (per cent body weight)

Dry matter intake during P₁ was highly significant (P < 0.01) over period P₂, P₃ and P₄. P₂, P₄ and P₃ were at par with each other.

The effects of interactions between periods and treatments on dry matter intake were non significant.

DM intake during period P1 might be higher due to tender, succulent feed which was palatable. Palatability of tree leaves decreased as the leaves advance maturity.

The observed values for dry matter intake on per cent live weight basis are in agreement with those reported by Kedar (1990) for Rain tree leaves and goat kids, Badbind *et al.* (1994) for babul ber, pipal tree leaves, Lucerne and maize fodder in goats. The observed values for dry matter intake were lower than that reported by Kundu *et al.* (1985) for mango leaves in goats, Mandal *et al.* (1995) for papal tree leaves in goats. However, the observed values are higher than those reported by Shinde *et al.* (2000) for feed as for feeding standard group I and ber leaves group II in Osmanabadi goats, Anandan *et al.* (2000) for oak tree leaves in goats.

4.3.1 Digestible crude protein

Treatments	T ₄	T ₃	T ₁	T ₂
DCP intake kg/100 kg body weight/ day	0.492	0.477	0.468	0.467

It is obvious from the data that there were non significant differences for DCP intakes amongst the treatments.

Kids received 45 per cent CP through *Peltophorum pterocarpum* tree leaves consumed more DCP on per cent live weight basis followed by T₃ and T₁, and lowest being recorded by T₂.

Periods	P ₁	P ₂	P ₃	P ₄
DCP intake kg/100 kg body weight	0.544	0.489	<u>0.449</u>	<u>0.422</u>

Data on period effects shows that there were significant ($P < 0.05$) differences amongst periods.

There was consistent significant decrease in the DCP intake on per cent body weight. DCP intake was higher during period P₁ followed by P₂, P₃ and P₄. P₃ and P₄ were at par with each other.

Data also revealed that interactions between period and treatments on DCP intake were non-significant. The presented values are comparable with Barbind *et al.* (1994) for Babul, ber, pipal tree leaves, Lucerne and maize fodder in Osmanabadi goat. The observed values for DCP intake kg/100 kg body weight are in agreement with those reported by Verma *et al.* (1995) for Casuarina leaves in goats, However, the observed values for DCP intake kg/100 kg are higher than those reported by Shinde *et al.* (2000) for paragrass and ber leaves in goats and Kedar (1990) for Rain tree leaves in goat kids.

During the present investigation, DCP intake was declined as CP replacement rate increased due to declined trend in intake of CP.

4.3.2 Total digestible nutrient

Treatments	T ₄	T ₃	T ₂	T ₁
TDN intake	<u>3.505</u>	<u>3.478</u>	<u>3.400</u>	<u>3.222</u>

Data indicated that there were significant ($P < 0.05$) differences among treatments.

Kids received 45 per cent CP through *Peltophorum pterocarpum* tree leaves consumed significantly more TDN than T₃, T₂ and

T₁. However, T₄, T₃ and T₂, T₁ were at par and lowest TDN intake was recorded by kids in T₁.

Periods	P ₁	P ₂	P ₄	P ₃
TDN intake Kg/100 kg /day	<u>3.568</u>	<u>3.521</u>	<u>3.269</u>	<u>3.246</u>

Period effect on TDN intake was significant ($P < 0.05$).

The consumption of TDN was significantly ($P < 0.05$) more during period P₁ and P₂ followed by P₄ and P₃. P₁, P₂ and P₄, P₃ were at par with each other.

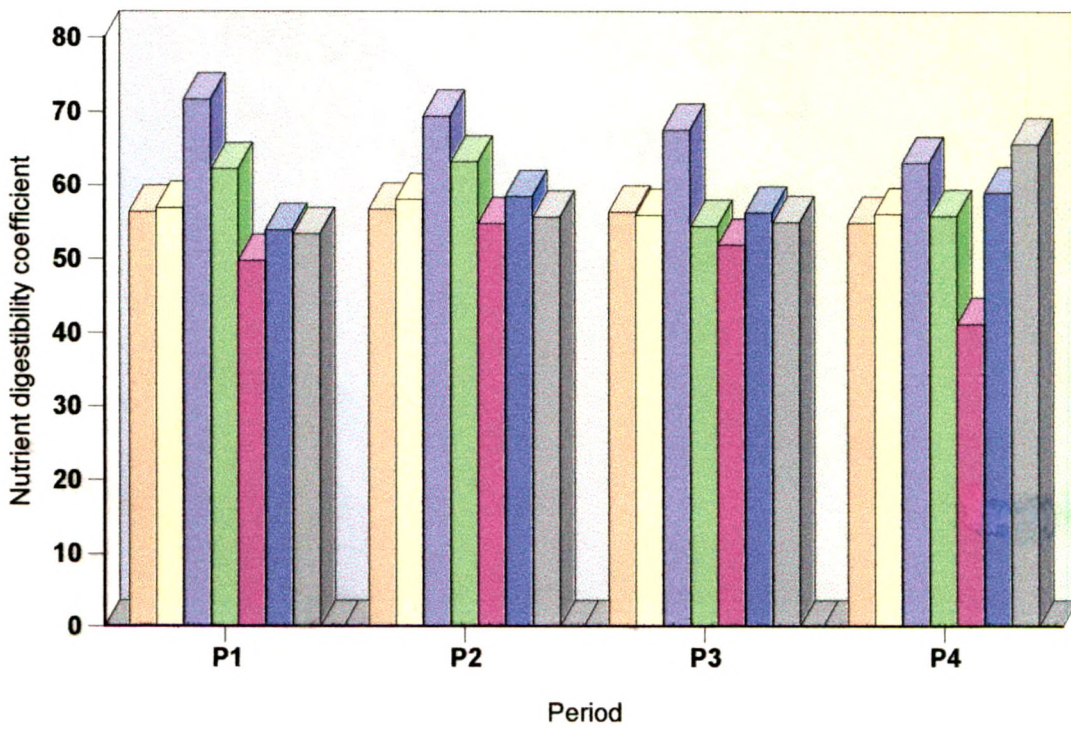
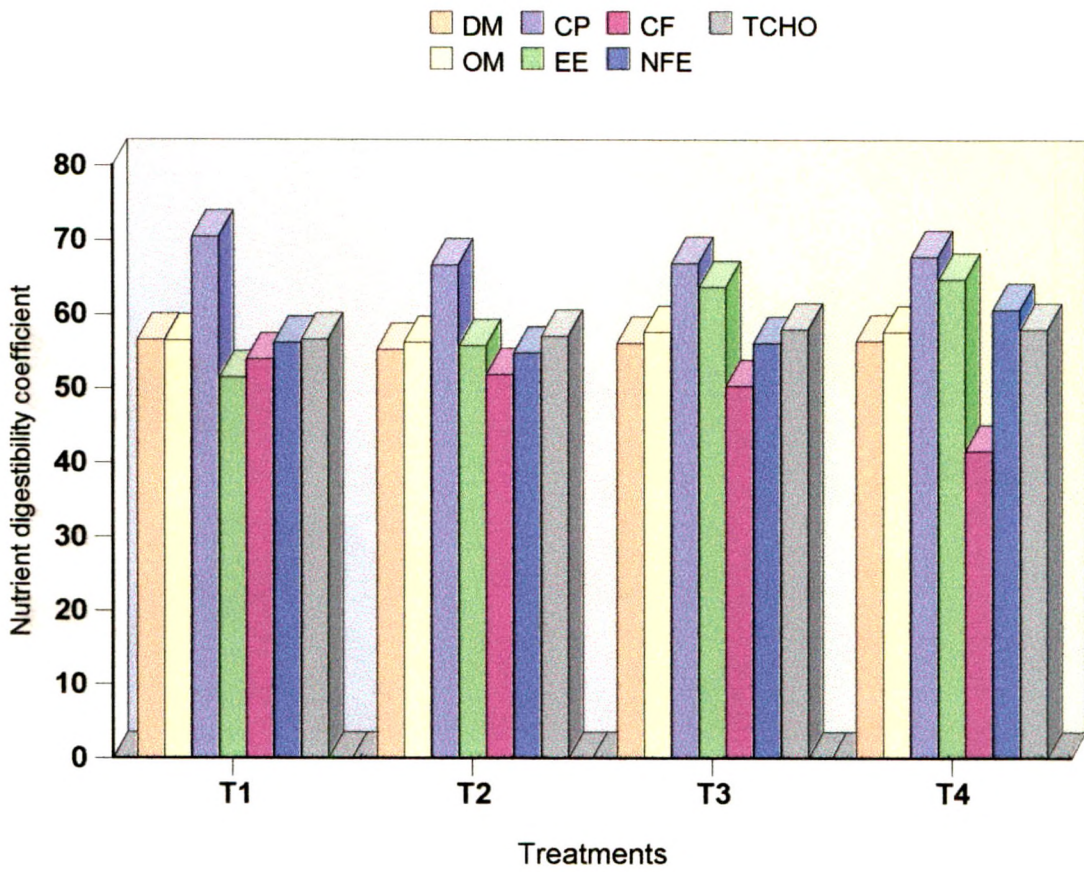
It is also obvious from the data that there were non significant differences amongst period x treatment interaction. TDN intake in treatment T₄ was significantly higher because of *Peltroforum* tree leaves were rich in fat content. Fat figure is multiplied by 2.25, thereby the per cent TDN intake might be higher. The dry matter intake during period P₁ was higher might have resulted in higher TDN intake. The observed values for TDN intake on per cent live weight basis are in agreement with those reported by Gupta *et al.* (1989) for *Nevaro* leaves and Singh *et al.* (1994) for *Anjan* tree leaves in goats.

However, the values observed for TDN intake on per cent live weight basis were lower than reported by Verma *et al.*, (1995) for *casuarina* leaves in goats. It can be concluded that intake of DM, DCP and TDN was proportionate to that of body weight of kids i.e. with increasing body weight intake increases.

Table 4. Effect of treatment and period on nutrient digestibility coefficients in the experimental kids

	DM	OM	CP	EE	CF	NFE	TCHO
Treatments							
T ₁	56.627	56.492 ^b	70.510 ^a	51.517 ^c	54.019 ^a	56.206 ^b	56.650
T ₂	55.328	56.232 ^b	66.706 ^b	55.848 ^b	51.929 ^a	54.836 ^b	57.119
T ₃	56.120	57.666 ^a	66.966 ^b	63.716 ^a	50.298 ^a	56.137 ^b	57.999
T ₄	56.404	57.671 ^a	67.829 ^b	64.782 ^a	41.569 ^b	60.632 ^a	57.988
SE +	0.401	0.4122	0.7304	1.386	1.339	0.912	0.4582
CD at 5%	NS	1.140	2.021	3.837	3.7077	2.526	NS
Period							
P ₁	56.380 ^a	56.962 ^b	71.650 ^a	62.229 ^a	49.763 ^b	53.980 ^c	53.436 ^c
P ₂	56.738 ^a	58.076 ^a	69.383 ^b	63.236 ^a	54.855 ^a	58.465 ^{ab}	55.706 ^b
P ₃	56.441 ^a	56.900 ^b	67.583 ^b	54.524 ^b	51.995 ^b	56.335 ^b	54.900 ^b
P ₄	54.920 ^b	56.123 ^b	63.125 ^c	55.874 ^b	41.202 ^c	59.032 ^a	65.620 ^a
SE	0.401	0.4122	0.7304	1.386	1.339	0.912	0.4582
CD at 5%	1.110	1.140	2.021	3.837	3.7077	2.526	1.268
Period x treatment							
P ₁ T ₁	56.330	56.120	75.265	57.340	52.812	53.995	53.125
P ₁ T ₂	55.410	56.385	71.857	58.338	50.535	53.283	51.968
P ₁ T ₃	56.950	56.672	69.950	65.195	50.157	50.025	53.377
P ₁ T ₄	56.830	58.672	69.527	68.043	45.550	58.615	55.273
P ₂ T ₁	57.535	57.885	74.095	63.015	62.975	61.018	54.473
P ₂ T ₂	56.305	57.890	66.632	56.015	56.682	55.603	56.198
P ₂ T ₃	56.330	58.205	66.797	66.612	59.127	57.918	57.450
P ₂ T ₄	56.783	58.323	70.008	67.303	40.635	59.318	54.703
P ₃ T ₁	57.832	56.467	69.552	37.602	55.323	52.013	53.382
P ₃ T ₂	55.678	56.393	66.878	53.145	55.120	54.155	54.688
P ₃ T ₃	56.005	57.855	66.447	61.225	53.862	55.787	55.550
P ₃ T ₄	56.248	56.887	67.457	66.123	43.677	63.387	56.355
P ₄ T ₁	54.812	55.497	63.128	48.112	44.967	57.798	53.665
P ₄ T ₂	53.920	54.262	61.457	55.895	45.380	56.302	52.462
P ₄ T ₃	55.195	57.932	63.590	61.832	38.048	60.820	55.570
P ₄ T ₄	55.755	56.803	64.323	57.657	36.413	61.207	53.537
SE ±	1.461	0.820	1.461	2.773	2.679	1.825	1.064
CD at 5%	NS	NS	NS	NS	NS	NS	NS

Note : Treatment / period / P x T effects carrying similar letters are at par and those carrying different letters are significantly differed from each other at 5% level.



4

Fig. 3. Effect of treatment and period on nutrient digestibility coefficients in the experimental kids

4.4 Nutrient digestibility

Data related to effects of treatment, period and its interaction on various nutrient digestibilities coefficients are presented in Table 4 and illustrated in Fig. 4.

4.4.1 Dry matter

Treatment	T ₁	T ₄	T ₃	T ₂
DM digestibility coefficient percentage	56.627	56.404	56.120	55.32

The observed data indicated that there were no significant ($P < 0.05$) differences among treatments for dry matter digestibility coefficient.

Highest and lowest values were observed in T₁ and T₂. However, T₁, T₄, T₃ and T₂ were at par.

Periods	P ₂	P ₃	P ₁	P ₄
DM digestibility coefficient percentage	56.738	56.441	56.380	54.920

Period effect was highly significant ($P < 0.01$).

Kids gave significantly higher DM digestibility in P₂, P₃ and P₁ over P₄. P₂, P₃ and P₁ were at par with each other.

The effects of interaction between period and treatments on DM digestibility were found non significant.

The presented values are in agreement with those reported by Barbind *et al.* (1994) for babul and ber tree leaves in goats, Rajendiran *et al.* (2002) for casuarina leaves in goats, while the observed values are

higher than those reported by Thakur *et al.* (1982) for jack tree leaves in kids, Kundu *et al.* (1985) for mango leaves in goats, Shinde *et al.* (2000) for paragrass and ber leaves in goats, whereas, observed values are lower than those reported by Mehta *et al.* (1985) for Arjun tree leaves in goats, Dehuri *et al.* (2000) for Tentulia tree leaves in goats.

4.4.2 Organic matter

Treatments	T ₄	T ₃	T ₁	T ₂
OM digestibility coefficient percentage	<u>57.671</u>	<u>57.666</u>	<u>56.492</u>	<u>56.232</u>

Observed data indicated that there were significant differences ($P < 0.05$) amongst treatment.

Highest and lowest values were noted in T₄ and T₂, respectively. Kids which received upto 45 % CP through *Peltophorum pterocarpum* tree leaves showed higher OM digestibility over T₂. However, OM digestibility in T₄, T₃ and T₁, T₂ were at par with each other.

Periods	P ₂	P ₁	P ₃	P ₄
OM digestibility coefficient percentage	<u>58.076</u>	<u>56.962</u>	<u>56.900</u>	<u>56.123</u>

Similarly period effect was found highly significant ($P < 0.01$).

Data indicated that OM digestibility coefficient in period P₂ was highly significant ($P < 0.01$) over other periods, however, P₁, P₃ and P₄ were at par.

Data indicated that digestibility coefficient was higher during period P₂ compared to other periods.

Further, the values for interaction between period and treatments were not significantly different from each other.

The present values are comparable with those reported by Gupta *et al.* (1989) for Navaro in Sikkim local goats, Singh *et al.* (1994) for Anjan tree in goats Saikia (2002) for Thalpadma in goats.

As presented values for OM digestibility in T₄, T₃ and T₁, T₂ were at par with each other, it could be inferred that *Peltophorum pterocarpum* tree leaves can be fed upto 45 per cent CP replacement of the kids without affecting OM digestibility.

4.4.3 Crude protein

Treatments	T ₁	T ₄	T ₃	T ₂
CP digestibility coefficient percentage	<u>70.510</u>	<u>67.829</u>	<u>66.96</u>	<u>66.706</u>

The presented data on CP digestibility coefficient indicates that there were highly significant ($P < 0.01$) differences among treatments.

Animals fed as per standard (50% CP through concentrates and 50% CP through paragrass (green)) digested CP significantly more than rest of the treatments. Treatment T₄, T₃ and T₂ were at par. The lowest value was recorded by T₂.

Period	P ₁	P ₂	P ₃	P ₄
CP digestibility coefficient percentage	71.650	<u>69.383</u>	<u>67.587</u>	63.125

Data revealed that CP digestibility coefficient was affected significantly by period.

Kids gave significantly higher CP digestibility in P₁ over P₂, P₃ and P₄, P₂ and P₃ were at par and P₄ has shown lower digestibility. However, non-significant differences of CP digestibility were noted due to interaction effect between periods and treatments. The observed values

corroborate the findings of Saikh *et al.* (1987) for Sajna in goats, Thirumalai *et al.* (1993) for Vagai tree leaves in goats and Dehuri *et al.* (2000) for Tentulia in goats.

While recorded values were higher than those reported by Tiwari *et al.* (1998) for Rhea tree leaves in goats, Shinde *et al.* (2000) for paragrass and ber leaves in goats, Rajendiran *et al.* (2002) for casuarina leaves in goats.

However, noted values were lower than those reported by Thirumalai *et al.* (1989) for Jack tree leaves in goats.

The presented values helped to suggest that replacement of CP through *Peltophorum pterocarpum* tree leaves upto 45 per cent can be possible in small ruminant feeding without affecting CP digestibility.

4.4.4 Ether extract

Treatment	T ₄	T ₃	T ₂	T ₁
EE digestibility coefficient percentage	<u>64.782</u>	<u>63.716</u>	55.848	51.517

Data on ether extract digestibility showed that effect of treatment was highly significant.

Highest and lowest values were recorded in T₄ and T₁, respectively. Kids received 45 per cent CP through *Peltophorum pterocarpum* tree leaves. T₄ and T₃ showed significantly higher EE digestibility over T₂ and T₁. However, T₄ and T₃ were at par. There was inclined trend of EE digestibility. It may be due to high Ca content in *Peltophorum pterocarpum* tree leaves, as the CP replacement by *Peltophorum pterocarpum* tree leaves increased with increasing treatment Ca intake also increases. Soap is formed from fatty acids and Ca in the internal tract and gives erroneously high value for the digestibility of EE.

This might be the reason the EE digestibility was found to be in increasing trend in the present study.

Period	P ₂	P ₁	P ₄	P ₃
EE digestibility coefficient percentage	<u>63.236</u>	<u>62.229</u>	<u>55.874</u>	<u>54.524</u>

Data indicated that the period effect was highly significant ($P < 0.01$) on EE digestibility.

Significantly highest EE digestibility was found in P₂ and P₁ over other periods. Lowest digestibility was recorded in P₃. However, digestibility during period P₂, P₁ and P₄, P₃ were at par with each other.

It is also obvious from the data that there were significant differences amongst interactions. The interaction effects were significantly higher in P₃ T₁, P₄ T₁ and P₂ T₂.

The observed values for EE digestibility coefficient were in agreement with those reported by Bhuyan *et al.* (1989) for banana leaves in kids, Shinde *et al.* (2000) for paragrass and ber leaves in goats, Barman *et al.* (2003) for Ghora Neem laves in crossbred goats.

A glance on data suggest that *Peltophorum pterocarpum* tree leaves can be fed upto 45 per cent CP level to yield maximum digestible energy from EE in animals.

4.4.5 Crude fiber

Treatment	T ₁	T ₂	T ₃	T ₄
CF digestibility coefficient percentage	<u>54.019</u>	<u>51.929</u>	<u>50.298</u>	41.569

The values of crude fiber digestibility differed significantly ($P < 0.05$) among treatments.

The significantly higher CF digestibility was observed in T₁, T₂ and T₃, respectively, while T₁, T₂ and T₃ were at par.

Period	P ₂	P ₃	P ₁	P ₄
CF digestibility coefficient percentage	<u>54.855</u>	<u>51.995</u>	<u>49.763</u>	41.202

Similarly period effect was found significant ($P < 0.05$).

Significantly ($P < 0.05$) higher CF digestibility was found in P₂ over other periods. P₃ and P₁ were at par with each other. Lowest CF digestibility was recorded in P₄. CF digestibility was not influenced by period and treatment interactions.

The observed values for CF digestibility coefficient are in agreement with those reported by Shinde *et al.* (2000) for paragrass and ber leave sin goats, Bais *et al.* (2002) for Sares and Neem leaves in Marwari goats and Saikia *et al.* (2002) for Tahalpadma tree leaves in goats.

However, the observed values are higher than those reported by Kundu *et al.* (1985) for mango leaves in goats, Mondal *et al.* (1994) for Banyan tree leaves in Black Bengal goats, Dehuri *et al.* (2000) for Tentulia in goats.

Whereas noted values were lower as compared to those documented by Thirumalai *et al.* (1990) for odi leaves in goats and Barman *et al.* (2003) for Ghora neem in crossbred goats.

4.4.6 Nitrogen free extract

Treatment	T ₄	T ₁	T ₃	T ₂
NFE digestibility coefficient	<u>60.632</u>	<u>56.206</u>	<u>56.137</u>	<u>54.836</u>

percentage

Data in respect of NFE digestibility coefficient indicates that there were significant differences among treatments.

Highest and lowest values were noted in T₄ and T₂ respectively. Kids received 45 per cent CP through *Peltophorum pterocarpum* tree leaves digested, NFE significantly ($P < 0.05$) higher than rest of the treatments.

Periods	P ₄	P ₂	P ₃	P ₁
NFE digestibility coefficient percentage	<u>59.032</u>	<u>58.465</u>	<u>56.335</u>	53.980

In further scrutiny of data the NFE digestibility was found highly influenced by period effect.

During period (P₄) kids gave significantly ($P < 0.05$) higher NFE digestibility than rest of the periods. P₄ and P₃ were at par similarly P₂ and P₃ were at par. Lowest digestibility was recorded in P₁.

There were non significant differences observed among different interactions between period and treatments.

The observed values were comparable with those documented by Kundu *et al.* (1985) for mango leaves in goats, Shinde *et al.* (2000) for paragrass and ber leaves in goats, whereas recorded values were higher than those reported by Mehta *et al.* (1986) for phephar leaves in goats. Anandan and Dey (2000) for oak tree leaves in goats.

4.4.7 Total carbohydrates

Treatments	T ₃	T ₄	T ₂	T ₁
TCH digestibility coefficient percentage	<u>57.999</u>	<u>57.988</u>	<u>57.119</u>	<u>56.650</u>

Data pertaining to total carbohydrates digestibility revealed that treatment effects were non significant.

Highest and lowest values were recorded by T₃ and T₁, respectively, while, T₃ showed numerically more total carbohydrate digestibility followed by T₄, T₂ and T₁.

Period	P ₄	P ₂	P ₃	P ₁
TCHO digestibility coefficient percentage	<u>65.620</u>	<u>55.706</u>	<u>54.990</u>	53.436

Further data revealed that the total carbohydrate digestibility was influenced by period effect.

During period P₄ kids gave significantly ($P < 0.05$) higher total carbohydrate digestibility than rest of the periods. Highest and lowest values were recorded for P₄ and P₁ respectively. However, P₂ and P₃ were at par with each other.

Non-significant differences among interaction of periods and treatments were found for total carbohydrate digestibility.

Observed values for total carbohydrate digestibility coefficient were comparable with. Verma *et al.* (1995) for casuarina in Barbari kids. Whereas, observed values were higher than Mehta and Bhaid (1986) for phephar leaves in young male goats.

It can be concluded that *Peltophorum pterocarpum* tree leaves can be fed upto 45 per cent CP replacement without affecting total carbohydrate digestibility.

During the present study, the DM, OM, CP, EE, CF and TCHO digestibilities showed slightly increasing trend with increased CP replacement rate through *Peltophorum pterocarpum* tree leaves in diet of kids. This might have been resulted due to inclined trend in daily intake of

DM, OM, CF. It is also well known fact that an increase in the level of dry matter intake resulted in a fall of digestibility due to increased faecal energy loss.

The digestibility of CP and EE observed was somewhat higher than other nutrients, though *Peltophorum pterocarpum* tree leaves contained antinutritional factors like alkaloids and polyphenols, that indicated goats can tolerate toxic effects of tannin very well.

4.5 Nutrient balances

The effect of treatment, period, and its interaction on intake, balance and per cent retention of nitrogen, calcium and phosphorus are presented in Table 5 and depicted in Fig. 5.

4.5.1 Nitrogen intake

Treatment	T ₃	T ₄	T ₂	T ₁
N intake g/day/kid	<u>8.400</u>	<u>8.208</u>	<u>8.042</u>	<u>7.922</u>

Treatment effect resulted in non significant differences amongst treatment for nitrogen intake.

Highest and lowest N intake was observed in T₃ and T₁. However, T₃, T₄ and T₂ were at par. Numerically, there was declined trend for N intake in T₃, T₄, T₂ and T₁.

Period	T ₄	T ₃	T ₂	T ₁
N intake g/day/kid	8.442	8.077	8.052	8.004

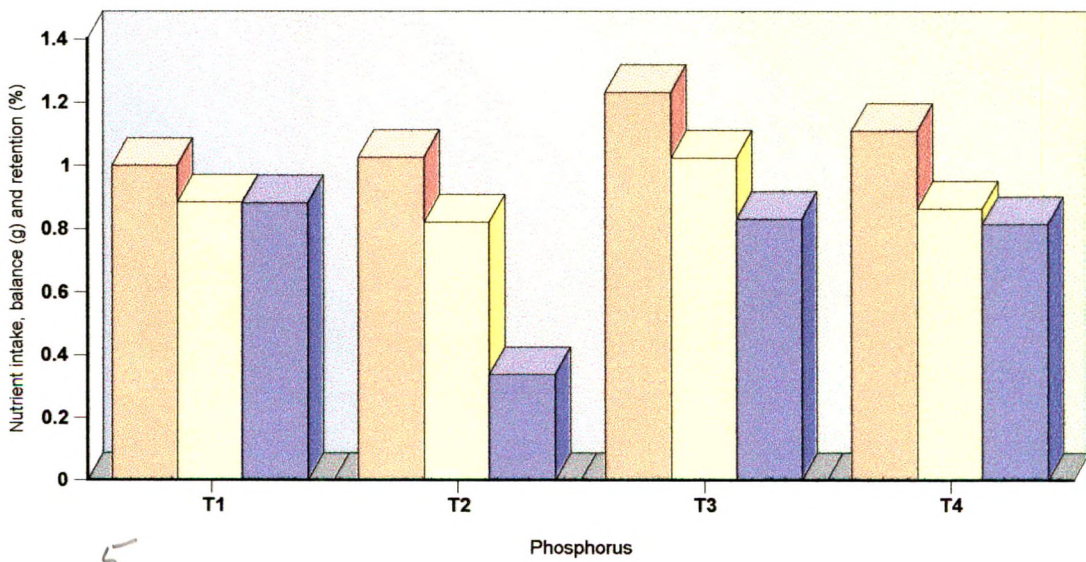
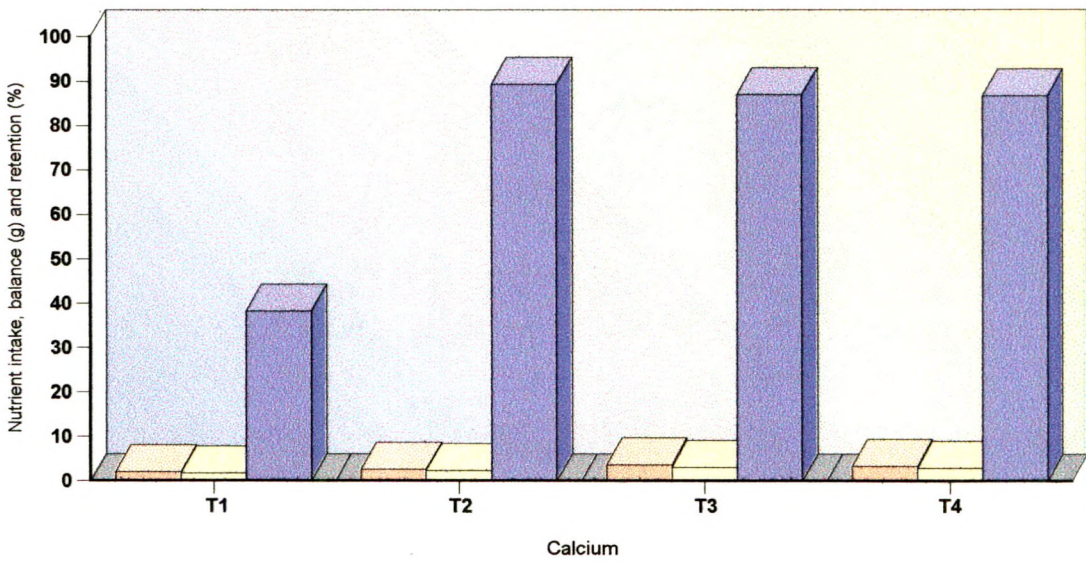
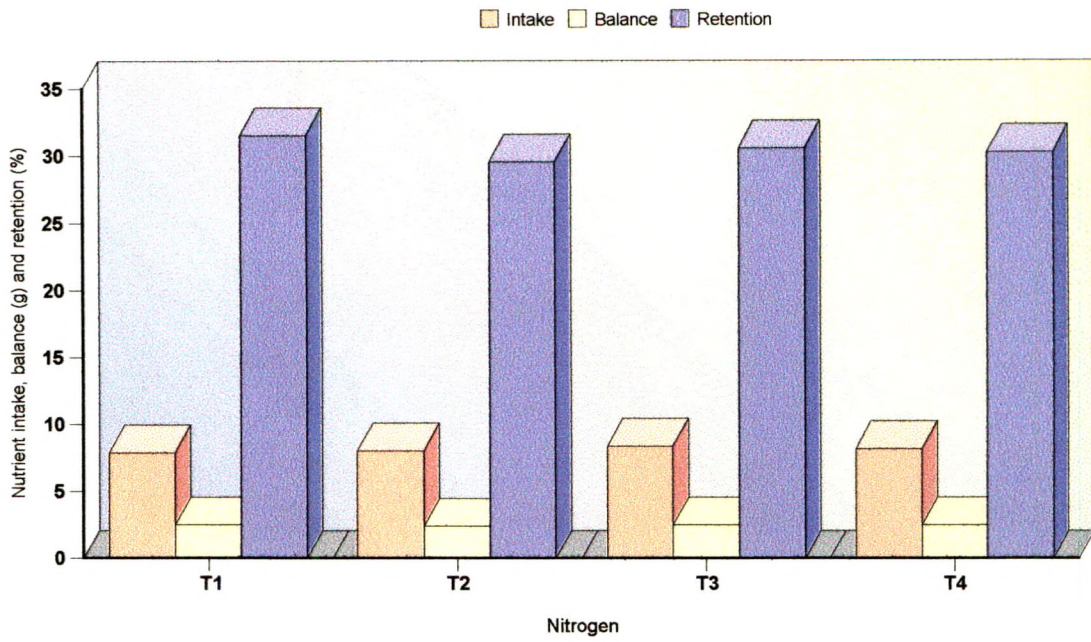
Similarly, periods did not influence significantly, daily intake of N, whereas kids during period P₄ consumed numerically more N.

Similarly, the interaction effects between periods and treatments on N intake was found non significant.

Table 5. Effect of treatment and period on daily nutrient intake balance (g) and per cent retention

	N			Ca			P		
	Intake	Balance	Retention (%)	Intake	Balance	Retention (%)	Intake	Balance	Retention (%)
Treatments									
T ₁	7.922	2.539	31.540	2.062 ^b	1.849 ^b	88.228 ^b	1.001 ^c	0.8853 ^b	88.217 ^a
T ₂	8.042	2.419	29.605	2.741 ^b	2.450 ^b	89.390 ^a	1.027 ^b	0.8216 ^c	98.869 ^b
T ₃	8.400	2.547	30.606	3.622 ^a	3.143 ^a	87.093 ^c	1.232 ^a	1.026 ^a	83.110 ^b
T ₄	8.208	2.532	30.327	3.401 ^a	2.994 ^a	86.796 ^c	1.110 ^b	0.8638 ^a	81.497 ^b
SE +	0.193	0.118	1.095	0.0963	0.092	0.406	0.037	0.0431	0.3647
CD at 5%	NS	NS	NS	0.266	0.256	1.124	0.103	0.1115	1.0095
Period									
P ₁	8.004	2.624 ^a	32.467 ^a	2.782 ^b	2.554 ^b	90.723 ^a	1.036 ^b	0.8978 ^a	86.662 ^a
P ₂	8.0525	2.762 ^a	34.118 ^a	2.905 ^b	2.582 ^a	88.738 ^a	1.151 ^b	0.9937 ^a	86.360 ^a
P ₃	8.0778	2.466 ^a	30.370 ^b	3.219 ^a	2.835 ^a	87.960 ^b	1.159 ^a	0.9011 ^a	84.851 ^b
P ₄	8.442	2.186 ^b	25.124 ^b	2.920 ^b	2.465 ^b	88.080 ^c	1.023 ^b	0.8029 ^a	78.820 ^c
SE	0.1939	0.118	1.095	0.0963	0.092	0.406	0.037	0.0431	0.3647
CD at 5%	NS	0.327	3.0326	0.266	0.256	1.124	0.103	0.1115	1.0095
Period x treatment									
P ₁ T ₁	7.931	3.063	38.350	1.916	1.860	90.530	0.968	0.883	91.240
P ₁ T ₂	7.831	2.741	32.778	2.360	2.171	91.953	0.967	0.844	87.195
P ₁ T ₃	8.136	2.383	30.381	3.316	3.058	92.005	1.112	0.945	84.543
P ₁ T ₄	8.105	2.310	28.358	3.536	3.131	88.405	1.099	0.920	83.672
P ₂ T ₁	8.277	3.572	43.337	1.998	1.837	91.923	1.050	0.970	92.410
P ₂ T ₂	7.497	2.359	31.170	2.672	2.403	89.823	1.068	0.920	85.955
P ₂ T ₃	8.171	2.398	28.965	3.605	3.080	86.148	1.309	1.111	84.395
P ₂ T ₄	8.265	2.722	32.998	3.347	3.008	87.057	1.178	0.974	82.682
P ₃ T ₁	8.089	2.505	30.720	2.285	1.993	87.227	1.102	0.968	87.867
P ₃ T ₂	8.300	2.733	32.822	3.077	2.765	89.620	1.113	0.771	84.017
P ₃ T ₃	8.178	2.474	30.127	3.507	2.998	85.552	1.165	0.962	82.617
P ₃ T ₄	7.745	2.154	27.812	4.008	3.585	89.458	1.257	0.903	84.903
P ₄ T ₁	7.393	1.019	13.755	2.048	1.707	83.232	0.885	0.720	81.350
P ₄ T ₂	8.544	1.846	21.648	2.857	2.463	86.162	0.960	0.752	78.310
P ₄ T ₃	9.116	2.936	32.953	4.063	3.438	84.667	1.343	1.088	80.887
P ₄ T ₄	8.718	2.945	32.140	2.715	2.253	82.263	0.907	0.677	74.732
SE ±	0.387	0.236	2.191	0.196	0.185	0.812	0.074	0.0806	0.729
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS

Note : Treatment / period / P x T effects carrying similar letters are at par and those carrying different letters are significantly differed from each other at 5% level.



5

Fig. 4. Effect of treatment on daily nutrient intake balance (g) and per cent retention

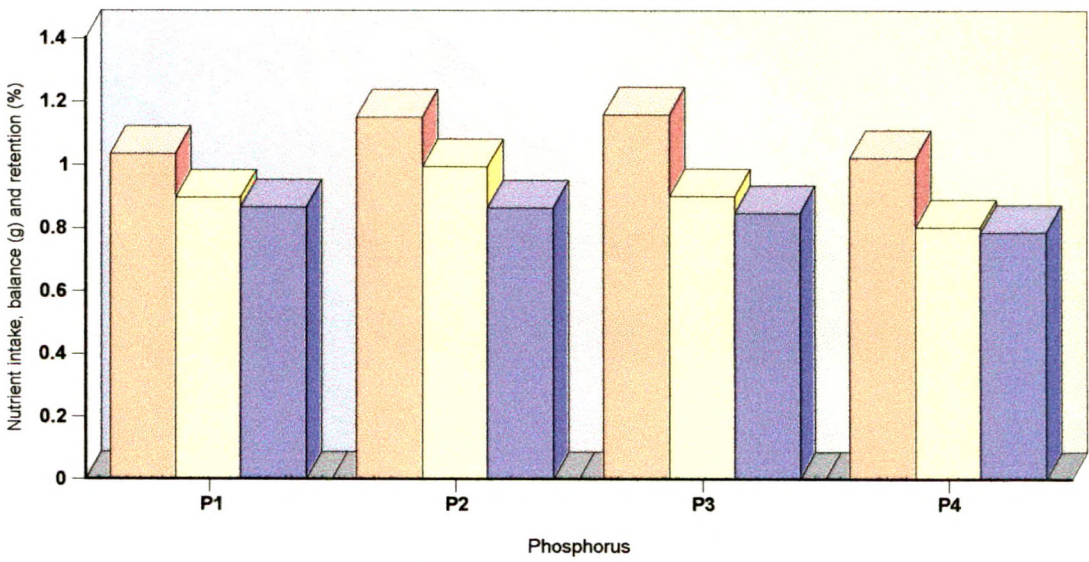
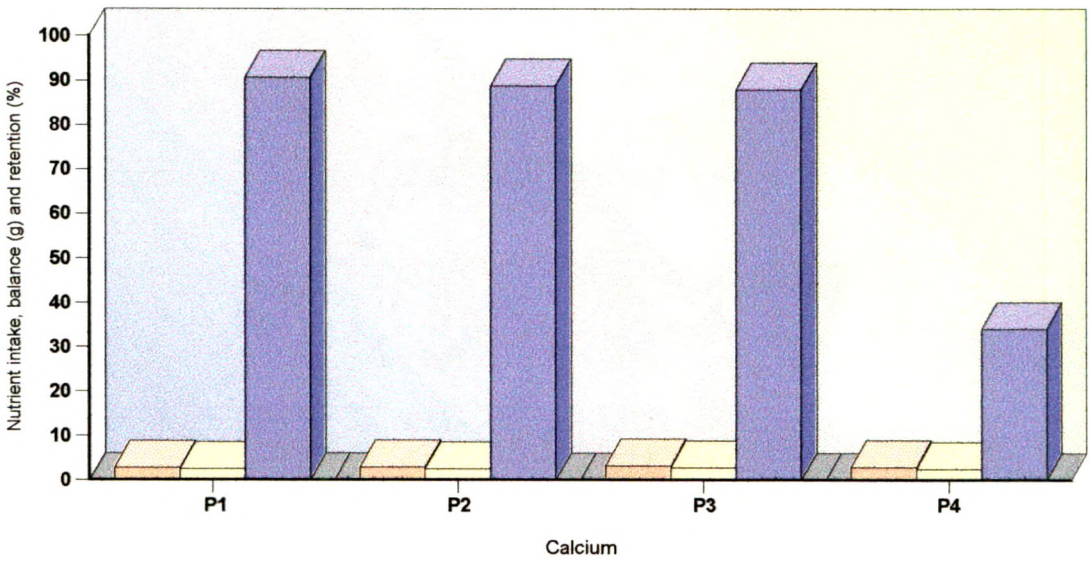
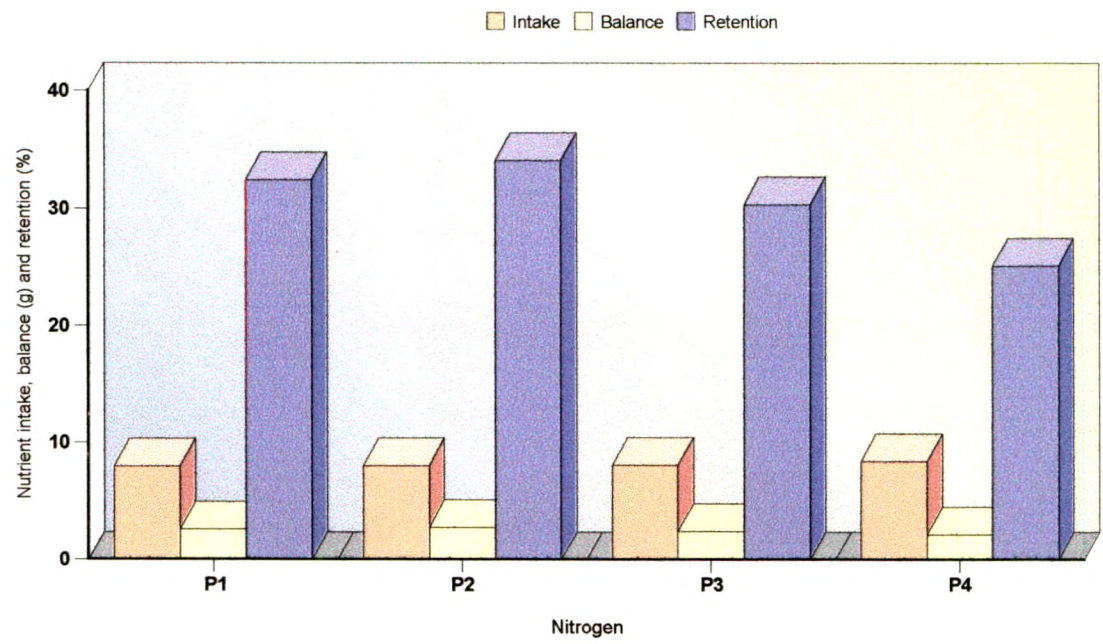


Fig. 5. Effect of period on daily nutrient intake balance (g) and per cent retention

4.5.2 Nitrogen balance

Treatment	T ₃	T ₁	T ₄	T ₂
N balance (g/day/kid)	<u>2.547</u>	<u>2.539</u>	<u>2.532</u>	<u>2.413</u>

The observed data indicates that N balance were positive in all the treatments. Daily N balance were non significant among treatments.

Highest and lowest values were noted in T₃ and T₂, respectively. However, the numerically higher value was observed in T₃, all the treatments were at par.

Periods	P ₂	P ₁	P ₃	P ₄
N balance (g/day/kid)	<u>2.762</u>	<u>2.624</u>	<u>2.466</u>	2.186

There were significant ($P < 0.05$) differences amongst periods for the daily N balance in kids.

The N balance g/day/kid was significantly more during P₂ than P₄. However, N balance in P₂, P₁ and P₃ were at par. The effect of interaction was non significant for daily N balance in kids for different periods and treatments.

The observed values for N balance are in agreement with those reported by Chanda and Bhaid (1987) for phephar tree leaves in goats, Gupta and Balaraman (1989) for Nevaro leaves in goats.

However, values were higher as compared to those reported by Thakur *et al.* (1982) for jack tree leaves in male kids, Verma *et al.* (1995) for casuarina leaves in goats, Bais *et al.* (2002) for Sares and Neem in goats.

The values were lower as compared to those reported by Panda *et al.* (1987) for *Calliandra calothyrsus* tree leaves in goats, Dehuri *et al.* (2000) for Tentulia in goats.

4.5.3 Per cent nitrogen retention

Treatment	T ₁	T ₃	T ₄	T ₂
N retention %	31.540	30.606	30.327	29.605

Per cent N retention was found to be non significant among different treatments.

Numerically highest N retention percentage was found in T₁ followed by T₃, T₄ and T₂.

Period	P ₂	P ₁	P ₃	P ₄
N retention %	<u>34.118</u>	<u>32.467</u>	<u>30.370</u>	<u>25.124</u>

Significant ($P < 0.05$) differences were observed in different periods for N retention percentage.

Kids during P₂ retained significantly ($P < 0.05$) higher percentage of over P₃ and P₄. However, N retention during periods P₂, P₁ and P₃, P₄ were at par. Lowest N retention percentage was observed in P₄.

The interaction effects between periods and treatments on N retention percentage were significant ($P < 0.05$). Maximum interaction effects were noted in P₄ T₁, P₄ T₂, P₃ T₄ and P₂ T₃, resulting into poor nitrogen retention.

N intake, balance and retention percentage can be affected by breed, species, age, growth rate, weight and rate of water intake, legume type and its stage and plane of nutrition.

In the present experiment, it seems that legume type might have affected the N retention.

4.5.4 Calcium

4.5.4.1 Calcium intake

Treatments	T ₃	T ₄	T ₂	T ₁
Ca intake (g/day/kid)	<u>3.622</u>	<u>3.401</u>	2.741	2.062

Daily calcium intake was highly influenced due to treatment.

Significantly ($P < 0.05$) highest values were recorded in T₃ and T₄ over T₂ and T₁. T₃ and T₄ were at par. It is obvious from the data that as the CP replacement rate increased through *Peltophorum pterocarpum* tree leaves in the diet of kids. Ca intake was found higher upto 30 per cent CP replacement level. It indicates that Ca from *Peltophorum pterocarpum* tree leaves is readily available and fulfils the requirement.

Period	P ₃	P ₄	P ₂	P ₁
Ca intake (g/day/kid)	3.219	<u>2.920</u>	<u>2.905</u>	<u>2.782</u>

Similarly, Ca intake in kids was affected significantly by period effect.

Ca intake was significantly ($P < 0.05$) higher in kids during period P₃ over rest of the periods. P₄, P₂ and P₁ were at par. The observed values are comparable with those reported by Thakur *et al.* (1982) for casuarina tree leaves in goats, Mondal *et al.* (1994) for Banyan tree leaves in goats. However, observed values were lower than those reported by Rajendiran *et al.* (2002) for casuarina leaves in goats. Gutpa *et al.* (1989) for Nevaro in Sikkim goats.

4.5.4.2 Calcium balance

Treatments	T ₃	T ₄	T ₂	T ₁
Ca balance (g/day/kid)	<u>3.143</u>	<u>2.994</u>	2.450	1.849

The daily calcium balance in kids were positive in all the treatments and highly influenced by treatment effect.

Significantly ($P < 0.05$) highest values were recorded in T₃ and T₄, respectively, T₃ and T₄ were at par. There was consistent

significant increase ($P < 0.05$) in the Ca balance with every increase in the CP replacement through *Peltophorum pterocarpum* tree leaves over its previous one.

Period	P ₃	P ₂	P ₁	P ₄
Ca balance (g/day/kid)	<u>2.835</u>	<u>2.582</u>	2.554	2.465

There were significant differences among periods for calcium balance.

The kids during (P₃) retained significantly more Ca than P₁ and P₂ periods. However, P₃ and P₂ were at par. The Ca retention percentage was not influenced by interaction between period and treatments.

The noted values are comparable with those reported by Mehta and Bhaid (1985) for Arjun tree leaves in goats. However, observed values are higher than those reported by Thakur *et al.* (1982) for jack tree leaves in male kids, Verma *et al.* (1995) for casuarina leaves in goats. However, observed values are lower than those reported by Gupta and Balaraman (1989) for Nevaro in Sikkim goats, Balaraman (1996) for Nevaro in goats.

4.5.4.3 Per cent Ca retention

Treatments	T ₂	T ₁	T ₃	T ₄
Ca retention	<u>89.390</u>	<u>88.228</u>	87.093	86.796

There were highly significant ($P < 0.01$) differences recorded among treatments.

Significantly ($P < 0.05$) highest values were recorded in T₂ and T₄ respectively. Ca was more efficiently retained in T₂ and T₁ over rest of the treatments. Treatments T₃ and T₄ were at par.

Period	P ₁	P ₂	P ₄	P ₃
Per cent Ca retention	<u>90.723</u>	<u>88.738</u>	<u>88.080</u>	<u>87.964</u>

Per cent Ca retention was affected significantly ($P < 0.05$) by periods during the trial.

Significantly highest per cent Ca retention values were noted in P₁ and P₂, respectively. P₁ and P₂ were at par. Lowest per cent Ca retention was found during P₃.

The interaction effect between treatments and periods was significant on per cent Ca retention, highest interaction was noted in P₃T₄.

It could be inferred from the presented data in respect of Ca intake, balance and per cent retention that, if the CP replacement rate increased in the diet the kids in the same proportion, daily intake and balance of Ca enhanced but per cent Ca retention was inversely proportionate to intake.

Little (1981) also reported that the amount of Ca absorbed was directly related to intake levels. Per cent Ca retention can be decreased with increased Ca intake. Ca absorption increased with low dietary P.

4.5.4.4 Phosphorus

4.5.4.4.1 Phosphorus intake

Treatment	T ₃	T ₄	T ₂	T ₁
P intake (g/day/kid)	<u>1.232</u>	<u>1.110</u>	<u>1.027</u>	1.001

Daily P intake was highly affected by treatments.

Highest and lowest values were noted in T₃ and T₁, respectively. Daily P intake was significantly ($P < 0.05$) higher in T₃, Whereas treatments T₄ and T₂ and T₂ and T₁ were at par.

Period	P ₃	P ₂	P ₁	P ₄
P intake (g/day/kids)	<u>1.159</u>	<u>1.151</u>	<u>1.036</u>	<u>1.023</u>

Similarly, P intake were highly influenced by period effect.

Significantly ($P < 0.05$) higher P intake was observed in P₃ and P₂, P₃ and P₂ were at par as well as P₁ and P₄ were also at par lowest P intake was observed during P₄.

Period and treatment interaction effects were found non significant for daily P intake.

4.5.4.4.2 Phosphorus balance

Treatment	T ₃	T ₁	T ₄	T ₂
P balance (g/day/kid)	<u>1.026</u>	<u>0.885</u>	<u>0.864</u>	<u>0.822</u>

The data in respect of P balance indicates that P balance were positive in all the treatments.

Highest and lowest values were observed in T₃ and T₂, respectively. P balance was significantly ($P < 0.05$) higher in T₃ over rest of the treatments. However, T₁, T₄ and T₂ were at par with each other.

Period	P ₂	P ₃	P ₁	P ₄
P balance (g/day/kid)	<u>0.993</u>	<u>0.901</u>	<u>0.897</u>	0.803

Data revealed that there were highly significant ($P < 0.01$) differences in P balance during the periods.

Highest and lowest values were recorded by P₂ and P₄, respectively. During P₂ significantly ($P < 0.05$) higher P balance over P₄

was recorded. However, P₂, P₃ and P₁ were at par as well as P₃, P₁ and P₄ were also at par with each other.

Further, data on interaction showed that daily P balances were not influenced by interaction effect.

The presented values are comparable with those reported by Panda *et al.* (1983) for pipal tree leaves in goats, Dehuri *et al.* (2000) for Tentulia in goats, Bais *et al.* (2002) for Sares and Neem in Marwari goats. However, the observed values were more than Thakur *et al.* (1982) for jack tree leaves in kids.

4.5.4.4.3 Per cent P retention

Treatments	T ₂	T ₁	T ₃	T ₄
Per cent P retention	<u>93.869</u>	<u>88.217</u>	<u>83.110</u>	<u>81.497</u>

Data in respect of per cent P retention indicates that there were highly significant ($P < 0.01$) differences among treatments.

Highest and lowest values were recorded by T₂ and T₄ respectively. Kids in T₂ retained more P of intake over T₁, T₃, T₄. As percentage of *Peltophorum pterocarpum* tree leaves increased in the diet, P retention percentage decreased proportionately. However, T₁, T₃ and T₄ were at par.

Period	P ₁	P ₂	P ₃	P ₄
P retention %	<u>86.662</u>	<u>86.360</u>	<u>84.851</u>	78.820

Per cent P retention was significantly ($P < 0.05$) affected by period during trial.

Kids retained significantly ($P < 0.05$) higher P during the first period over other periods. Lowest P retention percentage was observed during (P₄).

Per cent P retention data pertaining to interaction between period and treatment was found non significant. The observed values are comparable with.

4.6 Growth rate

Data on daily body weight gain and monthly gain in height, length and chest girth as affected by treatment, period and its interaction are presented in Table 6 and depicted in Fig. 6.

4.6.1 Body weight

Treatments	T2	T3	T4	T1
Weight gain (g/day/kid)	30.666	29.755	28.595	28.464

It is obvious from the data that daily body weight gain was not affected significantly ($P < 0.05$) by treatments.

Numerically higher body weight gain was observed in T2 and lowest body weight gain was recorded in T1. The daily weight gain obtained in the present study for T2, T3, T4 and T1 confirmed the results of Singh *et al.* (1986) in Black Bengal kids, Sarode (1988) in Osmanabadi x Beetal kids.

Period	P ₄	P ₂	P ₃	P ₁
Weight gain (g/day/kid)	<u>33.803</u>	<u>30.630</u>	27.833	23.214

There were highly significant differences amongst periods for daily body weight gain in kids.

Significantly ($P < 0.05$) higher values for body weight gain were recorded in P₄ over P₂, P₃ and P₁. However, P₄ and P₂ were at par. There were non significant differences found among period x treatment interaction on daily body weight gain in kids.

Table 6. Effect of treatment and period on daily body weight gain (g) and monthly linear body measurements (cm) of experimental kids.

	Body wt.	Height	Length	Chest girth
Treatments				
T ₁	28.464	1.3359	1.3625	1.1865
T ₂	30.666	1.3032	1.4202	1.2575
T ₃	29.755	1.3567	1.4041	1.2696
T ₄	28.595	1.1781	1.3799	1.2883
SE +	1.1959	0.0687	0.0437	0.0369
CD at 5%	NS	NS	NS	NS
Period				
P ₁	23.214 ^c	1.39925	1.5216	1.3313
P ₂	33.803 ^a	1.2822	1.4520	1.2741
P ₃	27.833 ^d	1.3031	1.3371	1.2111
P ₄	30.630 ^a	1.1961	1.2561	1.1854
SE	1.1959	0.0687	0.0437	0.0369
CD at 5%	3.3096	0.1902	0.1209	0.1022
Period x treatment				
P ₁ T ₁	22.3805	1.2855	1.4302	1.1907
P ₁ T ₂	26.1902	1.4282	1.5247	1.3103
P ₁ T ₃	26.1900	1.4282	1.5837	1.3943
P ₁ T ₄	18.0947	1.4282	1.5478	1.4300
P ₂ T ₁	29.9997	1.3447	1.4783	1.2620
P ₂ T ₂	34.9997	1.2853	1.4337	1.2620
P ₂ T ₃	34.4997	1.3568	1.4783	1.2620
P ₂ T ₄	35.7140	1.1422	1.4175	1.3103
P ₃ T ₁	27.3335	1.4280	1.2977	1.1423
P ₃ T ₂	30.9997	1.2853	1.4300	1.2137
P ₃ T ₃	27.9992	1.2138	1.3103	1.2263
P ₃ T ₄	24.9995	1.2852	1.3103	1.2620
P ₄ T ₁	26.0948	1.2853	1.2440	1.1510
P ₄ T ₂	29.9995	1.2138	1.2923	1.2440
P ₄ T ₃	30.0472	1.4282	1.2440	1.1957
P ₄ T ₄	36.9995	0.8570	1.2440	1.1510
SE ±	2.3917	0.1374	0.0874	0.0738
CD at 5%	6.6192	0.3805	0.2419	0.2044

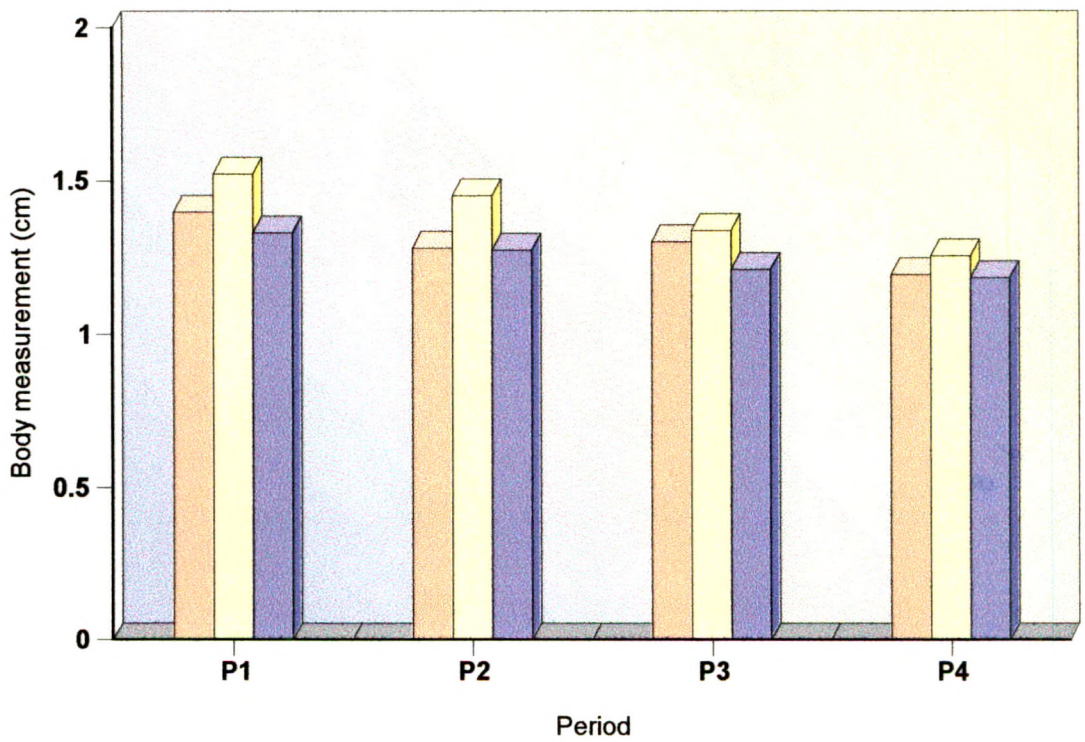
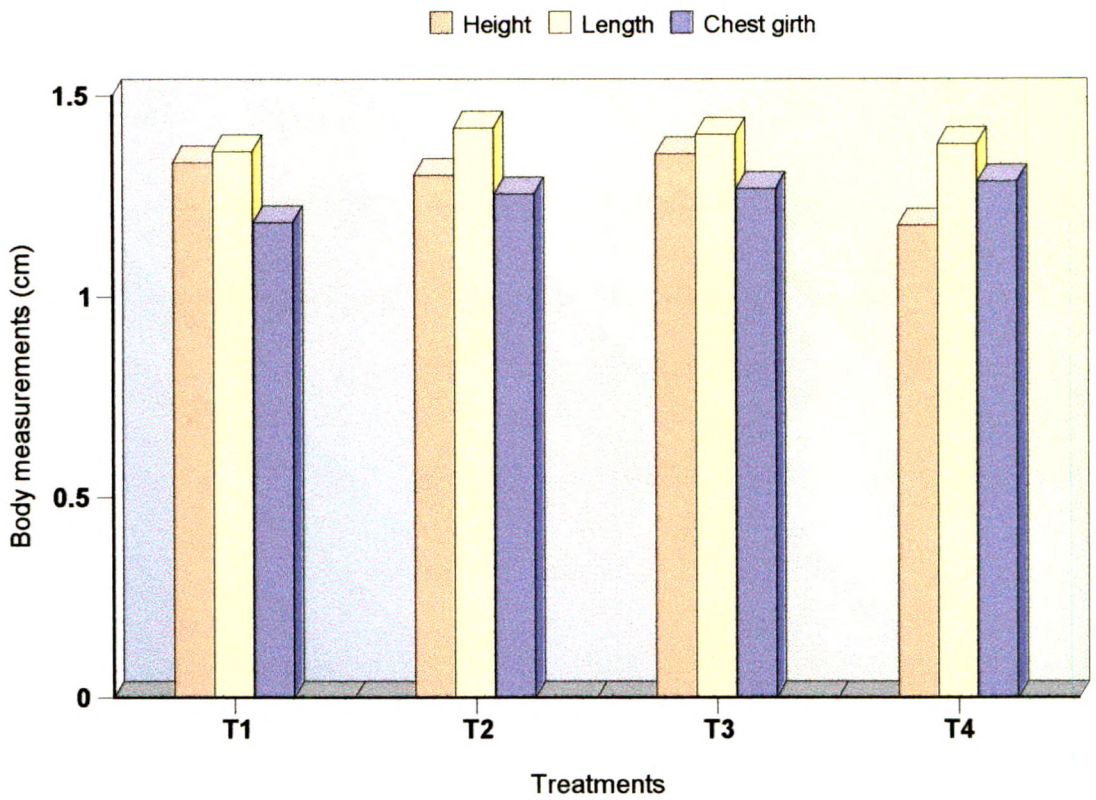


Fig. 6. Effect of treatment and period on monthly linear body measurements (cm) of experimental kids.

The observed values are comparable with those reported by different research workers, in different legumes; Varma *et al.* (1995) observed similar growth rate when casuarina leaves were fed ad-lib during the feeding trial of 30 days. Saikia *et al.* (2002) for Malawar goats fed Thalapadma tree leaves.

The observed values are lower than those reported by Sharma and Ogra (1990) for Barbari kids fed Khajri leaves with different levels of concentrates, Tomar *et al.* (2001) for Sirohi goats fed different levels of concentrates, Sen *et al.* (2002) for goats fed on Khejri leaves, Nageshwara Rao *et al.* (2002) for Marwari goats fed dry leaucanea leaves and barley straw.

Whereas presented values are higher than those reported by Mandal (1994) in Black Bangal goats fed fresh Banyan tree leaves, Anandan and Dey (2000) in bucks fed soely on fresh oak tree leaves lost body weight.

Therefore, it can be concluded that CP replacement through *Peltophorum pterocarpum* tree leaves upto 45 per cent in feeding of growing kids can be done successfully.

4.6.2 Height

Treatment	T3	T1	T2	T4
Height gain (cm/month/kid)	1.356	1.335	1.3032	.1.178

It is obvious from the observed data that monthly gain in height was not affected significantly by treatment.

Numerically T3 recorded highest gain in height / month / kid over other treatments. In the same direction, there were non significant differences among periods and their interaction with treatments.

Present values are similar to those reported by Newale (1979) in Osmanabadi kids (60-180) days age fed on 100, 120 and 80 per cent DCP of NRC. Mairal (1980) in Osmanabadi goats (12-13 months age) fed on 100, 120 and 80 per cent DCP of NRC. Sarode (1984) in Osmanabadi kids (3 to 15 months age) fed on different plane of nutrition and Adhao (1986) in Osmanabadi x Beetal kids (3-4 months age) fed on 50 per cent CP from calf ration.

Peltophorum pterocarpum tree leaves may be fed upto 45 per cent DCP level of required DCP in the diet of kids for satisfactory height gain.

4.6.3 Length

Treatment	T2	T3	T4	T1
Length gain (cm/month/kid)	<u>1.420</u>	<u>1.404</u>	1.379	1.362

Monthly gain in length was not affected significantly by treatment effect.

Highest and lowest values were recorded by T2 and T1, respectively. T2 and T3 were at par.

Period	P ₁	P ₂	P ₃	P ₄
Length gain (cm/month/kid)	<u>1.521</u>	<u>1.452</u>	<u>1.337</u>	<u>1.256</u>

Gain in length was affected significantly ($P < 0.05$) by period.

Period P₁ recorded significantly ($P < 0.05$) higher gain in body length over P₂, P₃ and P₄. Gain in length was not affected by period x treatment interaction. *Peltophorum pterocarpum* tree leaves may be fed upto 45 per cent CP replacement in the diet of kids for satisfactory gain in length.

4.6.4 Chest girth

Treatment	T4	T3	T2	T1
Chest girth (cm/month/kid)	1.288	1.269	1.257	1.186

The observed data regarding monthly gain in chest girth indicated that there were non significant differences among treatments due to treatment effects

Highest and lowest values were observed in T4 and T1, respectively all the treatments were found at par. Similarly, period and their interaction with treatments were found non significant.

All the observed values in respect of monthly gain in length and chest girth are comparable with those reported by Newale (1979) in Osmanabadi kids fed on 100, 120 and 80 per cent DCP of NRC. Sarode (1984) in Osmanabadi kids fed on different plane of nutrition and Adhao (1986) in Osmanabadi x Beetal kids fed on 50 per cent lucerne + 50 per cent calf ration, Mairal (1980) in Osmanabadi goats (12 to 13) months age fed on 10, 120 and 80 per cent DCP of NRC and Kaldate (1982) in Beetal x Osmanabadi kids for Dashrath browsing.

All linear body measurements in experimental kids were not affected significantly among treatments. Gain in body weight, height, length and chest girth were higher in T2 and T4, that indicates *Peltophorum pterocarpum* tree leaves may be fed successfully in the diet of Osmanabadi kids upto 45 per cent DCP replacement level.

4.7 Feed efficiency

Data pertaining to DM, DCP and TDN consumed for one kg body weight gain as affected by treatment, period and its interaction are presented in Table 7 and depicted in Fig. 7.

Table 7. Effect of treatments and period on DM, DCP and TDN requirement (kg) for one kg body weight gain in kids

	DM	DCP	TDN
Treatments			
T ₁	15.390 ^b	1.964	13.467
T ₂	12.559 ^a	1.590	11.457
T ₃	13.839 ^b	1.718	12.534
T ₄	12.533 ^a	1.678	11.869
SE +	0.888	0.122	0.775
CD at 5%	2.458	NS	NS
Period			
P ₁	16.113 ^a	2.251 ^a	14.584 ^a
P ₂	11.278 ^b	1.481 ^b	10.603 ^b
P ₃	14.272 ^a	1.773 ^b	12.942 ^a
P ₄	12.657 ^b	1.445 ^b	11.198 ^b
SE	0.888	0.122	0.775
CD at 5%	2.458	0.338	2.147
Period x treatment			
P ₁ T ₁	18.451	2.634	16.551
P ₁ T ₂	14.505	2.064	13.133
P ₁ T ₃	16.196	2.230	14.553
P ₁ T ₄	15.300	2.077	14.101
P ₂ T ₁	12.447	1.694	11.214
P ₂ T ₂	10.865	1.321	10.038
P ₂ T ₃	11.251	1.436	11.132
P ₂ T ₄	10.547	1.475	10.027
P ₃ T ₁	15.445	1.914	13.289
P ₃ T ₂	11.900	1.565	10.996
P ₃ T ₃	15.363	1.688	13.234
P ₃ T ₄	14.382	1.929	14.250
P ₄ T ₁	15.217	1.616	12.816
P ₄ T ₂	12.965	1.414	11.660
P ₄ T ₃	12.545	1.521	11.216
P ₄ T ₄	9.904	1.233	9.099
SE ±	1.776	0.244	1.551
CD at 5%	NS	NS	NS

Note : Treatment / period / P x T effects carrying similar letters are at par and those carrying different letters are significantly differed from each other at 5% level.

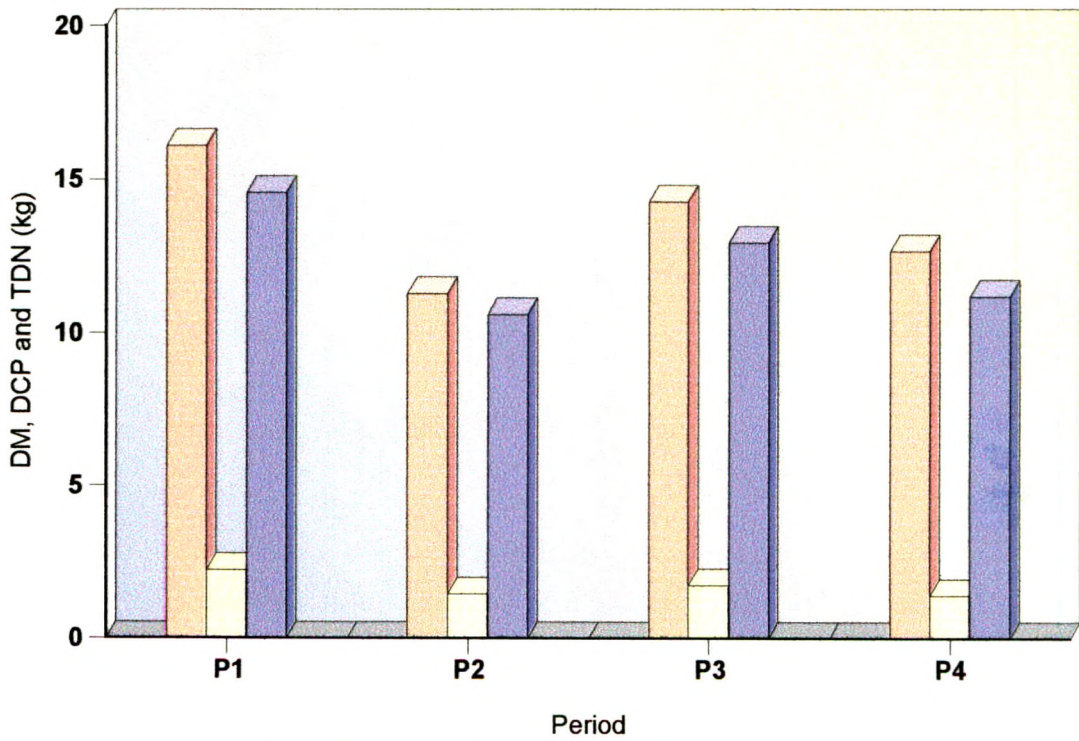
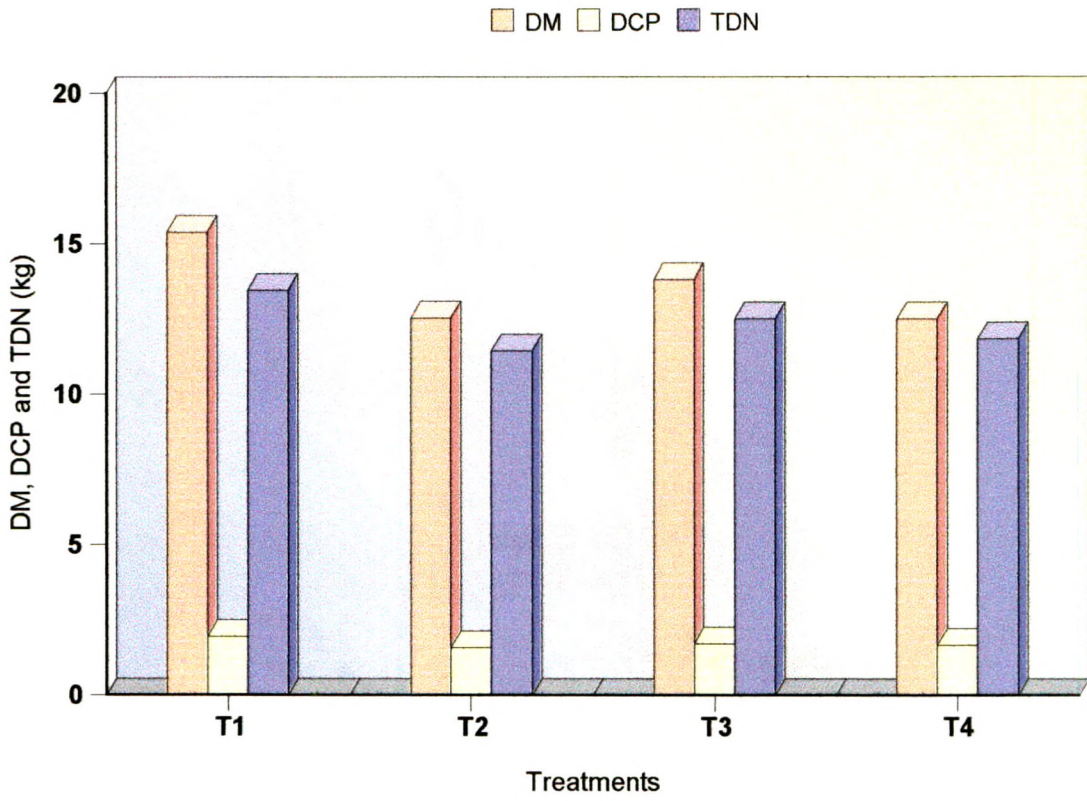


Fig. 7. Effect of treatments and period on DM, DCP and TDN requirement (kg) for one kg body weight gain in kids

4.7.1 Dry matter

Treatment	T4	T2	T3	T1
DM required (kg/kg gain)	<u>12.533</u>	<u>12.559</u>	<u>13.839</u>	<u>15.390</u>

It is evident from the data that DM consumed for 1 kg body weight gain was affected significantly ($P < 0.05$) by treatment effect.

Highest and lowest values were recorded for T1 and T4 treatments, respectively. T1, T3 and T2, T4 were at par. There was consistent decrease in the DM consumption with increase in the CP replacement through *Peltophorum pterocarpum*.

Feed efficiency was significantly ($P < 0.05$) higher in T4 than rest of the treatments. There was consistent reverse decrease in feed efficiency with peltophorum level, it was found lowest in T1 (control).

The data indicated that feed efficiency increases with an increased CP replacement level of *Peltophorum pterocarpum* to certain extent.

Periods	P ₂	P ₄	P ₃	P ₁
DM consumption (kg/kg gain)	<u>11.278</u>	<u>12.657</u>	<u>14.272</u>	<u>16.113</u>

Period effect resulted in highly significant ($P < 0.01$) increase in DM requirement.

Highest and lowest values were recorded for P₁ and P₂, respectively. During P₁ kids showed significantly ($P < 0.05$) higher consumption of DM over P₂, P₃ and P₄. The presented data shows that there were non significant differences amongst interaction between period and treatments.

The observed values are comparable with those reported by Sarode (1984) in Osmanabadi kids fed on different plane of nutrition, Sarode (1988) in osmanabadi x Beetal kids fed on *Stylozanthus hamata*. The values were lower than those of Mairal (1980) in Osmanabadi kids fed on 100, 120 and 80 per cent DCP of NRC.

Feeding of *Peltophorum pterocarpum* tree leaves in the diet of kids improved feed efficiency in respect of DM consumption for 1 kg body weight gain.

4.7.2 Digestible crude protein

Treatments	T2	T4	T3	T1
DCP requirement (kg/kg gain)	1.590	1.678	1.718	1.964

It is obvious from the presented data that there were no significant differences among treatments in respect of DCP consumption for 1 kg body weight gain in kids due to treatment effects.

Highest and lowest values were observed in T1 and T2, respectively. Data indicated that there were non significant differences among treatments. Highest and lowest feed efficiency was recorded in T1 and T2, respectively.

Period	P ₄	P ₂	P ₃	P ₁
DCP requirement (kg/kg gain)	<u>1.445</u>	<u>1.481</u>	<u>1.773</u>	<u>2.251</u>

Further examination of data indicated that DCP consumption for 1 kg body weight gain was influenced by period.

Data revealed that there were significant ($P < 0.05$) differences in the values of DCP requirement for 1 kg body weight gain.

During period P₄ feed efficiency was higher than other periods. Feed efficiency was lowest during P₁. DCP values for period P₄, P₂ and P₃ were at par.

It may be inferred that the experimental kids might be well adopted to *Peltophorum pterocarpum* tree leaves with progress in period and utilized it efficiently. However, DCP requirement was highly affected by interaction effect. Highest and lowest efficiency was recorded in P₁T₂, P₂T₂, P₃T₂ and P₄T₄, respectively.

The observed values are comparable with the values of Mairal (1980) in Osmanabadi goats fed with 100, 120 and 80 per cent DCP of NRC, respectively, Sarode (1988) in Osmanabadi kids fed with *Stylosanthus hamata*. However, the observed values were higher than Newale (1979) in Osmanabadi kids fed on 100, 120 and 80 per cent DCP of NRC, whereas the observed values were lower than Sarode (1984) in Osmanabadi kids fed on different plane of nutrition, Deshmukh (1988) in Osmanabadi goats fed on *Stylozanthus hemata* hay and green with dry jowar kadbi, Kedar (1990) in Osmanabadi goats fed with rain tree leaves, Sahu *et al.* (1993) in Black Bengal goats fed with concentrates and paragrass, Hembade (1994) in Osmanabadi kids fed banana leaves.

4.7.3 Total digestible nutrients

Treatments	T2	T4	T3	T1
TDN requirement (kg/kg gain)	<u>11.457</u>	<u>11.869</u>	<u>12.534</u>	<u>13.467</u>

Perusal of data related to TDN requirement for 1 kg body weight gain in kids (Table 7) indicated that there were non significant effect of treatment.

Highest and lowest values were noted in T1 and T2, respectively. T1 recorded highest value over others. T1T3 and T2T4 were at par. Highest and lowest feed efficiency was recorded in T2 and T1, respectively. Replacement of CP by *Peltophorum pterocarpum* improved the feed efficiency of kids in terms of TDN.

Data pertaining to period effect shows that there were significant differences among periods for TDN consumption. Maximum value recorded in P₁ which was significantly ($P < 0.05$) higher over rest of the periods. Higher feed efficiency was noted in P₂ than P₄ and P₃. Whereas TDN consumption was highly enhanced by interaction effect. Maximum efficiency was recorded in P₂T2, P₂T4, P₃T2 and minimum in P₁T₁, P₃T₄.

The presented values are comparable with the values reported by Sarode (1984) in Osmanabadi kids fed on different plane of nutrition. However, reported values were lower than Mairal (1980) in Osmanabadi goats fed on 100, 120 and 80 per cent DCP of NRC.

Peltophorum pterocarpum tree green leaves for CP replacement in the diet of kids improved the feed efficiency in respect of DM, DCP and TDN consumption per kg gain in body weight.

4.8 Sole feeding trial

The sole feeding trial of *Peltophorum pterocarpum* tree leaves was conducted for following objectives.

1. To study the acceptability of *Peltophorum pterocarpum* tree leaves for ascertaining the quantity of feed in fulfilling the requirement for avoiding wastage of fodder.

Table 8. Mean value of various parameters for sole feeding trial.

Acceptability (per cent)	Intake per cent body weight basis			Intake g/day/kid		
	DM	DCP	TDN	N	Ca	P
66.84	2.555	0.190	1.180	6.97	4.638	1.58
Nutrient digestibility coefficients						
DM	OM	CP	EE	CF	NFE	TCHO
39.76	46.04	46.25	44.10	26.10	50.14	46.43
Nutrient balances (g/day/kid)						
N	Ca	P	N	Ca	P	
+0.083	2.489	0.602	1.190	53.66	38.10	
Nutritive value (per cent)						
	DCP	TDN	DCP	Dig. CHO		
	7.63	46.83	1	5.12		

Table 9. Comparison between sole feeding (T₅) and all other treatments for various parameters

Treatments	Per cent live weight basis (g/day/kgid)													
	DM		DCP		TDN		N		Ca		P			
	Mean	't' value	Mean	't' value	Mean	't' value	Mean	't' value	Mean	't' value	Mean	't' value		
T1	3.634	3.36*	0.468	2.56*	3.222	9.47**	7.992	2.578*	2.062	14.6**	1.001	12.02**		
T2	3.718	4.99**	0.467	3.2*	3.400	10.08**	3.042	3.278**	2.741	14.3**	1.027	12.00**		
T3	3.794	4.82**	0.477	3.45*	3.478	8.43**	8.400	3.70**	3.622	4.996**	1.232	8.4**		
T4	3.717	6.06**	0.492	5.05**	3.505	8.46**	8.2080	4.440**	3.401	6.07**	1.110	6.5**		
T5	2.555		0.190		1.180		6.97		4.638		1.58			
Nutrient intake														
Nutrient digestibility coefficient														
Treatments	DM		OM		CP		EE		CF		NFE		TCHO	
	Mean	't' value	Mean	't' value	Mean	't' value	Mean	't' value	Mean	't' value	Mean	't' value	Mean	't' value
T1	56.62	23.76**	56.49	29.20**	70.51	46.55**	51.51	13.79**	54.01	23.56**	56.20	5.44**	56.65	20.77**
T2	55.32	30.01**	56.23	19.84**	66.70	40.77**	55.34	17.73**	51.92	35.92**	54.83	5.12**	57.11	14.04**
T3	56.12	26.78**	57.66	43.00**	66.69	27.05**	63.71	16.44**	50.29	8.70**	56.13	3.63*	57.99	11.52**
T4	56.40	25.25**	57.67	26.14**	67.82	22.85**	64.78	13.68**	41.56	9.92**	66.63	11.15**	59.98	11.49**
T5	39.76		46.04		46.25		44.10		26.10		50.14		46.43	
Nutrient retention (% of intake)														
Treatments	DM		DCP		TDN		N		Ca		P			
	Mean	't' value	Mean	't' value	Mean	't' value	Mean	't' value	Mean	't' value	Mean	't' value		
T1	2.539	63.35**	1.849	1.748	0.885	0.178	31.54	10.54**	88.28	3.135*	88.21	9.37**		
T2	2.419	16.29**	2.450	1.000	0.821	3.237*	29.60	21.32**	89.39	9.072**	83.86	8.83**		
T3	2.547	16.86**	3.143	2.415	1.026	4.61**	30.60	22.21**	87.09	6.38**	83.11	8.84**		
T4	2.532	20.37**	2.994	2.359	0.868	6.497**	30.32	8.21**	86.79	5.90**	81.49	9.27**		
T5	0.083		2.489		0.602		1.38		53.66		38.10			

**'t' value at 5% = 2.447

***'t' value at 1% = 3.707

2. To study the palatability and DM intake on body weight basis.
3. To study the digestibility of proximate principles and balances of N, Ca, P.
4. To evaluate the nutritive value and nutritive ratio in *Peltophorum pterocarpum* tree leaves.

Average values obtained for various components during sole feeding trial (T5) are presented in Table 8. The mean value for acceptability of feed was 66.84 per cent and for nutrients intake as DM 2.555, DCP 0.190 and TDN 1.180 per cent on body weight basis and intake of N 6.97, Ca 4.638 and P 1.58 g/day/kid were observed. The mean digestibility coefficients of proximate nutrients were as DM 39.76, OM 46.04, CP 46.25, EE 44.10, CF 26.10, NFE 50.14 and TCHO 46.43. The average balances were N 0.083, Ca 2.489 and P 0.602 g/day/kid and per cent retention was as N 1.190, Ca 53.66 and P 38.10.

The nutritive values found in sole feeding of *Peltophorum pterocarpum* tree green leaves were DCP 7.63 and TDN 46.83 per cent. The nutritive ratio was 1:5.12.

The observed values for various parameters are comparable with Thakur *et al.* (1982) for jack tree leaves, Singh and Gupta (1983) for dry Jhanji, Mehta and Bhaid (1985) for Arjun tree leaves, Tiwari *et al.* (1998) for Reha leaves, Saikia (2002) for Thalapadma tree leaves, Nageshwara Rao *et al.* (2002) for Leucaena leaves and barley straw mixture, Murugan and Katheperumal (1987) for *Ficus religiosa* and *Azadirachta indica* tree leaves.

Similarly digestibility coefficient of different nutrients are comparable with Thakur *et al.* (1982) for jack tree leaves, Singh and Gupta (1983) for Jhanji leaves, Panda *et al.* (1983) for pipal and jamun leaves. Kundu *et al.* (1985) for mango leaves. Mehta and Bhaid (1986) for phephor leaves.

The observed nutritive value is comparable with Majgaonkar *et al.* (1987) for Gumhar in cross bred calves, Panda *et al.* (1987) for *Calliandra calothyrsus* leaves in Black Bengal goats.

4.8.1 Comparison of sole feeding trial (T₅) with all other treatments

Mean values of various parameters obtained in sole feeding trial (T₅) which was statistically compared with rest of the treatments (T₁ to T₄) by students 't' test are presented in Table 9.

4.8.1.1 Nutrient intake

The absolute 't' value indicates that DM intake was significantly ($P < 0.05$) lower in T₅ as compared to other treatments (T₁ to T₄). DCP intake in T₅ was lower than rest of the treatments. TDN intake in T₅ was also significantly ($P < 0.05$) lower than rest of the treatments.

Nitrogen intake during sole feeding trial was significantly ($P < 0.05$) less than rest of the treatments. However, Ca intake was significantly higher over rest of the treatments. In case of daily P intake T₅ was significantly ($P < 0.05$) higher compared to other treatments.

4.8.1.2 Nutrient digestibility

Calculated 't' values for various nutrient digestibilities show that the digestibility of DM, OM, CP, EE, NFE and TCHO was significantly ($P < 0.05$) lower in T₅ compared to rest of the treatments.

4.8.1.3 Nutrient balance and per cent retention

Data in Table 9 revealed that N balance (g/day/kid) was significantly ($P < 0.05$) lower in sole feeding than T_1 , T_2 , T_3 and T_4 . Ca balance in T_5 was significantly ($P < 0.05$) higher than T_1 and T_2 whereas T_3 and T_4 Ca balance remain lower. P balance was significantly lower in T_1 over T_5 whereas T_2 , T_3 and T_4 remained significantly ($P < 0.05$) higher. P retention was found significantly ($P < 0.05$) higher in treatment T_1 , T_2 , T_3 and T_4 over T_5 .

Nitrogen per cent retention, Ca per cent retention and P per cent retention was significantly ($P < 0.05$) lower in T_5 than rest of the treatments.

Therefore, it may be inferred that sole feeding of *Peltophorum pterocarpum* green leaves not acquire equivalent status to that of partial replacement in respect of kid performance. There was no further advantage of CP replacement above 45 per cent through *Peltophorum pterocarpum* tree leaves for intake digestibility and retention of nutrients in kids.

It may be concluded that *Peltophorum pterocarpum* tree green leaves was not accepted fully (66.84 per cent). And also not palatable feed for sole feeding (2.55 per cent/ body weight basis). The *Peltophorum pterocarpum* tree leaves though having satisfactory nutritive value as DCP 7.63 and TDN 46.83 per cent. The DM intake was lower and could not meet the dry matter requirement as per nutrients requirement. Therefore may not meet the DCP and TDN requirement in

sole feeding. The dry matter intake was less due to higher tannin contained percentage.

The digestibility coefficient of various proximate principals was also lowered due to higher tannin, contains in the *Peltophorum pterocarpum* tree leaves.

4.9 Correlation and regression studies

The data regarding the correlation on coefficient between growth attributes in and DM, DCP, TDN intake, digestibility coefficient of variance or organic nutrients and balances of N, Ca and P is presented Table 9. It is observed from the data that intake of N, Ca and P, digestibility of EE, CF and NFE have recorded significant positive correlation with body weight gain, while intake of DM, DCP, TDN and digestibility of DM, CP have noted negative correlation with body weight gain.

Coefficient of multiple regression (R^2) was positively significant for nitrogen, calcium and phosphorus intake. The digestibility of EE, CF and NFE also related positively. Nitrogen balance was also found positively related with growth attributes, whereas DM and DCP intake was negatively related. Digestibility of DM and CP was also found negatively related. Balance of calcium and phosphorus also negatively relationship with body weight.

The results are in agreement with Mandava *et al.* (1988) while feeding raintree leaves in buffalo calves. The body weight gain was positive but non-significant correlation with DM, CP, EE and NFE

Table 9 Multiple linear regression analysis of body weight gain on different growth attributes

Variables	Partial regression coefficient (bi)	SE (bi)	T (bi)
Intake			
DM	-0.3866	3.2064	-0.1205
DCP	-243.2908	47.5479	-5.1167
TDN	-5.5947	3.6558	-1.5303
N	19.786	257.003	0.7698
Ca	990.776	95.1877	10.4087
P	5317.69	414.674	12.8238
Digestibility			
DM	-0.5736	0.3321	-1.7270
CP	-2.4931	0.4162	-5.9891
EE	0.1519	0.5144	2.9526
CF	0.1066	0.05181	2.0579
NFE	0.4806	0.3364	1.4287
Balance			
N	2020.72	238.345	8.47381
CA	-2338.14	208.974	-11.1887
P	1493.30	489.148	-3.0528

digestibility but negative correlation with DM, DCP and TDN intake and CF digestibility.

Sarode (1988) while feeding *Stylosanthes hamata* hay to Osmanabadi x Beetal kids, reported body weight gain has positive significant correlation with DCP and P intakes, OM digestibility and N and P balance on the contrary the correlation of other attributes could not achieve significant at 5 per cent level. The balance of Ca and EE digestibility have recorded significantly negative correlation with body weight gain. Coefficient of multiple determination was non significant implying thereby the linear function was not a better fit.

Hembade (1994) reported correlations amongst various variables while feeding banana leaves to ruminants. Intake of DM and TDN, digestibility of DM and CP and daily balance of nitrogen and phosphorus recorded significant positive correlation with body weight gain, while intake of DCP and digestibility of organic matter, CF and NFE have noted non significant but positive correlation with body weight gain. While intake of Ca, digestibility of EE and daily balance of Ca have recorded significantly positive correlation with body weight gain. Intake of nitrogen and digestibility of TCHO have shown non-significant correlation with body weight gain.



SUMMARY AND CONCLUSION

5. SUMMARY AND CONCLUSION

The present work was carried out to study the quality of *Peltophorum pterocarpum* (leguminous tree) leaves i.e. chemical composition, incriminating factors like phenols (tannin) and alkaloid, present in it and effect of 15, 30 and 45 per cent CP replacement in the ration of Osmanabadi kids with *Peltophorum pterocarpum* tree leaves performance on DM intake, growth / production.

Twenty four kids of 78 to 218 days age with 5 to 12 kg body weight were selected and four homogenous groups based on body weight, age and sex were formed. The groups were randomly distributed to four treatments. Treatment T₁ (control), 50 per cent CP from concentrate and 50 per cent from paragrass green fodder + dry jowar kadbi ad-lib, T₂ 50 per cent CP from concentrates, 35 per cent from green paragrass and the remaining 15 per cent from *Peltophorum pterocarpum* tree green leaves + dry jowar kadbi ad-lib, T₃ 50 per cent CP from concentrates + 20 per cent CP from green paragrass + 30 per cent CP from *Peltophorum pterocarpum* tree green leaves + dry jowar kadbi ad-lib and T₄ 50 per cent CP from concentrates + 5 per cent CP from green paragrass + 45 per cent CP from *Peltophorum pterocarpum* tree green leaves and dry jowar kadbi ad-lib.

The experiment with four trials, each of 28 days by prefixing 8 days experimental period was conducted. In the same experimental trials, the metabolism studies of four days were conducted during the last 20 days of each experimental period by involving all the kids. The

experiment was started on 13th of August 2003 lasted upto 16th February, 2004.

The average per cent chemical composition of *Peltophorum pterocarpum* during the month of August 2003 to January 2004 on DM basis was as OM 91.10, CP 18.18, EE 8.88, CF 11.60, NFE 52.42, TCHO 63.92, ash 8.90, Al₂O₃ 1.53, Ca 1.76, P 0.54, polyphenols (HT) hydrolysable 12.33 condensed (CT) 1.55 and alkaloids A+, B+.

The composition by Van Soet's Method of *Peltophorum pterocarpum* tree leaves on per cent DM basis was observed to be DM 32.66, CP 16.00, NDF 30.12, ADF 19.22, hemicellulose 10.9, cellulose 10.42 lignin 8.3 and silica 1.52.

The chemical composition of *Peltophorum pterocarpum* tree leaves varied during the period of investigation. DM content increased from 27.00 per cent to 32.66 per cent from August 2003 to January 2004. Whereas EE, CF, TCHO and ash contents were found to be increased from 8.5 to 9.16, 10.83 to 12.33, 63.28 to 64.66 and 7.86 to 10.68 per cent, respectively.

The overall DM intake was 3.684, 3.718, 3.794, 3.717 per cent of body weight of kids on T₁, T₂, T₃ and T₄, respectively. The differences in DM intake of different treatments were found non significant ($P > 0.05$).

The overall DCP intake values were 0.468, 0.467, 0.477 and 0.492 per cent of body weight for T₁, T₂, T₃ and T₄, respectively. The differences amongst the treatments were found non significant ($P > 0.05$).

The overall TDN intake values were 3.222, 3.400, 3.478 and 3.505 per cent of body weight in T₁, T₂, T₃ and T₄, respectively. There

were significant differences among treatments. There was increasing trend of TDN intake with increase in CP replacement through *Peltophorum pterocarpum* tree leaves.

The mean values for DM digestibility coefficient were 56.62, 55.32, 56.12 and 56.40 per cent in T₁, T₂, T₃ and T₄, respectively. There were no significant differences among treatments.

The mean values for OM digestibility coefficient were 56.49, 56.23, 57.66 and 57.67 per cent in T₁, T₂, T₃ and T₄. The differences were statistically significant.

The mean values for CP digestibility coefficient were 70.51, 66.70, 66.96 and 67.82 per cent for T₁, T₂, T₃ and T₄ treatments, respectively.

There were significant differences among treatments for CP digestibility.

The mean values for EE digestibility correlation were 51.51, 55.84, 63.71 and 64.78 per cent for T₁, T₂, T₃ and T₄ treatments, respectively. That effect of treatment was highly significant. T₄ and T₃ recorded significantly ($P < 0.05$) higher values over T₂ and T₁. T₄ and T₃ were at par.

Kids digested CF on an average as 54.01, 51.92, 50.29 and 41.56 per cent in T₁, T₂, T₃ and T₄, respectively. The values of CF digestibility coefficient differed significantly ($P < 0.05$). Values of T₁, T₂, T₃ were significantly higher over T₄, T₁, T₂ and T₃ were at par.

The mean values for NFE digestibility coefficient were 56.20, 54.83, 56.13 and 60.63 per cent in T₁, T₂, T₃ and T₄, respectively. There were significant ($P < 0.05$) differences amongst the treatments. Value of

T₄ was significantly higher over T₁, T₂ and T₃. However, values of T₁, T₃ and T₂ were at par with each other. The mean digestibility values of TCHO were 56.65, 57.11, 57.99 and 57.98 per cent in T₁, T₂, T₃ and T₄, respectively. TCHO digestibility was not affected significantly by treatments.

From the above results it may be concluded that there were no significant changes in the digestibility coefficient of DM due to treatment effects. The digestibility coefficient of OM, CP, EE and NFE were found significantly higher in T₄. While digestibility of CF was found significantly higher in T₁.

Mean daily nitrogen intake values were 7.922, 8.042, 8.400 and 8.208 g for T₁, T₂, T₃ and T₄, respectively. Similarly, nitrogen balances on an average were 2.539, 2.419, 2.547 and 2.532 g in T₁, T₂, T₃ and T₄, respectively. The mean N per cent retention of intakes were 31.54, 29.60, 30.60 and 30.32 for T₁, T₂, T₃ and T₄, respectively. The N intake was highest in T₃, the N balance was also highest in T₃ but the N retention per cent was highest in T₁.

The average daily Ca intake values were 2.062, 2.741, 3.622 and 3.401 g in T₁, T₂, T₃ and T₄, respectively. Similarly, daily Ca balances on an average were 1.849, 2.450, 3.143 and 2.994 g in treatment T₁, T₂, T₃ and T₄, respectively. There was consistent significant ($P < 0.05$) increase in the daily Ca intake and balance with every increase in the CP replacement percentage through *Peltophorum pterocarpum* tree leaves over its previous one. However, mean Ca per cent retention of intake was 88.22, 89.39, 87.93 and 86.79 for T₁, T₂, T₃ and T₄, respectively. The retention percentage was significantly ($P < 0.05$) higher in T₂.

The mean daily P intake values were 1.001, 1.027, 1.232 and 1.110 g in treatments T₁, T₂, T₃ and T₄, respectively. Similarly, daily P balances on an average were 0.885, 0.826, 1.026 and 0.868 g in T₁, T₂, T₃ and T₄, respectively. P per cent retention were 88.217, 93.869, 83.110 and 81.497 in T₁, T₂, T₃ and T₄, respectively.

The mean daily gain in weights were 28.46, 30.66, 29.75 and 28.59 g/day in T₁, T₂, T₃ and T₄, respectively. The daily body weight gain was not affected significantly ($P > 0.05$). Kids receiving upto 30 per cent CP replacement through *Peltophorum pterocarpum* tree green leaves recorded maximum growth.

The overall mean obtained for various body linear measurements were 1.335, 1.303, 1.356 and 1.178 cm height per month, 1.362, 1.420, 1.404 and 1.379 cm length per month, 1.186, 1.257, 1.269 and 1.288 cm chest girth per month in T₁, T₂, T₃ and T₄, respectively. All were not affected significantly by treatments.

The average DM consumption for 1 kg body weight gain was 15.390, 12.559, 13.839 and 12.533 kg for T₁, T₂, T₃ and T₄, respectively and these were not statistically ($P > 0.05$) different.

On an average DCP requirement for 1 kg body weight gain was 1.964, 1.590, 1.718 and 1.678 kg in T₁, T₂, T₃ and T₄, kg respectively and these were statistically ($P > 0.05$) different.

The mean TDN requirement for 1 kg gain was 13.467, 11.457, 12.534 and 11.869 kg for T₁, T₂, T₃ and T₄, respectively and these were not statistically ($P > 0.05$) different.

The average value obtained for various parameters during sole feeding trial (T₅) were as followed. The mean value for acceptability

of feed was 66.84 per cent. The nutrients intake were as DM 2.55, DCP 0.190 and TDN 1.180 per cent of body weight. Intake of nitrogen 6.97, Ca 6.638 and P 1.58 g/day/kid were observed. The mean digestibility coefficients of proximate nutrients were as 39.76, 46.04, 46.25, 44.10, 26.10, 50.14 and 46.43 for DM, OM, CP, EE, CF, NFE and TCHO, respectively. The average N balances were 0.083, Ca 2.489 and P 0.602 g/day/kid and per cent retention of intake was 1.190, 53.66 and 38.10 for N, Ca and P, respectively. The nutritive values found in sole feeding of *Petrophorum pterocarpum* tree green leaves were 7.63 and 46.83 per cent for DCP and TDN, respectively. The nutritive ratio was 1:5.12. The DM intake was lower and did not meet the dry matter requirement as per nutrients requirement. The experimental diet did not meet the DCP and TDN requirement in sole feeding.

CONCLUSION

1. The chemical composition of *Peltophorum pterocarpum* leguminous tree leaves is quite comparable with green leguminous forage crops like lucerne, berseem, cowpea, hay of lucerne, berseem and cowpea.
2. *Peltophorum pterocarpum* tree leaves are well accepted by the goats.
3. CP replacement upto 45 per cent through *Peltophorum pterocarpum* green leaves can maintain the normal growth rate
4. The nutritive values of *Peltophorum pterocarpum* tree leaves during flowering stage / pod formation stage was 7.63 and 6.83 8.00, 45.00 per cent DCP and TDN and nutritive ratio 1:5.12.
5. *Peltophorum pterocarpum* tree leaves are rich in respect of Ca content which fulfils the minimum requirement of ruminant production.
6. *Peltophorum pterocarpum* tree leaves contains 12 to 15 per cent polyphenols incriminating factors on DM basis did not affect digestibility adversely.

SUGGESTIONS

1. The experiments on growing kids, adults, breeding and lactating animals of various ruminants may be conducted for green leaves and hay feeding during different seasons.
2. Various ruminant animals grazing on pasture may be supplemented with *Peltophorum pterocarpum* tree leaves with different quantity without concentrates.
3. Experiments on admixing of *Peltophorum pterocarpum* in the form of fresh leaves and hay with other different sereal roughages at graded levels in stall feeding may be taken on ruminants.
4. Long term experiment may be conducted.

There is need of treatment of such tree leaves before feeding to animals because it contains a great amount of tannin, which is an antinutritional factor and may adversely affect animals health.



LITERATURE CITED

LITERATURE CITED

- Anandan, S. and Dey, A. 2000. Nutritive value of oak (*Quercus semecarpifolia*) leaves for goats. Indian J. Anim. Nutr., 17(1):84-86.
- Annual Report, CIRG. 2002-03. Executive Summary, 4-6. Makhadoom Farah, Mathura, India
- A.O.A.C. 1975. Association of Official Analytical Chemist, Official Method of Analysis, 12th Edn., A.O.A.C. Post Office Box No. 540, Washington, D.C.
- Bais, B., Purohit, G.R., Dhuria, R.K. and Pannu, U. 2002. Nutritive value of Sares and Neem leaves in Marwari goats. Indian J. Anim. Nutr., 19(3):266-268.
- Balaraman, N. 1995. Nutritive value of hybrid napier grass (*Pennisetum purpureum*) for goats. Indian J. Anim. Nutr., 12(4):245-246.
- Balaraman, N. 1996. Process of making Nevaro (*Ficus hookerii*) hay and its nutritive value for goats. Indian J. Anim. Nutr., 13(4):204-208.
- Barbind, R.P., Waghmare, P.S. and Patel, P.M. 1994. Nutritive value of some top feeds and cultivated fodders. Indian J. Anim. Nutr., 11(1):59-61.
- Barman, K.C., Das, a.K., Kanwar, B.N. and Sarma, S. 2003. Nutritive value of Ghora Neem (*Melia azedarach* Linn.) leaves for crossbred goats. Indian J. Anim. Nutr., 20(2):221-223.
- Baruah, K.K., Saikia, B.N., Bhattacharya, M. and Sarma, K. 1995. The nutritive value of paragrass for mithun (*Bos frontalis*). Indian Vet. J., 72:1333-1335.

- Bhadauria, K.K.S., Pailanbhadauri, Das, M.M., Kundu, S.S., Singh J.P. and Lodhi Bhadauri. 2002. Evaluation of shrubs and tree leaves for carbohydrate and nitrogen fraction. *Indian J. Anim. Sci.*, 72(1):87-90.
- Bhaskar, B.V., Prabhu, U.H., Gawali, S.R. and Sampath, S.R. 1985. Chemical composition and nutritive value of subabul leaf meal (*Leucaena leucocephala*) Hawaiian Gaint K 8. *Livestock Advisor*, 130.
- Bhatia, D.R., Ram Ratan and Patnayak, B.C. 1977. Evaluation and utilization of top feeds (*Khejri* leaves) for sheep and goats. Annual Report on Central sheep wool research Institute. Avikanagor P 64, Edited by Technical Section. CSWRI. Avikanagar, published by ICAR, Central Sheep and Wool Res. Inst., Avikanagar.
- Bhatta, R., Mohammed, F. and Krishnamoorthy, U. 1999. Effect of natural sources of tannin on rumen fermentation in vitro. *Indian J. Anim. Nutr.* 16(4):279-284.
- Bhavani Prasad, A., Raghavan, G.V. and Janardhan, Reddy, T. 1987. Studies on the utilization of Anjan (*Hardwickia benata* Roxb) tree leaves as roughage source for sheep. *Indian Vet. J.*, 64(2):160-163.
- Bhuyan, R., Buragohain, S.C. and Baruah, K.K. 1989. Evaluation of banana (*Musa* spp.) leaves in the diet of kids. *Indian J. Anim. Nutr.*, 6(1):62-64.
- Chanda S. K. and Bhaid M. U. 1987. Studies on the digestibility and nutritive value of common dried forest fodder tree leaves of M. P. on goats 2. Hey of Anjan tree leaves (*Hardwickia binata* Roxb) live stock advisor 12 (1), 17-20

- Chanda, S.K. and Bhaid, M.U. 1987a. Studies on the digestibility and nutritive value of common dried forest fodder tree leaves of Madhya Pradesh on goats (3) Hay of Arjun tree leaves (*Terminalia arjuna* Roxb.). Livestock Advisor, pp 5-8.
- Chanda, S.K. and Bhaid, M.U. 1987b. Studies on the digestibility and nutritive value of common dried forest fodder tree leaves of Madhya Pradesh on goats (4) Hay of Phephar tree leaves (*Ficus Triela* Roxb.), pp 5-8.
- Chaudhary, J.L. and Taparia, A.L. 1990. Utilization of ingadulcis (*Pithacellobonium dulce*) and babul (*Acacia nilotica*) dry leaves by goats. Indian J. Anim. Nutr., 7(1):41-44.
- Colomer, S., Fonolla, J., Raggi, L.A. and Boza, J. 1986. Nutritive value of *Atriplex mummularia* for goats. Nutrition Abstract and Review (Series B), 1988, Vol. 58.
- Directorate of Economics and Statistics. Govt. of Maharashtra, Bombay 1995-96. Socio Economic review and District statistical Abstract Parbhani, District.
- Das, Asit and Ghosh, S.K. 2001. Nutritive value of jack fruit tree laves for goats. Indian J. Anhim. Nutr., 18(2):185-186.
- Degan, A.A., Backer, K., Makkar, HPS and Borowy, N. 1995. *Acacia saligna* as a fodder tree for desert livestock and the interaction of its tannins with fiber fractions. J. Sci. Food and Agri., 68(1):65-71.
- Dehuri, P.K., Behura, N.C. and Mahapatra, A.K. 2000. Nutritive value of tentulia (*Aeschynomene americana*) in goats. Indian J. Anim. Nutr., 17(1):81-83.

- Deshpande, V.B. 1981. Crude protein replacement by Dashrath (*Desmanthus virgatys*) fodder in ration of kids. M.Sc. (Agri.) Thesis, MAU, Parbhani, India.
- Deshmukh, N.R. 1988. Growth response of crossbred kids to different levels of green *Stylosanthus hanata* in the ration. M.Sc. (Agri.) Thesis, MAU, Parbhani, India.
- Devendra, C. and Lokeshwar, R.R. 1992. Goats and rural prosperity. International Conference on Goats, Pre-Conference Proceedings, Plenary Papers and Invited Lectures, 6-25. CAB International
- Dharia, S.K., Sawant, A.G. and Toro, V.A. 1993. Potential of Glyricidia as a fodder tree. Indian Dairyman, 45(4):152-155.
- Federer, W.T. 1967. Experimental design, Theory and application, p 192-440. Oxford and IBH Publishing, Calcutta.
- Gholap G. V., 1984. Effect of crude protein replacement in the retain of half bread (HF x Deoni) heifers, by shevara (*Alyskaroups ruqosus*) hay. M.Sc. (Agri.) dissertation submitted to MAU, Parbhani (Maharashtra).
- Ganesh, CH., Ramchandra Reddy, R., Venka Reddy, D., Krishna N. and Srinivasa Rao, D. 1998. Nutritional evaluation of Amaranth (*Amaranthus cruentus*) plant meal as a roughage component of complete ration in lambs. Indian J. Anim. Nutr., 15(4):264-268.
- Gupta, H.K. and Balaraman, N. 1989. Nutritive value of nevaro (*Ficus hookerii*) leaves for goats. Indian J. Anim. Sci., 59(1):186-187.

- Hembade, A.S. 1994. Studies on partial replacement of roughage by banana leaves (*Musa spp.*) in the ruminant. M.Sc. (Agri.), MAU, Parbhani (Maharashtra).
- Hembade, A.S. 1988. Effect of partial replacement of protein in the ration of half bred growing calves by Shevra (*Alysicarpus rugosus*) Hay. M.Sc. (Agri.), MAU, Parbhani.
- Hussain Mia, W., Sahai, B., Mujumdar, B.N. and Kehar, N.D. 1960 (a). Studies on tree leaves as cattle fodder, Part-III. Nutritive value of Bargad leaves (*Ficus bengalensis*). Indian J. Dairy Sci., 13(1-8).
- Hussain Mia, W., Majumdar, B.N., Sahai, B. and Kehar, N.D. 1960 (b). Studies on tree leaves as cattle fodder, Part IV. The nutritive value of pipal leaves (*Ficus religiosa*). Indian J. Dairy Sci., 13:9-15.
- ISI 1995. Methods of test for animal feeds and feedings stuffs. Part I : General methods Part II : mineral and trace elements. Published by ISI : New Delhi.
- ICAR, 1998. Golden Jubilee National Symposium "Feeding strategies for sustainable livestock production with emphasis on non-conventional feeds and systems for protein evaluation in ruminants. Organised by IVRI, Regional Station, Palampur.
- Jayal, M.M. and Sahai, K. 1960. Studies on the palatability, chemical composition, digestibility and Nutritive Value of gauj (*Millettia auriculata*) leaves. Indian J. Dairy Sci., 13:77-82.
- Jain, R.K., Tiwari, S.P., Nema, S.K., Chourasia, S.K. and Rajgopal, S. 1998. Nutritional evaluation of tree leaves and range legumes. Indian J. Anim. Nutr., 15(1):35-39.

- Jain, A., Singh, A.K., Hori Lal and Banerjee, S.K. 2002. Chemical and biochemical composition of neem (*Azadirachta indica* A. Juss.) leaves in relation to soils of different agroclimatic zones. *Indian Forester*, pp 786-794.
- Jayal, M.M. and Kehar, N.D. 1962. A study on the nutritive value of mulberry (*Morus indica*) tree leaves. *Indian J. Dairy Sci.*, 15:21-27.
- Joshi, U.N., Arora, S.K., Paroda, R.S., Jatasara, O.S. and Rana, D.S. 1985. Chemical composition of Prosopis, leaves show the presence of anti-nutritional factors responsible for low in vitro. Dry matter digestibility. *Nutrition Abstract and Review (Series B)*, 57:1.
- Joshi, D.C. and Talapatra, S.K. 1960. The chemical composition and nutritive value of the Himalayan tree fodder, Bhimal (*Grewia oppositifolia* Roxb.). *Indian J. Dairy Sci.*, 13:68-76.
- Kaldate, D.S. 1982. Effect of Dashrath (*Desmanthus virgatus*) alone and general grazing on growing kids. M.Sc. (Agri.) Thesis, MAU, Parbhani, Maharashtra.
- Kathiresan, K. and Veera Ravi, A. 1990. Seasonal changes in tannin content of mangrove leaves. *Indian Forester*, pp 390-392.
- Kedar, A.B. 1990. Effect of replacement of C.P. by rain tree leaves (*Interolobium saman* L.) in the ration of goats kid. M.Sc. (Agri.) Thesis, MAU, Parbhani, Maharashtra.
- Kelley, T.G. and Rao, P.P. 1994. Trends in cultivated green fodder crops in India. ICAR, Agril. Univ. Wageningen, Netherlands, pp 98.

- Kelly, T. G. and Rao, P. P. 1994. Availability and requirement of different sources of conventional feed in India in : Variation in the quality and quantity of fibrous crop residues (EDS) A. L. Joshi, P. T. Doyleand, S. N. Oosting Syntec. Marketing services and products Pvt. Ltd. India. PP. 87-97
- Khatta, V.K., Tewatia, B.S. and Gupta, P.C. 1999. Nutritional evaluation of tree leaves of humid subtropical region of Himachal Pradesh. *Indian J. Anim. Nutr.*, 16(3):220-223.
- Khatta, V.K. and Katoch, B.S. 1983. Nutrient composition of some fodder tree leaves available in submount aims region of Himachal Pradesh. *Indian Forester*, 109(1):17-24.
- Kibria, S.S., Nahar, T.N. and Mia, M.M. 1993. Evaluation of important tree leaves available in Bangladesh using Black bengal goats. *Indian J. Ani. Sci.*, 63(9):989-992.
- Kurup M. P. G., 2000. Milk production in India. Perspective 2020. *Indian Dairy man*.
- Kumar, A. and Sharma, S.D. 2003. Nutritive evaluation of some fodder tree leaves for ruminants in Tarai region of Uttranchal. *Indian J. Anim. Nutr.*, 20(2):161-167.
- Kundu, H., Panda, N.C. and Sahu, B.K. 1983. Leaves of Ingadulis (*Manila tamarin*) as a fodder for goats. *Indian J. Anim. Sci.*, 53(6):669-671.
- Kundu, H., Sahu, B.K. and Panda, N.C. 1985. Chemical composition and nutritive value of mango (*Mangifera indica*) leaves for goats. *Indian Vet. J.*, 62:811-812.
- Lohan, O.P., Lall, D., Pal, R.N. and Negi, S.S. 1980. Cell wall constituents and in vitro dry matter digestibility of some fodder trees in Himachal Pradesh. *Forage Res.*, 6:21-27.

- Mudgal, V. D., Sengar, S. S., Singhal, K. K., Nawabsingh and Walli, T. K., 1979. Some aspects of protein and NPN utilization in goats. Protein and NPN utilization in ruminants P-63 edited by Gupta, B. N. and Arora, S. P. published by NDRI, Karnal.
- Mairal, V.K. 1980. Effect of feeding different levels of proteins on growth of Osmanabadi goats. M.Sc. (Agri.), MAU, Parbhani.
- Majgaonkar, S.V., Patil, S.S. and Toro, V.A. 1987. Chemical composition and nutritive value of *Gmelina arborea* tree leaves. Indian J. Anim. Sci., 97(111):1235-1236.
- Majumdar, B.N. and Momin, S.A. 1960. Studies on tree leaves as cattle fodder. Part V. The nutritive value of young Gular leaves (*Ficus glomerata*). Indian J. Dairy Sci., 13:16-19.
- Mandal, T., Chakrawarti, N. and Mandal, L. 1995. Nutritive value of pipal tree leaves (*Ficus religiosa*) in male Black Bengal goats. Indian J. Dairy Sci., 48(4):313-314.
- Mandava, R.M.R., Patel, P.M. and Pawar, A.S. 1988. Crude protein replacement value of rain tree (*Entrobobium saman*) leaves in buffalo calves. Abstract, Third Symposium on "Latest research, trends in livestock and poultry nutrition". Banaras Hindu University, Varanasi on March 23-26, p 72.
- Marimuthu, N. and Subbarayalu, M. 1986. Promising fodder trees for livestock feeding in tropics. Livestock Advisor, pp 7:11-15.
- Mehta, M.K. and Bhaid, M.U. 1986. Studies on the digestibility and nutritive value of common forest fodder tree leaves of Madhya Pradesh on goats (D). Phephar tree leaves (*Ficus tsiela* Roxb.). Livestock Adviser, pp 9-12.

- Mehta, M.K. and Bhaid, M.U. 1985. Studies on digestibility and nutritive value of common forest fodder tree leaves of Madhya Pradesh in goats (B) Arjun leaves (*Terminalia arjuna* Roxb.). Livestock Advisor, 85:32-35.
- Mishra, A.S., Chaturvedi, O.H., Mishra, A.K. and Prasad, R. 2000. A note on nutritive evaluation of pilu (*Salvadora persica*) leaves. Indian J. Small Ruminants, 6 (2) : 108-109.
- Mittal, G.K., Sharma, K.M., Maheshwari, M.L. and Barsual, C.S. 1989. Chemical composition of tree leaves during different seasons in Chakarata (Dehradun) hill area of Uttar Pradesh. Indian Vet. J., 766(3):246-248.
- Mondal, T., Chakraborty, N. and Mandal, L. 1994. Nutritive value of banyan (*Ficus bengalensis*) tree leaves in male Black Bengal goats. Indian J. Anim. Nutr., 11(2):117-119.
- Murugan, M. and Kathaperumal, V. 1987. Utilisation of tree fodder in sheep. Indian J. Anim. Sci., 57(10):1145-1147.
- Nag, A. and Matai, S. 1992. Chemical composition of some fodder trees in and around calcutta. Indian Vet. J., 69(5):411-414.
- Nag Datta, A., Lahiri, A.K., Matai, S. and L. Si. 1994. Proximate composition and polyphenol content of some tree leaves. Indian Forester, 1122-1125.
- Nageswara Rao, S.B., Chaudhary, U.B., Nawabsing and Dutta, T.K. 2002. A note on feeding leucaena leaves and Barli straw (1:1) with two levels of concentrates in goats. Indian J. Anim. Nutr., 19(3):273-274.
- Nageswara Rao, S.B., Nawabsing and Ogra, J.L. 1996. Tree leaves based palletted feeds and their utilization in goats. Indian J. Anim. Nutr., 13(3):174-177.

- Nawale, B.B. 1979. Effect of feeding different levels of proteins on the growth of Osmanabadi kids. M.Sc. (Agri.) Thesis, MAU, Parbhani, India.
- National Commission on Agriculture. 1976. Part-VII, Government of India, Animal Husbandry, Ministry of Agriculture and Irrigation, New Delhi.
- NDRI. 1996. Estimates of nutrient requirement and availability of bovine population across major states in India. Publication, No. 231.
- Nutritional Committee of ICAR. 1954. Memorandum on the Joint Meeting of ICAR and ICMR on the availability and requirement of feed and fodder.
- Pailan, G.H. and Singhal, K.K. Effect of dietary protein sources on water metabolism in lactating goats. Indian J. Anim. Nutr., 17(1):52-55.
- Pal, R.N., Dogra, K.K., Singh, L.N. and Negi, S.S. 1979. Chemical composition of some fodder trees in Himachal Pradesh. Forage Res., pp 109-115.
- Palani, M. and Dasthagir, M.G. 1996. Research notes (1) Studies on the seasonal variation in nutritive value of *Gmelina arborea* Linn. Indian Forester, pp 181-183.
- Panda, S.K., Panda, N.C. and Sahu, B.K. 1983. Effect of tree leaf tannin on dry matter intake by goats. Indian Vet. J., 60(8):660-664.
- Panda, S.K., Saha, B.K. and Panda, N.C. 1987. Leaves of *Calliandra calothyrsus* as fodder for goats.
- Pandy, U. K., 1992. Economic analysis goat farming in India. Indian J. Anim. Prod. mgmt. 8 : 1-2.

- Pankaj Biswas, Mandal, L., Gupta, R.D. and Banerjee, G.G. 1995. Toxic principles of some common plants. Indian J. Dairy Sci., 48(4):277-280.
- Parthasarathy, M. 1986. Effect of feeding varying levels of Khejri (*Prosopis cineraria*) leaves and concentrate on the performance of weaner kids. Indian J. Anim. Nutri., 3(4):249-253.
- Paterson, R.T. 1993. Use of trees by livestock 4:Antinutritive factors, Chatham, U.K. National Research Institute.
- Price, M.L. and Butler, L.G. 1977. Rapid visual estimation and spectrophotometric determination of tannin content of sorghum grain. J. Agric. Food Chem., 25:1268-1273.
- Price, M.L. Scoyoc, S.V. and Butler, L.G. 1978. A critical evaluation of the vanillin reaction as an assay for tannin in sorghum grain. J. Agric. Food Chem., 26:1214-1218.
- Rajendiran, A.S. and Kadirvel, R. 2002. The nutritive value of casuarina leaves (*Cladode*) for goats. Indian J. Anim. Nutr., 19(1):18-24.
- Ramana, D.B.V., Sultan Singh and Solanki, K.R. 2002. Nutritive value of leaves of some tree and shrub species. Indian J. Anim. Nutr., 19(3):262-265.
- Ranjhan. 1994. Consultants report on the availability and requirement of feed and fodder for livestock and poultry. Department of Animal Husbandry and Dairying, Ministry of Agriculture, Government of India, New Delhi.
- Ranjhan, S.K. 1998. Nutrient requirement of Livestock and poultry. Indian Council of Agriculture Research, New Delhi.

- Saha, R.C., Saha, R.N., Singh, R.B. and Chaudhary, A.B. 1985. Chemical composition of some fodders of Andamans. *Livestock Advisor*, 136-139.
- Saha, R.C., Saha, R.N., Singh, R.B. and Chaudhary, A.B. 1987. Chemical composition of some fodders of Andamans. *Indian J. Dairy Sci.*, 40(1):136-139.
- Saikia, G. 2002. Nutritive value of Thalapadma (*Hibiscus mutabilis* L.). Tree leaves for goats. *Indian J. Anim. Nutr.*, 19(3):269-271.
- Sarode, R.B. 1984. Influence of digestible protein and energy on growth and feed utilization in Osmanabadi kids. Ph.D. Thesis, MAU, Parbhani, India.
- Sarode, N.S. 1988. Studies on nutritive value of (cv. Verano) *Stylosanthus hamata* hay for feeding of Osmanabadi x Beetal kids. Ph.D. Thesis, MAU, Parbhani, India.
- Sehgal, J.P. 1984. Tannin content of different top feed leaves and utilization of tannin rich pala (*Ziziphus numularia*) leaves with concentrates for growing lambs. *Indian J. Anim. Sci.*, 54(1):126-128.
- Sehgal, J.P. and Bhatia, D.R. 1982. Utilization of four pala leaf (*Ziziphus nummularia*) based rations by crossbred weaners. *Indian J. Anim. Health*, pp 7-10.
- Sen, A.R., Shinde, A.K., Verma, D.L. and Karim, S.A. 2002. Growth and carcass traits of Sirohi finisher kids fed on ad-lib tree leaves and concentrate. *Indian J. Anim. Sci.*, 72(12):1179-1181.
- Shaikh Nur Mahatab, Ahmed Ali and Asaduzzaman, AHM 1987. Nutritional potential of sajna leaves in goats. *Livestock Advisor*, XII (12).

- Sharma, K. and Ogra, J.L. 1990. Growth rate and feed conversion efficiency of Barbari kids fed khejri (*Prosopis cineraria*) leaves with different levels of concentrate. Indian Vet. J., 67(3):252-254.
- Sharma, R.K., Singh, b. and Bhat, T.K. 2000. Nitrogen solubility, protein fractions, tannins and. In sacco dry matter digestibility of tree fodders of Siwalik Range. Indian J. Anim. Nutr., 17(1):1-7.
- Shinde, B.R., Barbind, R.P. and Patil, G.R. 2000. Feeding value for ber (*Ziziphus nummularia*) leaves for the growth performance of Osmanabadi kids. Indian J. Small ruminants, 6(2):82-85.
- Singh, B.R., Banerjee, G.C. and Gupta, B.N. 1989. Chemical composition and nutritive value of Gogun (*Saurauia napalensis*) tree leaves. Indian J. Anim. Nutr., 6(2):174-176.
- Singh, R.B. and Gupta, B.N. 1983. Chemical composition and nutritive value of dried Jhanji (*Scirpus articulatus*). Indian Vet. J., 60(2):134-137.
- Singh, A.K., Upadhyay, V.S., Misra, A.K. and Singh, K.K. 1999. Seasonal variation in chemical composition of important tree leaves of Bundelkhand region. Indian J. Anim. Nutr., 16(3):269-271.
- Singh, A.K., Lodhi, G.N., Misra, A.K. and Upadhyay, V.S. 1994. Nutritive value of Anjan tree (*Hardwickia binata*) leaves for goats. Indian J. Anim. Nutr., 11(3):197-198.
- Singh, K.K., Samanta, A.K. and Srinivas, B. 1995. Nutritional evaluation of tree leaves and range legumes. Indian J. Anim. Nutr., 12(4):234-236.

- Singh, N.P. 1981. Utilization of top feeds for sheep and goats. First Proceedings of the society and National Seminar on sheep and goat production and utilization. Central Sheep and Wool research Institute, Avikanagar.
- Singh, N.P. and Patnayak, E.C. 1981. A note on palatability of neem tree leaves for sheep. Food Farming and Agric., 14(5):47-48.
- Singleton, V.L. 1974. Analytical fractionation of the phenolic substances of grapes and wine add sonic practical uses of such analysis. Am. Chem. Soc. Adv. Chem. Ser., Washington, 137:184.
- Skerman, P.J. Tropical Forage Legumes. Published by Agreement with FAO of the United Nations by International Book Distributors, 9/3, Rajput Road, 1st Floor, Dehradun.
- Snedecor, G.W. and Cochran, W.G. 1968. Statistical Methods. Oxford and IBH Publ. Co., Calcutta.
- Yadav Surbhi and Bhadoria, B.K. 2001. Chemical and biochemical assesment of some leguminous tree leaves. Indian J. Anim. Nutr., 18(2):113-118.
- Thakur, S., Srivastava, J.P., Varma, A.K., Gupta, B.S. 1982. Nutritive value of jack (*Artocarpus integrifolia* L.) tree leaves. Forage Res., 8:75-77.
- Thirumalai, S., Vedhanayagam, K. and Kathaperumal, V. 1989. Nutritive value of jack leaf (*Artocarpus integrifolia*). Indian Vet. J., 66:877-878.
- Thirumalai, S., Vedhanoyagam, K. and Katheperumal, V. 1990. Nutritive value of odi leaves (*Lannes coromondolica*). Indian Vet. J., 67:88-89.

- Thirumalai, S., Vedhanayakam, K. and Katheperumal, Y. 1993. Vagai laves (*Albizia lebberk*) as feed for goals. Indian Vet. J., 70:475-476. ✓
- Tiwari, S.P., Jain, R.K., Nema, R.K. and Rajgopal, S. 1998a. Effect of feeding (*Malachra capitata*) leaves on rumen fermentation and blood constituents in kids. Indian J. Anim. Nutr., 15(1):67-68.
- Tiwari, S.P., Jain, R.K., Nema, R.K., Dhir, R.C. and Rajagopal, S. 1998b. Nutritional evaluation of rhea (*Acacia leucophloe* Will L.) tree leaves in goats. Indian J. Anim. Nutr., 15(2):129-133.
- Tomar, A.K.S., Arun Kumar and Sen, A.R. 2001. Growth and carcass traits of Sirohi goat kids under different feeding groups. Indian J. Anim. Sci., 71(9):874-875.
- Upase, B.T., Deshmukh, A.P. and Mali, S.L. 1982. Tree leaves as a fodder for goat and sheep. Dairy Guide, pp 27-29.
- Vaithyanathan, S., Ravindra Kumar and Mann, J.S. 1999. Effect of different lopping management upon phenolics content of leaves in khejri (*Prosopis caneraria*) tree. Indian Small Ruminant, 5(1):25-27.
- Van Soest, P.J. and Sniffen, C.J. 1984. Nitrogen fractions in NDF and ADF. Proc. Distiller's Feed Conf. Cincinnati, pp 73.
- Verma, A.K., Verma, D.N. and Omprakash 1995. Nutritive value of casuarina (*Casuarina equisetifolia*) leaves in goats. Indian J. Anim. Nutr., 12:53-55.
- Waghorn, G.C., Shelton, .D., McNabb, W.C. and McCutcheon, S.N. 1994. Effects of condensed tannins in *Lotus pedunculatus* on its nutritive value for sheep. 2. Nitrogenous aspects. J. agric. Sci., Cambridge, 123:109-119.

- Waghorn, G.C., Shelton, I.D. and McNabb, W.C. 1994. Effects of condensed tannins in *Lotus pedunculatus* on its nutritive value for sheep. 1. Non-nitrogenous aspects. J. agric. Sci., Cambridge, 123:99-107.
- Yadav, P.S. and Yadav, I.S. 1988. Proximate composition, tannin and mimosine content in different parts of cultivars of subabul. Indian J. Anim. Sci., 58:953-958.
- Yadav, R.K., Barasul, C.S. and Maheshwari, M.L. 1990. Goat rearing under range conditions. Indian Vet. J., 67:1080-1081.
- Yadav, P.K., Barasul, C.S. and Maheshwari, M. L. 1990. Nutrition of Barbari kids under range conditions. Indian J. Anim. Nutr., 7(4):303-304.
- Yadav, Surbhi and Bhadoria, B.K. 2001. Chemical and biochemical assessment of some leguminous tree leaves. Indian J. Anim. Nutr.; 18(2):113-118.



APPENDIX

APPENDIX-I

Details of experimental kids

Treatment	Sex	Kid tag No.	Age as on days	Body wt. (kg)
T ₁	M	667	218	8.500
	F	669	218	8.500
	M	678	210	11.000
	F	688	162	6.500
	F	691	182	6.700
	F	693	149	11.000
Total			1139	52.200
Mean			189	8.700
T ₂	F	635	220	9.000
	F	652	221	7.000
	M	679	208	12.000
	F	682	204	7.000
	M	687	177	5.500
	M	690	155	9.500
Total			1185	50.000
Mean			197	8.333
T ₃	F	645	221	9.000
	F	666	217	12.000
	M	677	218	11.000
	M	689	158	5.000
	F	694	149	6.500
	M	698	99	9.000
Total			1062	52.500
Mean			177	8.75
T ₄	F	660	220	8.500
	F	644	221	9.500
	M	663	219	11.000
	F	684	181	7.000
	M	692	154	8.000
	F	699	78	6.000
Total			1073	50.000
Mean			178	8.333

APPENDIX-II

Analysis of variance for body measurements

Source of variance	d.f.	M.S.S.			
		Body weight	Height	Length	Chest girth
Treatment	3	769.002NS	0.1536NS	0.01562NS	0.04752NS
Period	3	484.03**	0.0156Ns	0.335**	0.10304*
T x P	9	58.764NS	0.1125NS	0.01425NS	0.01692NS
Error	80	34.322NS	0.113NS	0.0437NS	0.03775NS

APPENDIX-III

Analysis of variance for DM, DCP and TDN requirement

Source of variance	d.f.	M.S.S.		
		DM	DCP	TDN
Treatment	3	0.0128NS	0.003229NS	0.39157**
Period	3	0.7223**	0.06710**	0.66864*
T x P	9	0.17115NS	0.00271NS	0.12487NS
Error	80	0.1272	0.00431	0.1219

APPENDIX-IV

Feeding schedule for goat at different body weights recommended by Rajhan (1980) on DM basis

Body weight (kg)	Average daily gain	DM intake	DM percentage of live weight	DCP (g)	TDN (kg)	Ca (g)	P (g)
10	50	380	3.8	27	265	2.0	1.4
	100	510	5.1	37	355	2.7	1.8
	150	635	6.3	47	445	3.4	2.3
15	50	510	3.4	33	330	2.7	1.8
	100	645	4.3	43	420	3.5	2.3
	150	785	5.2	53	510	4.2	2.8
20	50	640	3.2	39	385	3.3	2.2
	100	790	3.9	49	475	4.1	2.7
	150	985	4.9	59	590	5.1	3.4
25	50	760	3.0	44	440	3.8	2.5
	100	915	3.7	54	530	4.6	3.0
	150	1070	4.3	64	620	5.3	3.6

APPENDIX-V
Analysis of variance for digestibility coefficient

Source of variance	d.f.	M.S.S.							
		DM	OM	CP	EE	CF	NFE	TCHO	
Treatment	3	7.717NS	13.920*	77.560**	972.71**	718.86*	153.90*	10.721NS	
Period	3	15.935**	15.491*	313.27**	465.23**	830.52**	126.63*	73.549*	
T x P	9	7.087NS	4.123NS	19.147NS	161.37*	77.413NS	44.503*	7.2884NS	
Error	80	3.860	4.077	12.806	46.153	43.077	20.002	5.0388	

APPENDIX-VI

**Meteorological data from August 2003 to Feb. 2004, recorded at
Meteorological Observatory, MAU, Parbhani.**

MW	Rainfall (mm)	Rainy days	Temp. °C		Humidity (%)		Evapo ration (mm/ day)	BSS (hr/ day)
			Max.	Min.	Max.	Min.		
36	9.4	2	30.5	21.3	86	62	4.8	5.4
37	1.4	0	31.9	21.3	78	57	5.7	9.2
38	9.3	1	32.6	22.6	85	58	5.5	7.2
39	8.8	1	30.8	22.2	89	62	4.3	4.9
40	11.4	1	33	20.5	72	53	6	10.2
41	1.2	0	33.6	18.8	78	47	5.6	9.2
42	2.5	1	33.9	17.5	72	36	5.8	10.6
43	0	0	32.2	16.1	75	44	6	9.3
44	33.9	1	32.1	20.1	78	50	5.3	7.2
45	0	0	32.2	13	81	30	5.6	10.5
46	0	0	31.6	13.4	79	32	5.3	10.7
47	0	0	31.6	12.2	76	35	5.5	10.7
48	0	0	31.6	13.4	82	35	4.8	9.8
49	0	0	30.9	9.9	74	34	4.1	10.5
50	0	0	30.6	10	78	30	4.7	10.3
51	0	0	27.7	8.6	80	33	4.3	10.5
52	0	0	28	11.2	81	38	4.3	9.1
01	0	0	29.4	10.9	77	35	4.6	10.1
02	7.8	2	27.3	9.2	88	38	3.5	9.3
03	0	0	32.5	10.7	74	30	4.8	10.7
04	0	0	29.9	13.7	71	35	5.1	9.2
05	0	0	29.4	15.1	75	41	5.2	9.2
06	0	0	30.6	9.5	79	28	5.4	10.9
07	0	0	33.0	13.2	69	28	4.9	10.6
08	0	0	34.9	13.8	62	19	5.2	10.9

APPENDIX-VI
Average per cent chemical composition of feeds and fodders used in the experiment (offered)

Feed	DM	OM	CP	EE	CF	NFE	TCHO	Ash	Ca	P
Sugras (calf ration)	90	91.63	19.38	2.28	7.82	62.15	69.97	8.37	1.21	0.57
Paragrass (<i>Bracharia mutica</i>)	18.825	86.00	13.40	1.98	29.87	40.75	70.62	14.00	0.324	0.16
Radhachura (<i>Peltophorum pterocarpum</i>)	29.637	91.07	19.56	8.2	9.14	54.77	63.3	8.93	1.89	0.17
Dry jowar kadbi	90	91.31	1.08	2.34	41.6	46.29	87.46	8.69	0.23	0.18

APPENDIX-VII
Average daily nutrient intake, in the experimental kids (g/kid)

Treatment	DM	OM	CP	EE	CF	NFE	TCHO	Ash	Ca	P	CP	TDN
T1P1	352.23	296.63	49.53	7.92	92.84	156.42	245.42	44.90	1.91	0.96	49.53	257.18
T1P2	386.73	335.59	51.67	10.14	130.85	201.00	290.51	48.39	1.98	1.05	51.62	373.90
T1P3	412.84	360.58	50.65	6.65	116.22	178.45	295.04	48.04	2.29	1.10	50.65	231.32
T1P4	439.92	380.19	46.20	10.27	110.37	222.75	304.27	52.92	2.04	0.90	46.20	389.59
Average	397.93	343.24	49.51	8.745	112.57	197.63	279.56	48.56	2.03	1.0025	49.51	312.99
T2P1	342.65	300.95	48.98	10.25	80.52	160.92	251.13	39.13	2.36	0.96	48.98	251.69
T2P2	392.87	349.28	46.86	11.26	100.78	188.87	290.78	40.37	2.67	1.06	46.86	300.91
T2P3	415.11	366.59	57.87	11.78	108.5	191.02	300.41	45.82	3.07	1.11	51.87	311.30
T2P4	472.90	414.77	53.30	14.31	100.59	244.54	340.18	52.94	2.85	0.96	53.30	359.44
Average	405.88	347.89	50.25	11.9	97.59	196.33	295.62	44.56	2.73	1.02	50.25	305.83
T3P1	382.54	328.69	50.82	14.55	84.32	168.74	262.72	36.70	3.31	1.11	50.82	267.61
T3P2	411.99	370.38	52.73	17.26	115.52	209.42	314.53	41.17	3.57	1.30	52.73	342.2
T3P3	408.13	364.46	51.11	14.98	97.35	138.38	296.47	40.06	4.00	1.16	51.11	310.71
T3P4	471.33	424.60	55.93	16.51	71.42	262.20	334.54	47.75	4.06	1.32	55.93	350.13
Average	418.49	372.09	52.64	15.82	92.15	209.68	302.06	41.42	3.73	1.22	52.64	317.66
T4P1	381.44	346.72	50.65	16.63	73.28	192.80	274.27	34.01	3.53	1.09	50.65	288.71
T4P2	376.35	341.49	51.66	16.26	73.62	193.95	269.15	34.59	3.34	1.17	51.66	283.83
T4P3	369.14	347.25	48.40	18.28	79.12	198.60	277.49	33.73	4.34	1.25	48.40	296.00
T4P4	445.02	401.14	54.49	17.11	86.55	238.96	314.70	38.87	2.21	0.90	54.49	342.62
Average	392.98	359.15	51.3	17.07	79.64	206.07	283.90	35.3	3.35	1.10	51.3	302.79

APPENDIX-VIII
Average chemical composition of faeces of kids (on DM basis)

Treatment	Period	DM	OM	CP	EE	CF	NFE	TCHO	Ash
T1	P1	38	85	8	2.2	28	46.8	74.8	15
	P2	37	86	8.2	2.25	28.5	47.05	75.55	14
	P3	39	85	8.4	2.2	28	46.4	74.4	15
	P4	38	85	8.6	2.2	27	47.2	74.2	15
Average		38	85.25	8.3	2.2125	27.875	46.8625	74.7375	14.75
T2	P1	39	87	9	2.8	26	49.2	75.2	13
	P2	38	86	9.2	2.9	25	48.9	73.9	14
	P3	39	86	9.4	3	26	47.6	73.6	14
	P4	40	86.5	9.5	2.9	25	49.1	74.1	13.5
Average		39	86.375	9.275	2.9	25.5	48.7	74.2	13.625
T3	P1	38	85	9.3	3	24	48.7	72.7	15
	P2	38	86	9.5	3.2	2.5	48.8	73.3	14
	P3	38.5	85.5	9.6	3.25	24.5	48.65	73.15	14
	P4	39	85.8	9.7	3	25	48.1	73.1	14
Average		38.375	85.575	9.525	3.1125	19	48.5625	73.0625	14.25
T1	P1	37	87	9.4	3.2	26	48.4	74.4	13
	P2	37.5	87.5	9.6	3.3	26	48.6	74.6	12.5
	P3	38	88	9.8	3.5	27	47.7	74.7	12
	P4	38.5	88	9.9	3.5	27.5	47.1	74.6	12
Average		37.75	87.625	9.675	3.375	26.625	47.95	74.575	12.375

APPENDIX-IX
Effect of treatment and period on average daily nitrogen balance in experimental kids (g/kid)

Treatment	Period	Intake	Out go		Balance	Retention percentage of intake
			Faeces	Urine		
T1	P1	7.92	1.96	2.904	3.056	38.585
	P2	8.26	2.15	2.924	3.186	33.571
	P3	8.1	2.48	3.403	2.217	27.37
	P4	7.39	2.61	3.469	1.311	17.74
Average		7.9175	2.3	3.175	2.4425	29.3165
T2	P1	7.83	2.18	2.848	2.802	35.785
	P2	7.49	2.52	2.958	2.012	26.862
	P3	8.29	2.76	3.204	2.326	28.057
	P4	8.52	3.32	3.497	1.703	19.988
Average		8.0325	2.695	3.12675	2.21075	27.673
T3	P1	8.13	2.44	3.204	2.486	30.578
	P2	8.43	2.73	3.52	2.18	25.86
	P3	8.17	2.75	3.306	2.114	25.875
	P4	8.94	3.27	3.738	1.932	21.61
Average		8.4175	2.7975	3.442	2.178	25.98075
T1	P1	8.1	2.43	3.33	2.34	28.888
	P2	8.26	2.49	3.549	2.221	26.888
	P3	7.74	2.53	3.66	1.55	20.025
	P4	8.71	3.12	3.73	1.86	21.354
Average		8.2025	2.6425	3.56725	1.99275	24.28875

APPENDIX-X

Effect of treatment and period on average daily Ca balance in experimental kids (g/kid)

Treatment	Period	Intake	Out go		Balance	Retention percentage of intake
			Faeces	Urine		
T1	P1	1.91	0.76	0.056	1.094	57.277
	P2	1.98	0.82	0.064	1.096	55.353
	P3	2.29	0.92	0.102	1.268	55.371
	P4	2.04	0.95	0.09	1	49.019
Average		2.055	0.8625	0.078	1.1145	54.255
T2	P1	2.36	0.91	0.096	1.35	57.203
	P2	2.67	1.02	0.112	1.538	57.6
	P3	3.03	1.1	0.131	1.839	60.69
	P4	2.85	1.3	0.176	1.374	48.21
Average		2.7275	1.0825	0.12875	1.52525	55.92575
T3	P1	3.31	1.15	0.101	2.059	62.205
	P2	3.57	1.25	0.133	2.187	61.26
	P3	4	1.25	0.148	2.602	65.05
	P4	4.06	1.47	0.168	2.422	62.034
Average		3.735	1.28	0.1375	2.3175	62.63725
T1	P1	3.53	1.29	0.124	2.116	59.943
	P2	3.34	1.53	0.234	1.576	47.185
	P3	4.34	1.29	0.2	2.85	65.668
	P4	2.71	1.57	0.192	0.948	34.981
Average		3.48	1.42	0.1875	1.8725	51.94425

APPENDIX-XI
Effect of treatment and period on average daily P balance in experimental kids (g/kid)

Treatment	Period	Intake	Out go		Balance	Retention percentage of intake
			Faeces	Urine		
T1	P1	0.96	0.3	0.033	0.627	65.31
	P2	1.05	0.32	0.047	0.683	65.047
	P3	1.1	0.36	0.065	0.675	61.363
	P4	0.9	0.38	0.074	0.446	49.555
Average		1.0025	0.34	0.05475	0.60775	60.31875
T2	P1	0.96	0.45	0.064	0.446	46.4
	P2	1.06	0.51	0.074	0.476	44.905
	P3	1.11	0.55	0.093	0.467	42.072
	P4	0.96	0.65	0.11	0.2	20.833
Average		1.0225	0.54	0.08525	0.39725	38.5525
T3	P1	1.11	0.65	0.055	0.405	36.486
	P2	1.3	0.71	0.08	0.51	39.23
	P3	1.16	0.71	0.083	0.367	31.637
	P4	1.32	0.84	0.101	0.379	28.712
Average		1.2225	0.7275	0.07975	0.41525	34.01625
T1	P1	1.09	0.81	0.065	0.215	19.724
	P2	1.17	0.9	0.101	0.169	14.444
	P3	1.25	0.83	0.128	0.292	23.36
	P4	0.9	0.81	0.077	0.013	1.444
Average		1.1025	0.8375	0.09275	0.17225	14.743

VITA

Damodhar Narayanrao Maske was born on 12th March, 1950 at Raipur, Taluka and District Parbhani. He was graduated in Agril. Science from Marathwada Agricultural University, Parbhani in 1972 and postgraduated in 1974-75 in Animal Husbandry and Dairying from Marathwada Agril. University, Parbhani, Maharashtra. He served as Dairy Manager (25.10.1975 to 12.9.1977), Lecturer in Animal Husbandry (13.9.1977 to 1982), Asstt. Professor (1982 to 1984), Livestock Improvement Officer in National Demonstration Scheme (1984 to 1986) and thereafter as Farm Superintendent (1986 to 2000) at central Farm, MAU, Parbhani. He joined Ph.D. (part time) in 1997. Presently he is working as Asstt. Professor AHD, Agriculture College, MAU, Parbhani.