

**EFFECT OF FEEDING CRUSHED TAMARIND  
(*Tamarindus indica*) SEED ON GROWTH  
PERFORMANCE OF GROWING CALVES**

**THESIS**

**Submitted to  
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola  
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**MASTER OF SCIENCE  
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AGRICULTURE  
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## **DECLARATION OF STUDENT**

I hereby declare that the experimental work and its interpretation of the thesis entitled “**EFFECT OF FEEDING CRUSHED TAMARIND SEED ON GROWTH PERFORMAMANCE OF GROWING CALVES**” or part thereof has neither been submitted for any other degree or diploma of any university, nor the data have been derived from any thesis / publication of any university or scientific organization. The sources of material used and all assistance received during the course of investigation have been duly acknowledged.

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Date: / /2018

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## CERTIFICATE

This is to certify that the thesis entitled “**EFFECT OF FEEDING CRUSHED TAMARIND SEED ON GROWTH PERFORMAMNCE GROWING CALVES**” submitted in partial fulfilment of the requirement for the degree of “**Master of Science in Agriculture** in the discipline **Animal Husbandry**, Department of **Animal Husbandry and Dairy Science**” Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola is a record of bonafide research work carried out by **TAYDE RAHUL HARIDAS** under my guidance and supervision.

The subject of thesis has been approved by the Student’s Advisory Committee.

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**Place: Akola.**

**Date : / /2019**

**(TAYDE RAHUL HARIDAS)**

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## (D) List of Abbreviations

%	-	Per cent
@	-	at the rate of
°C	-	Degree Celsius
/	-	Per
Adlib	-	Adlibitum
ADG	-	Average daily gain
BW	-	Body weight
cm	-	centimeter
CD	-	Critical difference
CF	-	Crude fiber
CP	-	Crude protein
DCP	-	Digestible crude protein
DM	-	Dry matter
DMI	-	Dry matter intake
EE	-	Ether extract
et al.	-	et alia (and others)
Fig.	-	Figure
g	-	gram
i.e.	-	That is
Kg	-	kilogram
lit.	-	liter
ml	-	milliliter

NFE	-	Nitrogen free extract
No.	-	Number
NRC	-	National Research Council
NS	-	Non-significant
OM	-	Organic matter
SE (m) <sub>±</sub>	-	Standard error of means
Sig.	-	Significant
TDN	-	Total digestible nutrients
Viz.	-	Namely
FM	-	Fishmeal
BG	-	Brewer grain
CSM	-	Cottonseed meal

**(F) THESIS ABSTRACT**

- a. Title of the thesis** : “EFFECT OF FEEDING CRUSHED TAMARIND SEED ON GROWTH PERFORMANCE OF GROWING CALVES”
- b. Name of student** : TAYDE RAHUL HARIDAS
- c. Name and Address of Major Advisor** : **Dr. K.U. BIDWE**  
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**ABSTRACT**

The study entitled “Effect of feeding crushed tamarind seed on growth performance of growing calves” was conducted for period of 90 days. Twenty growing calves were divided into five groups on the nearness of age and weight. Four feeding treatments were studied namely T<sub>1</sub> (Dry

roughages + Green fodder + Concentrate), T<sub>2</sub> (Dry roughages + Green fodder + 80% Concentrate + 20 % crushed tamarind seed), T<sub>3</sub> (Dry roughages + Green fodder + 60% Concentrate + 40 % crushed tamarind seed), T<sub>4</sub> (Dry roughages + Green fodder + 40% Concentrate + 60 % crushed tamarind seed).

It was observed that the concentrate offered to the calves during experiment period by mixing with crushed tamarind seed were containing 90.20, 18.55, 6.44, 6.8, 60.98 and 7.23 per cent of DM, CP, EE, CF, NFE and Total ash, respectively.

Daily DM intake differed significantly between the treatments. The calves from T<sub>3</sub> groups consumed more DM than that of T<sub>4</sub>, T<sub>2</sub> and T<sub>1</sub> calves groups. The average daily DM intake was 1.96, 2.01, 2.08 and 1.99 kg/day/calves in T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> groups respectively. This trend thus indicated that there was increase in the daily DM intake when a crushed tamarind seed was incorporated as concentrate in the rations of calves. Weight gain per day per calves was found higher in treatment T<sub>3</sub> (60 % concentrate + 20 % crushed tamarind seed).

All the calves exhibited satisfactory growth rate of 0.238 to 0.296 kg per day and differences were significant. The per kg gain of body weight was higher in T<sub>3</sub> treatment. It was over experimental result, the treatment T<sub>3</sub> showed better and desirable result as compared with T<sub>1</sub>, T<sub>2</sub> and T<sub>4</sub> treatment. Therefore feeding cost was desirable (Rs.561.69) in T<sub>2</sub> treatment. Growth rate was higher in calves when fed 60% concentrate mixture with 40 % crushed tamarind seeds in treatment T<sub>3</sub> group than other group of treatment T<sub>1</sub>, T<sub>2</sub> and T<sub>4</sub> respectively.

# CHAPTER I

## INTRODUCTION

### 1.1 Background Information

India is an agricultural country and livestock plays an important role in Indian agriculture. About 70% of the total population are engaged in agriculture and rearing livestock mainly, cattle and buffaloes are maintained by all sections of society irrespective of their caste and income level. In all the livestock, dairy animal is known as an efficient producer of foods for human being. In India, dairy industry contributes major economic role. Agro-industrial production decides the socio-economic status of the country.

Agriculture and livestock go side by side for the upliftment of Indian farmers. Livestock industry has tremendous potential to provide employment and income to rural people. Livestock ecosystem have been main stay of agriculture industry along with food for man, milk for diet and motive power for activation and transport. Hence, Animal Husbandry forms the backbone of rural economy especially when there is failure of monsoon.

India is messed with huge bovine population of 199.9 million cattle and 108.7 million buffaloes accounting for about 47 per cent of Asia and 17 per cent of world's bovine population (Anonymous 2012).

Tamarind (*Tamarindus indica* L.) belong to family Fabaceae, is popularly known as 'Indian Date' that originated from India and is widely distributed in Africa and Asia. It is highly cross pollinated crop with a wild variation in species and the number of genotypes are estimated to be 19,327.

The species has a wide geographical distribution in the subtropics and semi-arid tropics and is cultivated in numerous regions. It is a multipurpose tropical fruit tree used primarily for its fruit, which are eaten fresh or processed, used for seasoning or as a spice. India is the largest producer of tamarind with an annual production of over 3,00,000 tonnes

most of which are locally consumed and 11,500 tonnes are exported to Europe and North American country.

Tamarind is a perennial, slow growing evergreen tree, up to 20-30 m tall and with a thick upright trunk. The bright foliage with a dense spreading crown makes it an attractive shade tree that can be used for fodder during the dry season. The tree is highly tolerant to drought and grows in a wide range of agro-climatic condition. Tamarind is cultivated for its valuable fruit pulp which is slightly sweetish and more acidic in nature and is widely used as a spice. The pulp is rich in ascorbic and tartaric acids hence, used as a preservative in the pickle industry. The tree also provides valuable wood and medicinally the leaves and fruit pulp are used as anti-inflammatory agent against leucorrhoea and skin disorders. The fruits are pods 5-10 cm long and 2 cm broad, oblong, curved or straight with rounded. The pod has an outer epicarp which is light grey or brown and scaly which is firm within but soft pulp is traversed by formed seed cavity which contain seed. Each pod contains 1-12 seeds which are flattened, glossy, orbicular to rhomboid. Seed are hard, red to purple brown, non arillate and ex-albuminous. Seed chamber are lined with a parchment like membrane.

Tamarind seed comprises of seed coat or testa 20-30% and the kernel or endosperm 70-75%. Tamarind seed is the raw material used in the manufacture of tamarind seed kernel power, polysaccharide adhesive and tannin. Tamarind seed are important source of protein and valuable amino acid. Whole tamarind seed and kernels are rich in protein i.e. 13-20% and the seed coat in fiber 20% and tannin 20%. Seed contains 131.3 g/kg crude protein, 67.1 g/kg crude fiber, 48.2 g/kg crude fat, 56.2 g/kg tannin and trypsin inhibitor activity of 10.8, with most of the carbohydrate in the form of sugar. Tamarind seed are reported as a source of food ingredient due to the presence of protein. The seeds are rich in cystine and methionine but threonine and tryptophan are limiting. Tamarind has a very good balance of essential amino acid and nitrogen free extract comprises of 15.5% and 59% of seed respectively.

The nutritive value of tamarind seed hull has been reported by various scientists. The inadequate supply of conventional feed both quantitative and qualitative is one of the major limiting factor for the efficient animal production. Unconventional feedstuffs are not fully utilized due to inadequate information. Formulation of compound animal feed and their utilization by the non-conventional feed resource is required because of rising cost of conventional feed stuff and deficit supply. Therefore, a study was undertaken to know the effect of different dietary inclusion of tamarind seed in the ration on the performance of calves.

## **1.2 Importance and need of the study**

The Vidarbha region comprises of eleven districts having different climatic zones and different cropping pattern. The region provides number of cattle; however the constraints like summer temperature, non-availability of irrigation facilities for growing fodder crop have given at setback for improvement of dairy industry in this region. Thus, the low productivity of animal is on account of under feeding and lack of knowledge for balanced feeding. Even though some farmers are feeding concentrates but they do not have the knowledge about quality.

The use of nutritious green fodder rich in vitamins, minerals and protein will not only increase milk production but also help further to raise the efficiency of working animals and will provide comparatively faster growth rate to the young calves.

The term nutritional requirement is defined as the amount of nutrient that must be supplied in the ration to meet the need of normal healthy animal, our cattle on the whole are so badly under fed that no improvement in the milk production can be affected unless the feeding condition to a great extent. Malnutrition is perhaps the greatest single factor responsible for the degeneration of livestock.

Nutrition is one of the important aspects which influences livestock production. The most important nutrient required by the animals are protein, carbohydrates, fat, water, mineral and vitamins. Each class of these nutrient performs one or more function in the body. Proteins are

essential for growth, for repairing wear and tear of the tissues and are responsible for formation of muscular tissues, skin and blood cells. Carbohydrates are the chief source of energy in the animal body and maintained body temperature. Water is essential for physiological function such as digestion, absorption of nutrients and elimination of undigested nutrient. It also regulates body temperature. Minerals form approximate 4 to 5 percent of the weight of matured cattle. They are essential for promoting cell activity in the tissues and aids in digestion. Vitamins are essential for the life and health of the animals. In their absence animal suffer from disease such as poor growth, rickets, deformed bones and teeth. Therefore a balanced ration must be given to the animals to fulfil the requirement of the nutrient for maintenance and production.

Balanced feeding is another necessity. It has been observed that animal in certain region are suffering from various mineral disease. There are instances where animal do not grow and perform well even after feeding adequately due to nutritional imbalance. Therefore, it is beneficial to analyze available feed and fodder and prepare a feed schedule, balancing the entire beneficial nutrient. Such effort in planned feeding of the animals will not only enhance the production and profit but also reduce feed shortage.

It is therefore, proposed to undertake the present investigation on “Effect of feeding crushed tamarind seed on the growth performance of growing calves.”

### **1.3 Objectives**

- 1) To find out the optimum level of tamarind seed.
- 2) To assess the chemical composition of different feeds.
- 3) To study the growth performance of calves.
- 4) To work out economics of feeding.

### **1.4 Hypothesis**

India has very large livestock population but that population does not get a balance diet. Therefore we are not in position to satisfy the

daily requirement of an animal. The use of crushed tamarind seed can improve the growth of calves. Tamarind whole seed contains useful amount of crude protein up to 22.20 percent and seed nut contains crude protein 21.25 percent (Yusuf, *et al.* 2007).

Tamarind is rich in dietary fibre contains low cholesterol which helps in digestion and is a great natural appetizer. The polyphenols in tamarind have antioxidant and anti-inflammatory properties. Therefore, the present investigation has been undertaken to evaluate the “Effect of feeding crushed tamarind seed on the growth performance of growing calves.”

### **1.5 Scope and limitations**

The result of the present study is scope for judicious feeding to animals on one hand and maintaining their productivity on the other hand. Considering this aspect it seems necessary to utilize the fodder resources very carefully so as to fulfil the requirement of animals. Therefore by selecting the calves, they would be feed with known quantity of feeds and fodder on the basis of performance of calves assessment for feeds and fodder would be judged.

Crushed tamarind seeds are economic and efficient feed substitute for livestock, because of its high protein and low lignin content it becomes easily digested by livestock. In the present situation due to scarcity of good quality feeds and fodder, it has become very difficult to rear such type of valuable animal for efficient production. Tamarind seed is an ideal feed substitute for almost all animals and it is available at low price in market.

## **CHAPTER II**

### **REVIEW OF LITERATURE**

Balanced feeding is required for maintaining health and production of dairy animal. However, presently majority of the livestock is maintained under the system called grazing on field boundaries and forest areas. Under this approach nobody knows whether the animal received the diet up to their appetite or the intake of required nutrients to the body. In the view of this, it is necessary to have the information on the feeding practices of the animal so as to ascertain their nutritional requirement. Because of this, requirement of concentrates in this country is much greater than in other advanced countries. The present investigation is planned to investigate the effect of feeding crushed tamarind seed on the growth performance of calves. The related research work has been reviewed in this chapter under the following heads.

2.1 Chemical composition of feed stuffs.

2.2 Feed intake

2.3 Dry matter intake

2.4 Water intake

2.5 Body weight

2.6 Body measurement

2.7 Feeding cost

#### **2.1 Chemical composition of feed stuffs**

Calves feed on different types of feed. They feed on the concentrate, dry roughages i.e. soybean straw, red gram straw, gram straw etc. also feed on green roughages i.e. berseem, napier etc.

##### **2.1.1 Chemical composition of dry roughages**

Shelar (2004) studied the effect of feeding of soybean straw on growth performance of crossbred heifers. The average chemical

composition of SBS was 91.02 % DM and 7.04, 41.20, 38.29, 1.52 and 11.80 % CP, CF, NFE, EE, and TA on DM basis respectively.

Kamble (2006) compared the chemical composition of soybean straw with jowar straw and concentrate. The nutrient contents of different feed stuffs on DM basis were as follows.

<b>Name of feeds</b>	<b>DM</b>	<b>CP</b>	<b>EE</b>	<b>NFE</b>	<b>CF</b>	<b>TA</b>
Jowar straw	86.40	2.15	1.62	46.63	41.40	8.20
Soybean straw	88.60	5.12	2.36	39.08	42.19	10.98
Concentrate (Sugras)	90.10	17.34	8.62	55.20	11.84	3.91

Baswade *et al.* (2007) reported that the soybean straw contained 89.15, 7.75, 38.30, 1.19, 39.82 and 12.97 per cent DM, CP, CF, EE, NFE and total ash, respectively on DM basis. Whereas, the bajra straw contained 92.52, 3.90, 38.10, 1.70, 50.08 and 6.22 per cent DM, CP, CF, EE, NFE and ash, respectively.

Bansod (2008) found that the chemical composition of soybean straw and other feed stuffs on dry matter basis was as follows.

<b>Name of feeds</b>	<b>DM</b>	<b>CP</b>	<b>EE</b>	<b>NFE</b>	<b>CF</b>	<b>TA</b>
Jowar straw	89.25	3.70	2.89	52.46	32.45	8.50
Soybean straw	87.70	5.30	2.60	36.70	45.42	9.98
Hybrid Napier	29.23	5.77	2.50	49.22	27.25	15.26
Concentrate (Sugras)	90.13	17.32	5.25	61.69	11.84	3.90

Chopade *et al.* (2010) reported that the chemical composition of untreated soybean straw and urea treated soybean straw were 87.90 and 87.38, 8.75 and 12.13, 39.30 and 36.92, 1.50 and 1.74, 12.10 and 12.62, 37.48 and 37.33, 53.33 and 52.64, 35.67 and 32.12 and 16.24 and 12.55 per cent for DM, CP, CF, EE, TA, NFE, NDF, ADF and lignin, respectively.

Mule *et al.* (2008) reported values of soybean straw as 88.45, 7.88, 38.10, 1.25, 38.99 and 13.78 per cent DM, CP, CF, EE, NFE and Total ash, respectively.

Naser *et al.* (2011) studied the chemical composition of soybean straw for Dry Matter (DM), Crude Protein (CP), Ether Extract (EE), Organic Matter (OM), Neutral Detergent Fibre (NDF), Acid Detergent Fibre (ADF) and Acid Detergent Lignin (ADL) of pooled samples were 89.18, 5.10, 2.85, 96.90, 80.80, 63.20 and 13.00%, respectively.

Dongare (2018) studied the effect of feeding tamarind crushed seed on the growth performance of osmanabadi goat kids and reported that chemical composition of soybean straw as DM, CP, EE, CF, NFE and total ash were 87.62, 6.13, 2.51, 44.21, 37.29 and 9.86 percent respectively.

### **2.1.2 Chemical composition of green roughages**

Agrawal *et al.* (2002) revealed the microbial status and rumen enzyme profile of crossbred calves fed on different microbial feed additives. Four groups of newly born crossbred calves (average body weight 23.5 kg) were reared on green Berseem and calf starter which was devoid of cereal grains.

Mandal and Banerjee (2009) conducted an experiment on the nutritive value of Berseem at higher ages using Garole sheep as an experiment material. The chemical composition of experimental fodder showed that it contained 14.5, 19.7, 1.2, 51.9 and total ash 12.7 percent CP, CF, EE, NFE, and total ash respectively.

Sonone (2016) studied that Subabul seed, soybean straw, hybrid Napier and concentrate were containing 30.00, 87.62, 29.75 and 91.12 DM respectively. The Subabul seed was containing 24.98 to 36.39, 18.09 to 27.57, 2.59 to 5.88, 46.70 to 59.91, 10.23 to 17.23 and 7.49

to 10.90 per cent CP, EE, NFE, CF and ash while soybean straw was containing 6.13, 2.51, 37.29, 44.21, 9.86 per cent, CP, EE, NFE, CF and Ash respectively. The contents of nutrients in hybrid napier was 5.77, 2.50, 49.22, 26.28 and 16.23 per cent CP, FE, NFE, CF and Ash respectively. similarly the contents of nutrient in concentrate were 17.34, 5.27, 61.74, 11.84 and 3.81 per cent CP, EE, NFE, CF and Ash respectively.

### **2.1.3 Chemical composition of concentrate**

Adangale *et al.* (2009) observed that the concentrate contains DM, CP, CF, EE, NEF and ash as 90.18, 19.17, 10.46, 3.42, 51.55 and 5.58 percent respectively and chemical composition of jowar straw DM, CP, CF, EE, NEF and ash was 90.82, 90.74, 2.72, 6.68, 35.04, 41.70, 2.42, 1.51, 38.96, 28.03 and 12.26, 11.68 percent respectively.

Pachauri *et al.* (2010) reared the female crossbred heifer on Wheat straw and concentrate mixture (conventional system, T<sub>1</sub>), wheat straw based total mixed ration (WSTMR, T<sub>2</sub>) and urea ammoniated Wheat straw bases mixed ration (AWSTMR, T<sub>3</sub>). The composition of different rations indicated that they were nutritionally sufficient for the feeding of growing crossbred heifer. The chemical composition of rations on DM basis was 11.46, 12.38 and 14.18 per cent CP, 22.78, 21.25 and 20.78 per cent CF with 87.79, 87.70 and 87.42 per cent DM for T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> rations, respectively.

Hembade (2014) conducted trial on Nutrient Digestibility and Growth in Crossbred (HF × Deoni) Calves Fed on Shevra (*Alysicarpus rugosus*) Hay in Replacement of Concentrate Mixture Fifteen crossbred (HF × Deoni) calves (Age - 183 to 323 days, Av. B. Wt. - 80.50 kg) were randomly distributed into 3 groups of 5 animals each. Shevra hay was used in place of concentrate mixture to replace 50, 65 and 80 per cent of its CP in treatments T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>, respectively. Thereby contributing 25, 32.5 and 40 per cent of dietary CP. Replacing concentrate mixture on nitrogen basis by Shevra hay hasn't any adverse effect on the daily live weight gain or body measurements like height, length or chest girth in calves. The animals in T<sub>1</sub> and T<sub>2</sub> groups gained higher body weight with less amount of feed

consumed followed by T<sub>3</sub> group. Shevra hay could be incorporated safely to provide up to 32.5 per cent of CP in the diet of calves.

Mawal (2015) also reported that jowar straw, soybean straw, hybrid Napier and concentrate were containing 90.23, 87.62, 29.75 and 91.12 DM respectively. The jowar straw was containing 3.74, 2.84, 51.52, 32.48 and 9.42 per cent CP, EE, NFE, CF and ash while soybean straw was containing 6.13, 2.51, 37.29, 44.21, 9.86 per cent, CP, EE, NFE, CF and ash respectively. The contents of nutrients in hybrid napier containing 5.77, 2.50, 49.22, 26.28 and 16.23 per cent CP, FE, NFE, CF and Ash. The contents of nutrient in concentrate were 17.34, 5.27, 61.74, 11.84 and 3.81 per cent CP, EE, NFE, CF and Ash.

Wandhare (2018) analysed and reported that the chemical composition of concentrate were containing 90.20, 18.55, 6.44, 60.98, 6.80, 7.23 percent DM, CP, EE, NFE, CF and total ash respectively.

#### **2.1.4 Chemical composition of tamarind**

Bhatta *et al.* (2000) conducted an experiment on the effect of feeding of tamarind (*tamarindus indica*) seed husk (TSH) as a source of tannin on dry matter intake (DMI), digestibility, N balance, milk yield and milk composition in cross bred dairy cows in mid lactation. The cows were divided into three groups having three cows in each group. The animals of group I (GP1) received a compounded feed mixture (CFM) without tamarind seed husk (control group), group II (GP-II) CFM with 2.5 per cent TSH and group III (GP-III) CFM with 7.5 per cent TSH. The diet consisted finger millet straw (FMS) and CFM. There was significant difference in body weight gain ( $P < 0.05$ ) between GP-I and GP-III. Although there were significant difference among the group in faecal N ( $P < 0.05$ ) and urinary N ( $P < 0.01$ ) excretion. The nitrogen balance was similar. There was non-significant ( $P > 0.05$ ) difference among the three groups in CP digestibility, whereas, the digestibility of other nutrients were similar. It was concluded that TSH tannin at low concentration has beneficial effect on the performance of crossbred lactating cows.

Ravi *et al.* (2000) reported that the proximate chemical composition of water soaked tamarind seed includes CP, EE, CF, NFE, TS tamarind were 17.23, 3.89, 2.77, 72.90, 3.22 percent respectively.

Yusuf *et al.* (2007) studied the Proximate composition of whole seed and seed nut of *Tamarindus indica* (% Dry matter basis ) and calorie (Kcal/100g) as following

Parameter	Whole seed	Seed nuts
Moisture	11.75	19.90
Dry matter	88.25	80.1
Ash content	7.35	9.51
Organic matter	92.65	90.49
Carbohydrate	17.10	8.9
Crude lipid	11.43	6.94
Crude fibre	3.82	2.33
Crude protein	22.20	21.25
Caloric value	210.90	122.41

Sahoo *et al.* (2010) reported that chemical composition of whole tamarind seed as moisture, protein, fat, crude fibre, carbohydrate, total ash, nitrogen free extract was comprises of 9.4, 13.3, 4.5, 7.4, 50.0 and 1.60 percent respectively.

Balaji *et al.* (2013) determined feeding value of decorticated tamarind seed meal (DTSM) for broilers. DTSM a by-product of tamarind pulp industry had the nutrient (%) like crude protein-16.58, crude fibre-2.27, ether extract-7.84, total ash- 3.59, calcium 0.34, phosphorus-.29, methionin-0.17, nicotinic acid-0.17 mg/g and tannin 0.40%.

Johanis ly *et al.* (2017) observed that enriching nutrient value of tamarind seed by *saccharomyces cerevisiae* fermentation proximate analysis showed that tamarind seeds kernel flour contains crude protein 16.2%, fat 7.06%, crude fiber 17.7%, nitrogen free extract (NFE) 57.88% and ash 1.16%.

Ling wang *et al.* (2017) studied effect of feeding tamarind kernel powder extract residue on digestibility, nitrogen availability and ruminal fermentation in wethers, the digestibility of DM, crude protein, and ether extract (EE) of TKPER-R diet were 57.0%, 87.0% and 86% respectively.

Dongare (2018) reported that chemical composition of soybean straw as DM, CP, EE, CF, NFE and total ash were 87.62, 6.13, 2.51, 44.21, 37.29 and 9.86 percent respectively. Also berseem contain asDM, CP, EE, CF, NFE and total ash were 20.50, 14.50, 1.20, 19.70, 51.90 and 12.70 percent respectively. The nutritive value of concentrate and tamarind seed contain was 89.70 and 88.25 DM, 19.70 and 22.20 CP, 12.30 and 7.63 EE, 5.25 and 3.82 CF, 58.51 and 59.00 NFE and 4.15 and 7.35 total percent respectively.

## **2.2 Feed intake**

Rajmane and Deshmukh (2000) observed the DMI of 615.924 and 829 g/d and DMI per 100 kg BW as 2.19, 3.33 and 2.75 kg, respectively for three complete rations containing sorghum straw (CR<sub>1</sub>). Soybean straw (CR<sub>2</sub>) and corn cobs (CR<sub>3</sub>) each at per cent level and concentrate mixture at 40 per cent level in osmanabadi goats.

Tripathi and Sharma (2002) observed that, 25 percent concentrate could be saved by feeding urea treated straw without adversely affecting the growth rate in crossbreed heifers. They offered crossbreed heifers with untreated maize stover (T<sub>1</sub>) and the urea treated maize stover and concentrarte mixture to meet 75 & 50 percent NRC requirement.

Deshmukh *et al.* (2004) studied the effect of feeding of gliricidia (*Gliricidia maculata*) tree leaves on performance of growing crossbred heifers. The daily dry matter intake (DMI) was significantly ( $P < 0.01$ ) higher (3.43+or-0.18 kg) in group T<sub>2</sub> compared to T<sub>3</sub> (2.88+or-0.25 kg). Although there were no significant differences in digestibility coefficient among the dietary treatments, the values for DM (62.85+or-1.82%), CP (63.37+or-2.88%), CF (crude fibre, 58.86+or-0.90%) and NFE

(nitrogen-free extract, 72.34±1.36%) were higher in group T<sub>1</sub> than in groups T<sub>2</sub> and T<sub>3</sub>. However, the digestibility coefficient of EE (61.63±2.61%) was higher in T<sub>2</sub>. There was a significantly ( $P<0.05$ ) lower intake of digestible CP in groups T<sub>2</sub> (26.93%) and T<sub>3</sub> (29.62%) than T<sub>1</sub>. The total digestible nutrients (TDN) intake was higher ( $P<0.01$ ) by 28.18 per cent in group T<sub>2</sub> and was lower by 15.16 per cent in T<sub>3</sub> as compared to T<sub>1</sub>. In conclusion, *G. maculata* leaves may replace 25 per cent CP of conventional proteins in the diet of crossbred heifers.

Gupta and Tiwari (2005) observed that the heifers consumed  $3.42 \pm 0.22$ ,  $3.46 \pm 0.19$  and  $3.65 \pm 0.21$  kg dry matter per day in Groups 1, 2 and 3, respectively. The average dry matter intake (DMI) per 100 kg body weight, dry matter intake per kg metabolic body size, total digestible nutrients (TDN) and digestible crude protein (DCP) intake/ $W^{0.75}$  kg did not differ significantly among the 3 groups. The digestibility coefficient of organic matter (OM), crude protein (CP) and crude fibre (CF) was significantly ( $P<0.05$ ) higher in Group 3.

Jaglan and Kishor (2006) observed that heifers consumed higher DM on urea treated wheat straw complete diet. The DMI was 1.79, 2.04, 2.41, 2.50 and 2.73 kg/100 kg BW on feeding untreated wheat straw, 1.5 urea treated WS, 1.5 per cent urea treated straw + 0.5 per cent single super phosphate, 4 per cent urea treated straw and 4 per cent urea treated straw + 1.5 single super phosphate, respectively.

Bansod (2008) studied the requirement of Gaolao cows by offering jowar straw, soybean straw, green Hybrid Napier and concentrate mixture (sugras). The treatments were 100 per cent jowar straw with 5 kg Hybrid Napier and concentrate (T<sub>1</sub>) 50 per cent Jowar straw and 50 per cent soybean straw with 5 kg Hybrid Napier and concentrate (T<sub>2</sub>) and 100% soybean straw with 5 kg Hybrid Napier and concentrate (T<sub>3</sub>). The average daily intake of DM was 7.492, 8.390 and 8.28 kg/day/cow in T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> groups, respectively. It was noted that the daily DM intake was differing significantly between treatments. This trend indicated that there was increase in daily DM intake when soybean straw was fed as sole roughage

or incorporated as roughage with jowar straw in the ration of cow. The average per cent BW DM intake was 2.668, 3.089 and 3.089 kg in T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> treatments, respectively. The DM intake /100 kg body weight in T<sub>2</sub> and T<sub>3</sub> was found more by 15.78 per cent over that of the intake in T<sub>1</sub> group.

Adangale *et al.* (2009) studied the effect of feeding jowar straw in combination with soybean straw on the growth performance of crossbred calves. In T<sub>0</sub> control group 100 per cent jowar straw + concentrate were fed while T<sub>1</sub> group was maintained 50 per cent jowar straw + 50 per cent soybean straw + concentrate and T<sub>2</sub> group was fed with 100 per cent soybean straw + concentrate. The average DMI / 100 kg BW was 3.050, 3.262, and 3.178 kg under T<sub>0</sub> T<sub>1</sub> and T<sub>2</sub> group, respectively. The differences among the groups were non-significant. It was observed that the calves liked the soybean straw as dry roughage, hence could be fed alone or in combination with jowar straw to crossbred calves.

Mahto *et al.* (2010) studied that effect of tamarind (*Tamarindus indica*) feeding on feed intake and nutrient utilization in desi pigs. The experimental group T<sub>1</sub> served as control having 60% crushed maize as energy supplement, group T<sub>2</sub> 50% maize replaced with tamarind seed meal, group T<sub>3</sub> maize was completely replaced by tamarind seed meal. The chemical composition of ration all groups are almost similar percentage of CP, EE, NFE and OM calcium, phosphorus. However tannin and crude fiber content was higher in tamarind seed containing diet and its level is increased with the increased level of tamarind seed. Tannin containing in T<sub>1</sub>-00.50, T<sub>2</sub>-4.65, T<sub>3</sub>- 9.30 and crude fiber T<sub>1</sub>-4.45, T<sub>2</sub>- 5.32, T<sub>3</sub>-6.10 respectively.

Pachauri *et al.* (2010) observed the TDN and protein intake through both wheat straw total mixed ration and urea ammoniated WS mixed ration was higher than that recorded in conventional fed group which might be due to higher DM intake. Hence, urea ammoniation was found effective in improving the DMI in crossbred calves.

Yadav and Chaudhary (2010) offered each animal in all the groups were fed standard ration, comprising 5 kg green berseem (*Trifolium alexandrinum*) and wheat (*Triticum aestivum*) straw *ad lib.* and in treatment T<sub>1</sub> heifers were given untreated GNC, while in treatment T<sub>2</sub> and T<sub>3</sub> formaldehyde (FA) treated @ 0.5 g FA/100 g CP and FA treated @ 1.0 g FA/100 g CP, respectively, as a source of protein in the concentrate mixtures as per their requirements. The crude protein (CP) intake per 100 kg body weight was significantly ( $P < 0.05$ ) higher in T<sub>1</sub> as compared to T<sub>3</sub> group.

Shelke *et al.* (2011) studied the growth performance of cross bred heifers on feeding silage prepared from Sorghum and Gliricidia. The 20 heifers divided into five groups under control T<sub>1</sub> were fed sorghum (Jowar) + Gliricidia (100+0), T<sub>2</sub>- Sorghum (Jowar) + Gliricidia (75+25), T<sub>3</sub>- Sorghum (Jowar) + Gliricidia (50+50), T<sub>4</sub>- Sorghum (Jowar) + Gliricidia (25+75), T<sub>5</sub>- Sorghum (Jowar) + Gliricidia (0+ 100) It was shown that the palatability of T<sub>1</sub>- Sorghum (Jowar) + Giliricidia (100+0) was higher over other silage combination. The daily dry matter intake per 100 kg body weight of heifers was higher in T<sub>3</sub> followed by T<sub>5</sub> and T<sub>4</sub> treatment respectively.

Jamara *et al.* (2014) studied on effect of the fed shatavari (*Asparagus racemosus*) on body weight and puberty of sahiwal heifers and reported that the dry matter intake of the herifers was more ( $P < 0.05$ ) in treatment group heifer due to the saponin contents of shatavari.

### **2.3 Dry matter intake**

Rajmane and Deshmukh (2000) observed the DMI of 615, 924 and 829 g/d and DMI per 100 kg BW as 2.19, 3.33 and 2.75 kg respectively for three complete ration containing sorghum straw (CR<sub>1</sub>), soybean straw (CR<sub>2</sub>) and corn cobs (CR<sub>3</sub>) each at 60 per cent level and concentrate mixture at 40 per cent level in osmanabadi goats.

Sahu and Agrawal (2000) studied the effect of defaunation and two levels of protein on nutrient utilisation and growth of crossbred heifers. Showed that the Voluntary dry matter intake was higher

( $P < 0.05$ ) in the faunated group than in defaunated group. Defaunation increased ( $P < 0.05$ ) the apparent digestibility of DM, OM, CP and ADF. The digestibility of OM and CP was higher ( $P < 0.05$ ) in heifers fed sub optimal protein diet (67.62 vs 63.18 and 61.03 vs 52.99 per cent respectively).

Jagginavar *et al.* (2001) showed that the concentrate mixture and rain tree pods were offered in the ratio of 100:0 (Gr I), 75:25 (Gr II), 50:50 (Gr III) and 0:100 (Gr IV). The intake of DM and DCP were higher ( $P < 0.05$ ) in groups I and II over group IV.

Sharma (2003) observed effect of feeding oats, peas and sarson mixed fodder on growth and nutrient utilization in crossbred heifers. The dry matter intakes in  $T_1$  and  $T_2$  were  $2.625 \pm 0.17$  and  $3.676 \pm 0.09$  kg/100 kg body weight, respectively. The mean digestible crude protein (DCP) and total digestible nutrient (TDN) values were  $7.14 \pm 0.12$  and  $50.26 \pm 1.44$  per cent in  $T_1$ , and  $11.00 \pm 0.18$  and  $62.53 \pm 1.30$  per cent in  $T_2$ , respectively. The DCP and TDN intakes were significantly higher in  $T_2$  ( $11.50 \pm 0.57$  and  $65.42 \pm 3.51$  g/kg  $W^{0.75}$ , respectively) than in  $T_1$  ( $5.26 \pm 0.21$  and  $37.14 \pm 1.90$  g/kg  $W^{0.75}$ , respectively).

Pathak *et al.* (2005) showed that the highest (3.72 kg/100 kg body weight) and lowest (2.88 kg/100 kg body weight) DMI were recorded in urea treated bald wheat straw diet and concentrate mixture in  $T_4$  and  $T_3$  respectively. Digested dry matter intake values were 67.93, 66.80, 53.74 and 75.93 g/kg wt for  $T_1, T_2, T_3$  and  $T_4$  respectively. The straw DMI was 52.93, 68.83, 66.01 and 77.90 g/kg for  $T_1, T_2, T_3$  and  $T_4$  respectively.

Adangale *et al.* (2009) reported that the digestibility of dry matter in crossbred calves under treatment  $T_1$  (56.77%) was significantly ( $P < 0.05$ ) superior over treatment  $T_0$  (55.75%) and  $T_2$  (55.35%).

Singh *et al.* (2009) fed sixteen crossbred heifers were divided into four groups of 4 each for 120 days. The feeding  $T_1$  0kg maize green fodder,  $T_2$  5 kg maize green fodder,  $T_3$  10 kg maize green fodder, and  $T_4$  15 kg maize green fodder supplementation with wheat straw (*Triticum aestivum*) adlib. and concentrate mixture as per requirement. Daily DMI was significantly higher ( $P < 0.05$ ) in  $T_4$  as compared to  $T_2$  and  $T_1$  groups.

The DMI per kg metabolic body size was significantly ( $P<0.05$ ) higher in  $T_4$  and  $T_3$  as compared to  $T_1$  group.

Ikhar *et al.* (2011) studied on effect of different feeding regimen on growth and reproductive performance of sahiwal heifer; eighteen sahiwal heifers (2.5-3 year,  $170.55 \pm 19.02$  kg b. wt.) were randomly divided into three groups. Heifers in control ( $T_1$ ) group were fed concentrate mixture as per their nutritional requirement along with wheat straw ad libitum, whereas those in group  $T_2$  and  $T_3$  were fed same diet except that the supply of DCP and TDN were only 80 per cent and 70 per cent of requirement recommended by ICAR (1998), respectively. Reduced level of dietary DCP and TDN did not affect DM intake.

Das *et al.* (2012) reported that the average daily dry matter intake (DMI) was higher in  $T_2$  and the values being 5.89, 6.34 and 5.93 kg in  $T_1$ ,  $T_2$  and  $T_3$ , respectively. DCP intakes in  $T_1$  and  $T_2$  were sufficient for daily gain of 600 g, while it was sufficient for 500 g only in  $T_3$ .

Iraira *et al.* (2012) observed that the concentrate intake and total dry matter intake of heifers fed with the CH feeding method were higher ( $P<0.01$  and  $P<0.05$ ) than when fed with TMR (5.1 and 5.3 v. 4.7 and 5.0 kg dry matter (DM)/day, respectively).

Jabbar *et al.* evaluated (2012) evaluating varying energy levels for optimum growth and early puberty in sahiwal heifers. Twenty sahiwal heifers (Age=12+or +2months and avg. Wt=125kg) were assigned to four dietary treatments having five animals on each treatment. Dry matter and protein intakes were similar ( $p<0.05$ ) across the dietary treatments.

Kahate (2012) offered urea untreated and urea treated soybean straw, green hybrid napier and concentrate mixture to the calves. Out of which, a restricted amount of green hybrid napier and concentrate mixture were given to the cows while; the calves has liberal opportunity of SBS. The intake of SBS in total feed intake under different treatment was recorded as 2.17, 2.42, 2.18 and 2.08 kg on feeding untreated SBS 1.0, 1.5

and 2.0 % urea treated SBS with higher urea levels decreased the DMI/unit body size in calves.

Mahesh *et al.* (2013) showed that the daily DM ( $P<0.05$ ), digestible crude protein ( $P<0.01$ ), and ME intakes were also higher ( $P<0.05$ ) in group T<sub>2</sub> with higher ( $P<0.05$ ) nitrogen (N) retention.

Mawal (2015) reported that the daily DM intake was differing significantly between the treatments. The cow from T<sub>3</sub> groups consumed more DM than that of T<sub>1</sub> and T<sub>2</sub> cow. The average daily intake was 8.086, 8.584 and 7.701 kg/day/cow in T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> groups respectively.

Lalit V. *et al.* (2016) studied eighteen male crossbreed ( Black Bengal × Beetal ) kids were randomly divided into three group of six each in completely randomized block design and fed three iso-nitrogenous diets. The average daily DM intake of kids ranged non-significant from  $415.92 \pm 9.30$  g (T<sub>1</sub>) to  $439.65 \pm 14.39$  g (T<sub>2</sub>). The DM intake was  $3.80 \pm 0.42$ ,  $3.81 \pm 0.42$  and  $3.88 \pm 0.59$  Kg/100 Kg body weight in the group T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> respectively. Digestibility of coefficient for DM, CP, CF, EE, NFE 69.17, 71.83, 71.33, 69.67, 74.17 percent respectively.

Sonone (2016) reported that average daily intake of dry matter was 2.29, 2.40, 2.21 and 2.07 kg per calves T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> treatment, respectively. It was noted that the daily DM intake was differing significantly between the treatments. The calves from T<sub>2</sub> groups consumed more DM than that of T<sub>1</sub>, T<sub>3</sub> and T<sub>4</sub> calves. The average daily intake was 2.29, 2.40, 2.21 and 2.07 kg/day/Calves in T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> groups, respectively. This trend thus indicates that there was increase in the daily DM intake when soybean straw was incorporated as roughage in the rations of calves.

Kumar *et al.* (2017) revealed that the daily intake was 2.32, 2.59 and 2.47 kg/day/calves in T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> groups respectively. Higher intake of DM per 100 kg body weight was noticed in treatment T<sub>2</sub> and lowest in T<sub>1</sub> and T<sub>3</sub>.

Dongare (2018) reported that the daily dry matter intake per 100 kg body weight of goat kids of treatment groups T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> were 3.40, 3.51, 3.94 and 3.45 kg respectively. It indicated that the supplementation of 41% tamarind crushed seed in treatment group T<sub>3</sub> improved the DM intake over the goat kids group of T<sub>1</sub>, T<sub>2</sub>, T<sub>4</sub> treatment.

## **2.4 Water intake**

Deshmukh (2000) studied the water intake in crossbred heifers. The water intake was 9.284, 8.546 and 8.046 lit. per day per heifer in control T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> respectively.

Tipare (2003) reported that average water intakes over an experimental period was 15.37, 13.14 and 12.14 lit. per day per heifer in treatment T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> respectively.

Shelar (2004) noticed that the daily water intake of the heifers did not differ significantly between the feeding groups. The heifers from T<sub>1</sub> group drunk slightly more water (9.445 litres) than that of T<sub>2</sub> (9.172) T<sub>3</sub> (9.245) and T<sub>4</sub> (9.364 litres). This trend indicated that the feeding of soybean straw slightly lowered the intake of water in treatment T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub>. The average water intake per 100 kg body weight was 11.08, 10.72, 10.886 and 11.011 litres per heifer per day in T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> respectively.

Yadav and Choudhary (2008) reported that the voluntary water intake (VWI) and total water intake (TWI) were significantly ( $P < 0.05$ ) influenced by the treatments.

Singh *et al.* (2009) observed that feeding different levels of green maize in the rations of crossbred heifers resulted in higher ( $p < 0.05$ ) amount of water intake per kg compared to supplemented group.

Tauqir *et al.* (2013) observed that the Urea molasses block supplementation significantly ( $p < 0.05$ ) increased feed and water intake in Sahiwal heifers.

More (2018) reported that the daily water intake of crossbreed calves differ significantly and that was 14.70, 16.50, 17.70, 15.50 lit for T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub> respectively.

## 2.5 Body weight

Obispo *et al.* (2001) noted the effect on daily gain of weight (kg) was significantly increased when supplemented with FM (0.59), BG (0.89) and CSM (0.69) compared with the control (0.13). Among these sources, the highest ADG ( $P < 0.01$ ) was observed with the BG treatment.

Gupta and Tiwari (2005) studied the effect of herbs as a feed additive on nutrient utilization and growth in crossbred heifers fed paddy straw based rations. The average total live weight gains during the growth trial in groups 1, 2 and 3 were 57.34 $\pm$ 1.89, 62.88 $\pm$ 0.63 and 70.58 $\pm$ 2.35 kg, respectively, and were significantly higher in group 3.

Adangale *et al.* (2009) reported that total body weight gain over an experiment period under 100 percent jowar, 50:50 percent combination to jowar, soybean, 100% soybean were 5.622, 5.889, 5.722 kg respectively. Combination treatment is superior over both but different were non significant. The combination effect of both the straw was increased the daily body weight gain under treatment were 0.201, 0.210, 0.204.

Das *et al.* (2012) showed that the TDN intake was significantly higher in T<sub>2</sub> than T<sub>1</sub> or T<sub>3</sub>. N balance (g/d) and daily live weight gain (g) was non- significantly higher in T<sub>1</sub> and T<sub>2</sub> than T<sub>3</sub>.

Tauqir *et al.* (2013) worked on effect of supplementing maize fodder with urea molasses block (UMB) on their feed intake and weight gain of sahiwal heifers. Animal in group A were offered maize fodder ad libitum without UMB (control), while the animals in group B, C and D were offered green fodder at 100, 75 and 50 per cent of their requirement with ad libitum UMB, respectively. Daily weight gain was significantly ( $p < 0.05$ ) higher for heifer in group B than those in groups A and C.

Jamara *et al.* (2014) investigate the effect of shatavari on growth and puberty; sixteen Sahiwal heifers were selected from the institute herd. The treatment group sahiwal heifers were fed shatavari @150 mg/kg BW/day once in morning. The body weight of the heifers

varied ( $P < 0.05$ ) between the group due to more feed intake ( $P < 0.05$ ) and increase in plasma GH levels ( $P < 0.05$ ). The incidence of puberty and age at first service was achieved earlier in the treatment group in comparison to control suggesting that shatavari could be fed to augment growth and puberty in sahiwal heifer.

Mawal (2015) observed that mean daily body weight gain was 0.045, 0.052 and 0.049 kg per day in  $T_1$ ,  $T_2$  and  $T_3$  treatment, respectively.

Sreedhar (2015) conducted study on growth performance of indigenous and crossbred calves under field conditions. Twelve each from indigenous and cross bred calves were selected for the present study. The average birth weight of indigenous and cross bred calves was  $23.39 \pm 1.23$  and  $25.27 \pm 1.54$  kg respectively. The mean body weight of indigenous calves and cross bred calves at 24 weeks of age was recorded as  $87.94 \pm 1.31$  and  $96.89 \pm 1.37$  kg respectively, which indicated faster growth of cross bred calves. The mean ADG of indigenous and cross bred calves were  $314 \pm 11.2$  and  $365 \pm 10.2$  g/day respectively. The maximum average daily gain was observed at 22-24 weeks in indigenous calves whereas in cross bred calves, peak ADG obtained at 12-14 weeks during 24 weeks of growth period. It was found that cross bred calves have grown faster as compared to the indigenous calves. Hence it can be concluded that in addition to genetic inheritance of cross bred calves, improved feeding and managerial practices that are being followed by the dairy farmers resulted higher body weight of the calves.

Sonone (2016) reported that the average final weight gain was highest in  $T_2$  followed by  $T_1$ ,  $T_3$  and  $T_4$  significantly lowest weight gain was recorded in  $T_4$  treatment i.e. only soybean straw feeding. Daily intake of DM was highest in the treatment  $T_2$  which had adequate amount of DCP and TDN to calves. This situation might have favoured the growth in calves. The average daily body weight gain was 0.203, 0.243, 0.160 and 0.110 kg/day/ calves in  $T_1$ ,  $T_2$ ,  $T_3$  and  $T_4$  treatment, respectively.

Dongare (2018) reported that the different treatments at the beginning of the feeding crushed tamarind seed had nearly the same body

weights which were 12.40, 12.60, 13.20, 13.00 kg in treatment groups T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> respectively. The difference in betwn the treatment in respect of initial total body weight was non-significant. The final body weights were recorded per kid at the end of experiment was 14.90, 15.60, 16.80, 16.28, kg in treatment groups T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> respectively.

## **2.6 Body measurements**

Zanton and Heinrichs (2007) while evaluating growth rate of heifers on high forage or high concentrate ration reported that high concentrate feeding improved body structure. The objective of this study was to evaluate high forage or high concentrate ration on growth of dairy heifers. The experimental diets were formulated having same ingredients but with 75 per cent forage or 75 per cent concentrate proportion. Results indicated that wither height and body length were higher (103 & 111 cm vs. 101 & 108cm) in heifers fed high concentrate comprising high dietary energy. The possible reason for this improvement might be due to factor that high concentrate diet might provide adequate dietary energy and other nutrients which may be lacking in high forage diet. Conclusively, the improvement in body structures in reviewed studies might be due to extra supply of energy than required for maintenance which may be utilized for growth of body height, length and girth.

Yadav and Choudhary (2010) studied the effect of feeding formaldehyde treated groundnut cake on dry matter intake, digestibility of nutrients and body measurements in crossbred heifers. The results revealed that the body measurement parameters were significantly ( $P < 0.05$ ) higher in T<sub>3</sub> group as compared to T<sub>2</sub> and T<sub>1</sub> except height in crossbred heifers.

Shelke *et al.* (2011) reported that the feeding of silage prepared from sorghum and gliricidia increases height, chest girth and length of heifers.

Jabbar *et al.* (2012) reported the heifers fed dietary level of ME 124 per cent of NRC acquired higher body length, height and heart girth as compared to those fed other dietary energy levels.

Wandhare (2018) studied the effect of feeding jowar straw in combination with soybean straw on the growth performance of crossbreed calves.

The results revealed that the body growth parameters were significantly higher in T<sub>3</sub> group as compared to T<sub>1</sub>, T<sub>2</sub>, and T<sub>4</sub> respectively.

## **2.7 Cost structure**

Ravi et al. (2000) studied the utilization on water soaked seed in diet of pregnant crossbred gilt. It was record that the cost of freed per kg weight gain was Rs. 406.89 and 332.41 for R<sub>1</sub> and R<sub>2</sub> respectively.

Kalbande and chainpure (2001) observed costs of feed (concentrate+ roughage) per kg gain in body weight for control ration C and experimental ration T<sub>1</sub> were Rs.39.44 and 32.55 respectively. The cost of experiment ration T<sub>1</sub> was higher (Rs.6.57) due to urea treatment of Jowar kadbi and inclusion of protein sources with high UDP level as compared to C (Rs. 6.18), but the significantly higher growth rate, digestibility of almost all the nutrients and efficiency of feed conversion contributed substantially to lower the cost of feed per kg gain in body weight in T<sub>1</sub> as compared to C.

Verma (2001) conducted a trial in crossbred growing heifers fed with complete feed containing crude protein at the level of 12 per cent (Group II) and 14 per cent (Group III) in complete feed I and II, respectively and compared the results with control (Group I). It was found that cost per kg weight gain (Rs.) 39.97, 27.71 and 29.28. Thus, it suggested that the complete feed containing 12 per cent crude protein can be successfully and economically used for feeding.

Kumar (2002) reported that the cost per kg body weight gain was 100 per cent less in 120 per cent NRC feeding level as compared to calves fed as per NRC recommendation.

Zanton and Heinrichs (2007) concluded that the limit feeding high concentrate diets does not need to be excluded as a management option and may offer an opportunity for heifer growers to reduce feed cost.

Adangale *et al.* (2009) observed that the cost per kg body weight gain was highest in treatment T<sub>0</sub> (Rs. 48.99) and followed by T<sub>1</sub> (Rs. 43.09) and T<sub>2</sub> (Rs. 39.11).

Singh *et al.* (2009) determined that the cost of feeding per kg live weight gain was lower in T<sub>4</sub> (Rs 24.90) followed by T<sub>3</sub> (Rs. 29.07), T<sub>2</sub> (Rs. 35.02) and T<sub>1</sub> (Rs.39.53) indicating live weight gain was cheaper by Rs. 14.63 in 15 kg green maize fed group (T<sub>4</sub>) then in the control group.

Ikhar *et al.* (2011) observed that the effect of different feeding regimes on economics of feeding in sahiwal heifers are as follows.

Avg. Feed cost/animal/d(Rs.)	31.29	26.30	23.39
Economics (Rs./kg gain)	69.5	72.0	88.9

Anjum *et al.* (2014) observed that the cost per kg of NRC ration fed was rupees (Rs.17.37); stair-step low energy ration was Rs. 13.06 and stair-step high energy ration cost was Rs. 20.12. Overall feed cost incurred on heifers fed on SSF was significantly lower (12%) than the heifers fed as per NRC requirement.

Lalit vijay *et al.* (2016) studied on the tamarind seed meal can be used in replace of wheat bran in the concentrated mixture of growing kid up to 1/3<sup>rd</sup> level (w/w) without any adverse effect. It was recorded cost of concentrated mixture per quintal for T<sub>1</sub>, (Rs.1540) was maximum followed by T<sub>2</sub> (Rs.1529) and T<sub>3</sub> (Rs. 1515).The cost of feed per kg live weight gain remained non-significant among three group.

Dongare (2018) reported that the total cost of feed per goat kid during the experimental period (60) days was Rs. 1296.60, 1310.20, 1327.4 and 1344.03 under T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, and T<sub>4</sub> group respectively. The corresponding values for feed cost per kg body weight gain were Rs. 518.64, 436.73, 368.72 and 409.76 in treatment T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, and T<sub>4</sub> group of kids, respectively. The cost of feeding/day/kid was 21.6, 21.83, 22.12 and 22.40 under T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, and T<sub>4</sub> group. T<sub>1</sub>, T<sub>2</sub>, and T<sub>4</sub> indicated that higher amount of feed intake by goat kids increased the cost of feeding, though

the cost feeding is higher in T<sub>3</sub> (132.40). But higher weight gain also observed in T<sub>3</sub> (3.60 kg), hence it is economical for farmer. But the cost of BW gain per kg per goat kid was observed Rs. 103.72, 87.34, 73.74, 81.95 in treatment T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, and T<sub>4</sub>. The cost of gain in BW per kg per kid was higher.

## CHAPTER III

### MATERIAL AND METHODS

The present investigation entitled “Effect of feeding crushed tamarind (*Tamarindus indica*) seed on the growth performance of growing calves.” was undertaken at Livestock Instructional Farm, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the year 2018-2019 for a period of 90 days. The material used and methods employed for this investigation are presented in the following pages under appropriate heads.

#### 3.1 Information about place of work

The Livestock Instructional Farm is located at Department of Animal Husbandry and Dairy Science, Dr. PDKV, Akola, which is one of the districts of ‘Vidarbha’ region in Maharashtra state. The environmental condition is one of the most dominant factors. It is therefore, necessary to describe the topographical and climatological situation of the place. Akola is located on the latitude of 22.41<sup>o</sup> and longitude of 77.02<sup>o</sup> East with height 307.4 meter above mean sea level.

#### 3.2 Selection of Calves

Twenty growing calves were selected. The calves were divided into four groups. Thus each group was consisted of five calves for the study. The detail of selected calves is tabulated in Table 1.

**Table 1. Selection of experimental Calves**

Group	Tattooing Number	Body weight At start of expt. (kg)	Average body weight (kg)
I	117	54	46.4
	230	48	
	669	40	
	857	44	



**T<sub>1</sub> Dry roughages + Green fodder + Concentrate**



**T<sub>2</sub> Dry roughages + Green fodder + 80%Concentrate + 20% Crushed tamarind seeds**



**T<sub>3</sub> Dry roughages + Green fodder + 60%Concentrate + 40% Crushed tamarind seeds**



**T<sub>4</sub> Dry roughages + Green fodder + 40%Concentrate + 60% Crushed tamarind seeds**

**Plate 1: Experimental calves**

II	855	50	<b>44.4</b>
	859	46	
	667	40	
	671	44	
	853	42	
III	668	54	<b>44.8</b>
	673	42	
	862	42	
	321	40	
	858	46	
IV	670	52	<b>45.2</b>
	316	46	
	507	42	
	860	40	
	856	46	

### 3.3 Methods adopted

#### 3.3.1. Allotment of treatments

The present experiment was conducted by randomized block design with 4 treatments as detailed below in Table 2.

**Table 2. Allotment of treatments in feeding trials**

Treatment	Details
T <sub>1</sub>	Dry roughages + Green fodder + concentrate.
T <sub>2</sub>	Dry roughages + Green fodder + 80 % concentrate + 20 % crushed tamarind seeds.
T <sub>3</sub>	Dry roughages + Green fodder + 60 % concentrate + 40 % crushed tamarind seeds.
T <sub>4</sub>	Dry roughages + Green fodder + 40 % concentrate + 60 % crushed tamarind seeds.

( **Note** : Dry roughages were fed ad.lib for all treatments.)



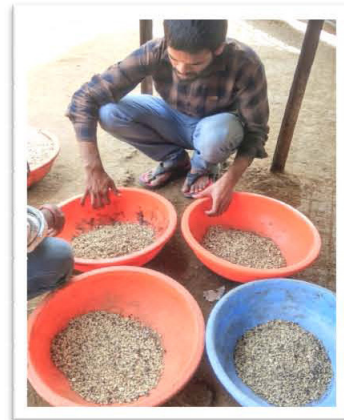
**Drying of tamarind seeds**



**Crushing of seeds**



**Concentrate**



**Mixing of crushed tamarind seeds with concentrate**

**Plate 2: Experimental Feeds**

**Table 3. Allotment of animals in treatments**

Treatment	Replication				
	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>
T <sub>1</sub>	117	230	669	857	854
T <sub>2</sub>	855	859	667	671	853
T <sub>3</sub>	668	673	862	321	858
T <sub>4</sub>	670	316	507	860	856

### **3.3.2. Preparation of experimental feeds**

The ingredients used for feeding of experimental growing calves were green fodder, dry roughages, concentrate and crushed tamarind seed in respective proportion according to the treatment.

100 per cent dry roughages, green fodder and concentrate were used for feeding in treatment T<sub>1</sub>. After that in each successive treatment concentrate is altered with the tamarind seed. 80 per cent concentrate and 20 per cent tamarind seed were used for feeding in combination with green and dry fodder in treatment T<sub>2</sub>. 60 per cent concentrate and 40 per cent tamarind seed were used for feeding in combination with green and dry fodder in treatment T<sub>3</sub>. 40 per cent concentrate and 60 per cent tamarind seed were used for feeding in combination with green and dry fodder in treatment T<sub>4</sub> respectively.

### **3.3.3. Watering of calves**

Fresh and clean water was provided to the experimental calves throughout the course of investigation. Animals were offered drinking water through measuring bucket twice daily at 9.30 a.m. and 3.30 p.m., daily water intake of each calves was recorded throughout the investigation period.

### **3.3.4. Management practices**

All the four groups of calves were kept under identical standard management practices. The calves were groomed twice daily at 9.30 a.m. and 3.30 p.m. They were washed daily at 9.30 a.m. after



**Watering of experimental calves**



**Feeding of experimental calves**

**Plate 3: Management of experimental calves**

watering and grooming, the calves were kept free in open paddock for an hour.

All the experimental animals were dewormed 15 days prior to start of the experiment. The health of the calves was checked periodically by the doctor.

### **3.3.5. Health and sanitation**

The calve pens where the calves were housed during the period of experiment were used to clean daily. The byres and surrounding area were disinfected with phenyl. The help of veterinarian was taken whenever necessary. The calves were kept in open paddock from 8.00 a.m. to 9.30 a.m. daily.

## **3.4 Records of observation**

Following parameters were recorded during the investigation.

### **3.4.1. Daily dry matter (DM) consumption**

The daily feed intake per animal was recorded by providing feed as per treatment during morning and afternoon and subtracting the residue of the feed left in the next day morning. The record of each animal was kept separately and daily DM intake was calculated.

### **3.4.2. Daily water intake**

The daily water intake of each animal during 24 hours was recorded. The calves were offered measured quantity of clean fresh water daily in the morning and evening hours and the water consumption was recorded by measuring the left water in the bucket.

### **3.4.3. Body weight**

The body weight of experimental animals was recorded at the start of experiment for 3 consecutive days and then at weekly interval. The weight was taken in morning hours in between 8 to 9 a.m. before watering and feeding of calves on weighing balance.



**Plate 4: Vaccination of experimental calves**

#### **3.4.4. Body measurement**

Along with weight gains, the following linear body measurements were also taken at the end of each period for knowing the increment in growth of experimental Indigenous calves.

##### **Chest girth**

It was recorded as a circumference of chest measured just behind the elbow point passing through the wither point.

##### **Body Height**

It was recorded as the perpendicular between the ground level and the point of wither. While measuring the height, the calves were made to stand easily on four legs on leveled ground.

##### **Body length**

It was recorded as the straight line distance between the point of shoulder and the pin-bone.

#### **3.5 Analysis of feed and fodder**

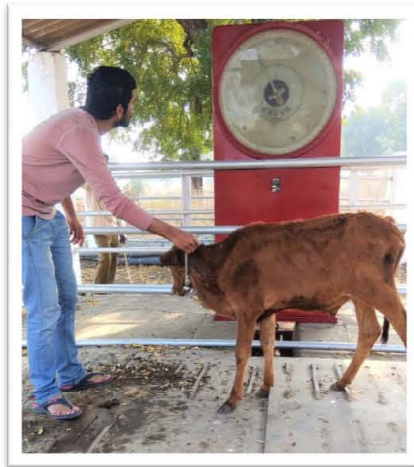
Dry matter, crude protein, crude fiber, ether extract, nitrogen free extract and total ash were determined as per procedure given in Bureaus of Indian standard (AOAC 1990).

##### **3.5.1. Dry matter**

The dry matter percentage was determine as per the procedure recommended by BIS, IS: 7874(part-I)-1975.

Weighted accurately 100 g of the feed and fodder in to aluminum dish. Heated the dish containing the material in hot air oven maintained at 100-120<sup>o</sup>c for about 3 hours, cooled it and weighted with the cover on. Repeated the process of drying, cooling and weighting at 30 minutes intervals for appropriate reading.

$$\text{Moisture percent by weight} = \frac{100(W_1 - W_2)}{W_1 - W_3}$$



**Weighing of calves**



**Measuring chest girth of calves**



**Measuring length of calves**



**Measuring height of calves**

**Plate 5: Measuring of growth performance of calves**

Dry matter (%) = Weight of sample - weight of moisture in sample

Where,

$W_1$  = Weight of gram of the dish with feed before drying

$W_2$  = Weight in gram of the dish with feed after drying

$W_3$  = Weight in gram of empty dish

### 3.5.2. Crude protein

Nitrogen percentage was estimated by Kjeldahl's method as per the procedure recommended by BIS, IS: 7475(part I)-1975 and crude protein percentage was calculated by multiplying the percentage of total nitrogen by 6.25. After determining the moisture content, the oven dried sample was ground and further processed for chemical analysis. Weighed 10 g of sample was transferred to the kjeldahl's flask. About 10 g of potassium sulphate and 0.5 g of copper sulphate were added to flask 25 ml of concentrated sulphuric acid was added. The flask was plays on digestion chamber and heated gently to boil until contents were clear and allowed the liquid to cool and diluted with 200 ml of distilled until all ammonia was passed over and was received over standard sulphuric acid which was then back titrated with standard NaOH in order to determine the amount of standard acid used to neutralize the ammonia evolved from digested material. Similarly bland sample was run.

$$\text{Total nitrogen (\%)} = \frac{1.4 (B-A) N}{W}$$

Total protein = total nitrogen X 6.25

Where,

B = Volume of N/10 NaOH for blank

A = Volume of N/10 NaOH used for sample

N = Normality of standard NaOH

W =Weight of sample in g

### 3.5.3. Crude Fiber

Crude fiber percentage will be determined as per the procedure recommended by BIS, IS: 7874 (part) - 1975.

After determining ether extract, the oven dried sample was ground 10 g of sample was transferred into a flask and boiled with 1.25 per cent sulphuric acid 1.25 per cent sodium hydroxide for half an hour. Then left residue was dried, weighted and ignited. Loss in weight was taken as fiber contents of the sample.

### 3.5.4. Ether extract

The ether extracts percentage was determined as per the procedure recommended BIS, IS: 7874 (part I) – 1975.

Dried the extraction flasks in an oven. Cooled in desiccators. The weight of the empty flask. 3 to 5 g of dry sample was taken in an extraction thimble, with tongs and placed in the extraction unit. Connected with the flask containing petroleum ether at 2/3 of total volume and adjusted head to obtain about 10 reflexes per hour. The length of the extraction was depending on the quantity of lipids distillation. Cooled the flask in a desiccator and weighed these within milligrams.

$$\text{Ether extract content (\%)} = \frac{(B (\text{Fat flask}) - A (\text{Flask}))}{C} \times 100$$

### 3.5.5. Total ash

Total ash was estimated as per the procedure recommended by BIS, IS: 7874 (part I) - 1975.

Weighed the empty and dried silica crucible. Accurately 10 g of feed sample was taken. Evaporated the sample to dryness on a hot plate. Placed the crucible in a pre-heated Muffle furnace and heated the contents at 550-600°C until ash was free carbon. Cooled the crucible by placing in desiccators.

$$\text{Percent ash by weight} = B/A \times 100$$



**Determination of dry matter**



**Determination of Ash**



**Determination of Crude Protein**



**Determination of ether extract**

**Plate 6: Determination of different Nutrients in feeds**

Where,

A = Weight of feed sample

B = Weight of ash

### **3.5.6 Nitrogen free extract**

NFE was estimated as per the BIS, IS: 7874 (part I) - 1975. The sum of all (i.e. Moisture Crude Fiber, Ether Extract and Total Ash) was subtracted from the percentage of total nutrients.

Nitrogen free extract (%) =  $100 - (A + B + C + D + E)$

Where,

A = Moisture content(%)

B = Crude protein (%)

C = Ether extract (%)

D = Crude fiber (%)

E = Ash content (%)

### **Statistical method**

The data was subjected to the statistical analysis by the Randomized Block Design for testing their difference as per procedure by Amble (1975).

### **Economics of feeding**

The prices of different constituents of feed stuff approved at the university rates were considered for calculating per kg of feed.

## CHAPTER IV

### RESULTS AND DISCUSSION

The present experiment entitled “Effect of feeding crushed tamarind seed on the growth performance of growing calves.” was conducted for 90 days and the observation recorded during the experiment were analyzed statistically. The results obtained are discussed in this chapter and presented under the following heads.

4.1 Chemical composition of feed stuff

4.2 Feed intake

4.3 Dry matter intake

4.4 Water intake

4.5 Body weight and weight gain

4.6 Body Measurements

4.7 Cost of economics

#### **4.1 Chemical composition of feed stuff**

The data pertaining to the chemical composition of feeds used during experiment period for feeding to the calves is tabulated and presented in Table 4.

From the Table 4, it was observed that soybean straw, berseem, concentrate and tamarind seeds were containing 90.04, 20.90, 90.20, 88.25 per cent DM respectively. The content of nutrients in soybean were 7.9, 2.30, 39.19, 40.56, 10.90 per cent CP, EE, NFE, CF and ash respectively. Whereas content of nutrients in berseem were 5.40, 2.47, 50.44, 25.80 and 15.89 per cent CP, EE, NFE, CF and ash respectively.

**Table 4. Chemical composition of feed stuffs (on % DM)**

Sr. No.	Particulars	Soybean Straw	Berseem	Concentrate	Tamarind seed
1	DM	90.04	20.90	90.20	88.25
2	CP	7.9	5.4	18.55	22.20
3	EE	2.30	2.47	6.44	7.63
4	NFE	39.19	50.44	60.98	3.82
5	CF	40.56	25.8	6.8	59.00
6	Total Ash	10.90	15.89	7.23	7.35

(Concentrates are given to calves as per thumb rule.)

The content nutrients in concentrates were observed 18.55, 6.44, 60.98, 6.80, 7.23 per cent CP, EE, NFE, CF and ash respectively. Tamarind seeds were containing 22.20, 7.63, 3.82, 59.00, 7.35 per cent CP, EE, NFE, CF and ash respectively. The most significant finding of CP, EE, NFE was in tamarind seed in comparison with soybean straw, berseem and concentrate.

In present study, the crushed tamarind seed was fed to growing calves by mixing with concentrate as per the treatments, thereby; the tamarind provides protein as well as other nutrients calves. The soybean straw also provides some sort of nutrients. Chemical composition of jowar straw is nearer with that of reported by Bansod *et al.* (2008) who observed that the content of CP, CF, EE and NFE in jowar straw as 3.70, 32.45, 2.89, and 52.46, per cent respectively. Slightly lower values of CP and CF, but the values of EE and NFE are in line with present value. Similar observations were also noted by Kamble (2006).

Shelar (2004) also reported that the average chemical composition of SBS was 91.02 % DM and 7.04, 41.20, 38.29, 1.52 and 11.80% CP, CF, NFE, EE, and TA on DM basis, respectively. Also the similar chemical composition of soybean straw was reported by Basawade *et al.* (2007) and Mule *et al.* (2008).

Green berseem contained 20.90 per cent DM along with 5.4, 2.47, 50.44, 25.8 and 15.89 per cent CP, EE, NFE, CF and total ash on dry matter basis, respectively. The present CP values are nearer with the composition reported by Bansod (2008) as 5.77 percent is substantially higher than the present value.

#### 4.2 Daily feed intake

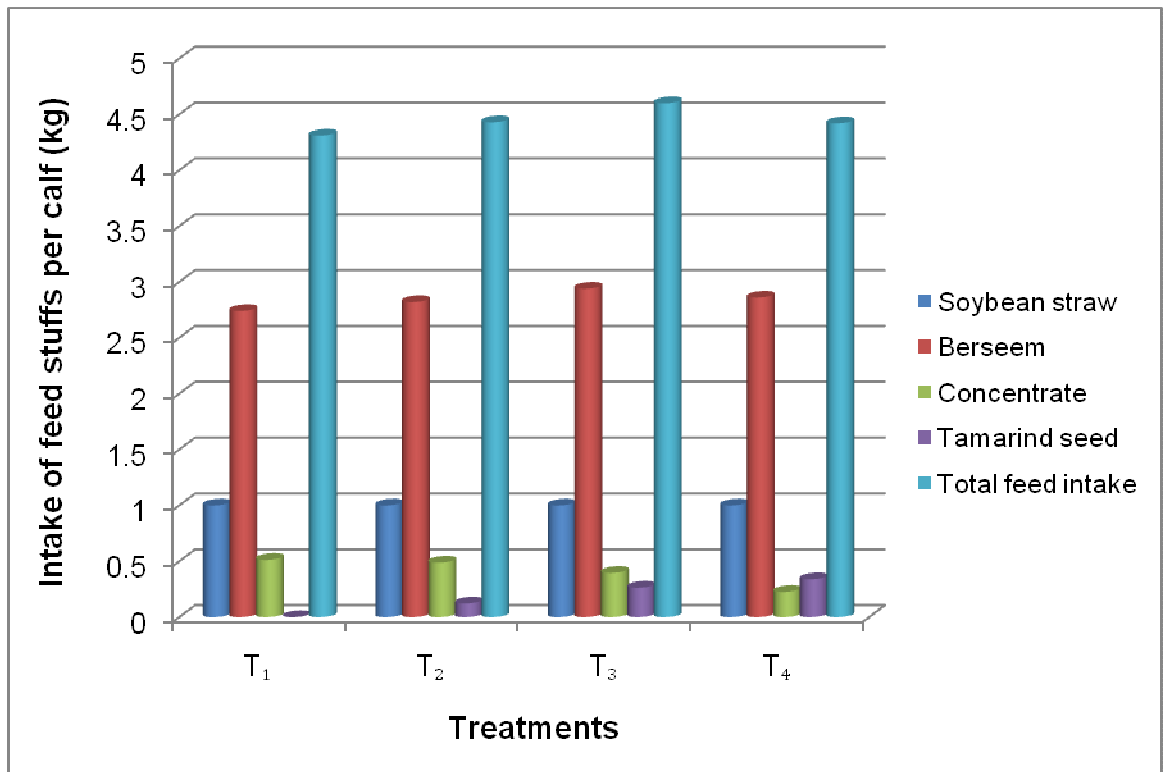
The dry matter is the most important component of the feeds and fodder. It excludes the moisture content of feed and fodder. The feed requirement of animal is based on the DM content of feed.

The feed intake of different feed stuffs by the growing calves under different groups are shown in Table 5. The soybean straw, berseem, concentrate and tamarind seed were provided to calves in different groups to meet out the DCP and TDN requirement.

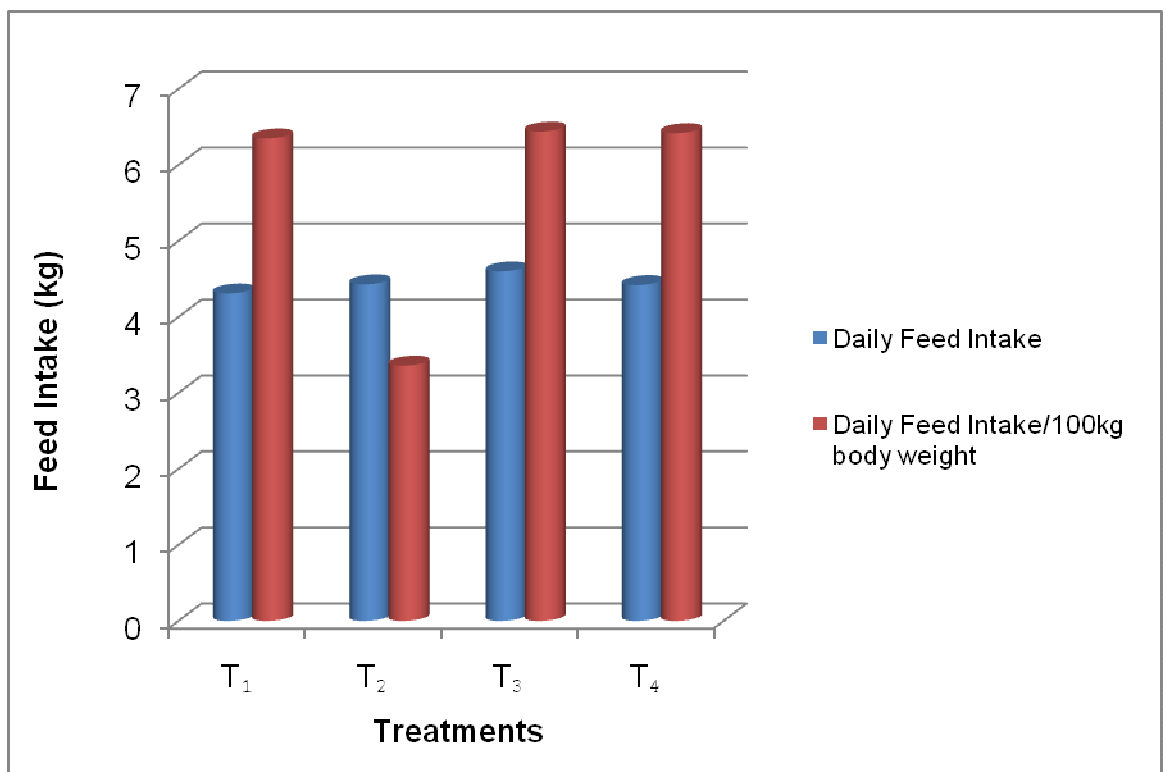
**Table 5. Average intake of different feed stuffs under different groups (kg/day/calf)**

Treatments	Average body weight	Daily feed intake	Daily feed intake/100kg body weight
T <sub>1</sub>	67.8	4.31	6.35
T <sub>2</sub>	69.6	4.43	6.36
T <sub>3</sub>	71.4	4.60	6.44
T <sub>4</sub>	68.8	4.42	6.42
F test	Sig	Sig	Sig
SE (M) ±	0.913	0.010	0.011
C.D. at 5%	2.181	0.030	0.034

It was revealed from Table 5 that on an average the calves consumed 4.31, 4.43, 4.60, and 4.42 kg of feed per day under T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> treatment respectively. The differences in respect of feed intake among the treatments indicating that all the calves consumed adequate quantity of feed and the incorporation of tamarind seed in the ration of the calves did not influence on the feed intake. However, the incorporation of



**Fig. 1 Average Intake of different feeds/day/calf (kg)**



**Fig. 2 Effect of feeding crushed tamarind seed on the daily feed intake of calves (kg)**

tamarind seed in the ration increased the feed intake in T<sub>3</sub> treatments comparing to T<sub>1</sub>, T<sub>2</sub> and T<sub>4</sub> groups.

It was further observed that the T<sub>2</sub> and T<sub>3</sub> groups preferred more consumption of green fodder with proportionate quantity of tamarind seed. The intake of soybean straw is almost similar through all the treatments. This could be due to more coarseness of soybean straw and thereby reducing the palatability. It is already pointed out by the past workers that the soybean straw possessed lower palatability (89%) compared to traditional straw which was the reason for reduction in feed intake in animal.

Kamble (2006) reported that the crossbred cows in T<sub>1</sub> group consumed 6.580 kg jowar straw while, cows in T<sub>2</sub> groups consumed 3.270 kg jowar and 3.270 kg soybean straw and 6.410 kg soybean straw in T<sub>3</sub> group. Concentrate @ 4kg was fed to each cow in all groups. On an average DM intake were 9.502, 9.450 and 9.319 kg in T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> treatments, respectively. Daily DM intake of 2.699, 2.684, and 2.687 kg per 100kg body weight were observed in T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> respectively. DCP and TDN intake kg / day were 0.447 and 4.751, 0.601 and 4.725 and 0.642 and 4.659 in T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> groups. The intake of DCP and TDN were found lowest in T<sub>1</sub> and highest in T<sub>3</sub>.

### **4.3 Daily DM intake**

Daily DM intake was calculated from intake of different feeds and data is tabulated in Table 6.

It was observed from Table 6 that the daily DM intake was differing significantly between the treatments. The average daily intake was 1.96, 2.01, 2.08, and 1.99 kg/day/calves in T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> groups respectively. The DM intake was observed more in treatment group T<sub>3</sub> followed by treatment T<sub>4</sub>, T<sub>2</sub> and T<sub>1</sub> group of growing calves. It indicated that, the influence of incorporation 40 % tamarind crushed seed with concentrate mixture as per DCP and TDN requirements improves the DM intake of the experimental growing calves. The lowest DM intake kg/day

observed under treatment group T<sub>1</sub>. It might be due to feeding of calves without crushed tamarind seeds.

**Table 6. Effect of feeding crushed tamarind seed on daily dry matter intake per calves over an experimental period (kg)**

Treatments	Average body weight	Requirement of daily DMI	DMI	Daily DMI / 100 kg BW
T <sub>1</sub>	67.8	1.70	1.96	2.85
T <sub>2</sub>	69.6	1.74	2.01	2.89
T <sub>3</sub>	71.4	1.79	2.08	2.93
T <sub>4</sub>	68.8	1.72	1.99	2.87
"F" test	Sig.	-	Sig	Sig
SE (M) ±	0.913	-	0.010	0.014
CD at 5%	2.181	-	1.132	0.043

This trend therefore indicates the feeding of tamarind seed to calves as a source of protein in corporation with concentrate had not affected dry matter intake up to certain limit.

The present intake values are nearer to the values reported by past research workers like Das *et al.* (2012) reported that the average daily dry matter intake was higher in T<sub>2</sub> and the values being 5.89, 6.34 and 5.93 kg in T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> respectively. On the other hand Iraira *et al.* (2012) reported the intake of dry matter (DM)/day 5.1, 5.3 and 5.0 kg, respectively. Yadav and Chaudhary (2010) reported that the crude protein (CP) intake per 100 kg body weight was significantly higher in T<sub>1</sub> as compared to T<sub>3</sub> group. Whereas, Jadhav (2016) reported that the average daily intake was 3.34, 4.62 and 4.38 kg/day/heifer in T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> groups respectively.

#### 4.4 Water intake

The feeding trial was conducted during month September to December. Water was offered two times daily during the period of trial.

It was observed from Table 7 that the daily water intake of the calves was differ significantly between the feeding group, the calves from T<sub>3</sub> group drank more (8.65) than that T<sub>1</sub> (7.41), T<sub>2</sub> (7.92) and T<sub>4</sub> (7.76).

This trend indicates that the water in treatment T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> were significant, indicating, that level of tamarind seed has no effect on the water consumption of calves.

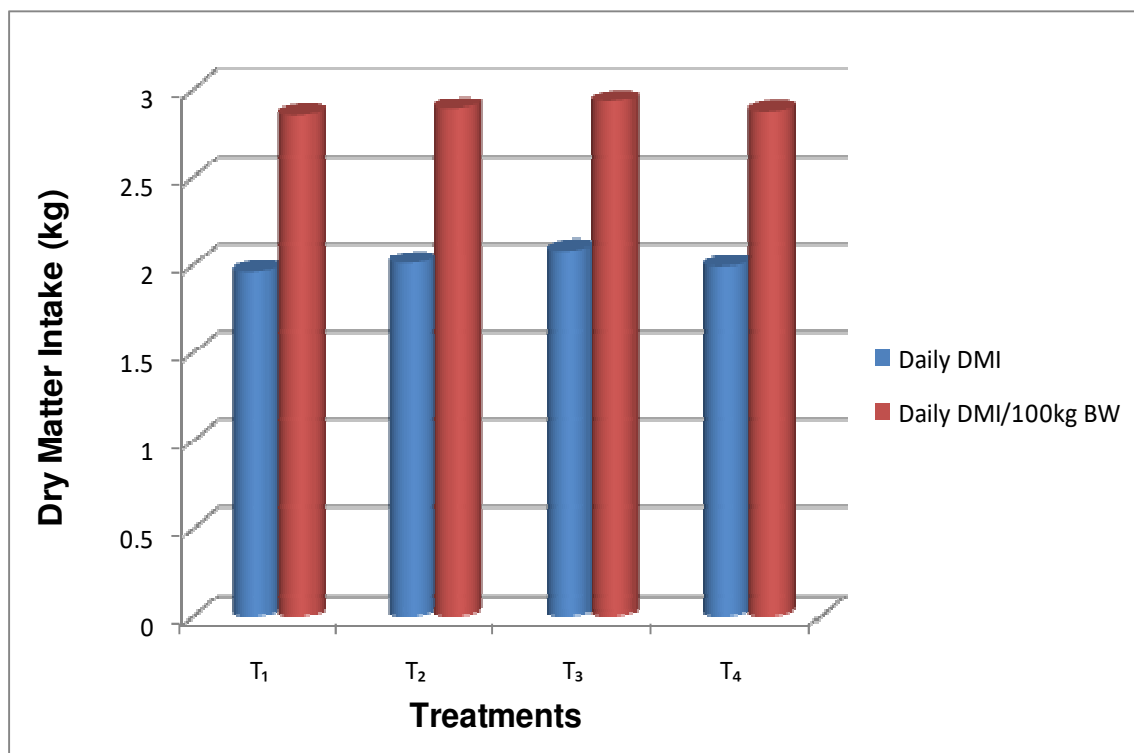
**Table 7. Effect of feeding crushed tamarind seed on daily water intake of experimental calves under various treatments (lit.)**

Treatment	Water intake/day/ calf	Water intake /week/calf (lit)	Water intake/day/calf/ 100kg body weight	Ratio of Water : DM
T <sub>1</sub>	7.41	51.81	11.09	1:4.09
T <sub>2</sub>	7.92	55.44	11.79	1:4.10
T <sub>3</sub>	8.65	60.55	12.29	1:4.24
T <sub>4</sub>	7.76	54.32	11.58	1:4.13
F test	Sig.	Sig.	Sig.	-
SE (M) $\pm$	0.011	0.651	0.016	-
C.D at 5%	0.035	2.029	0.050	-

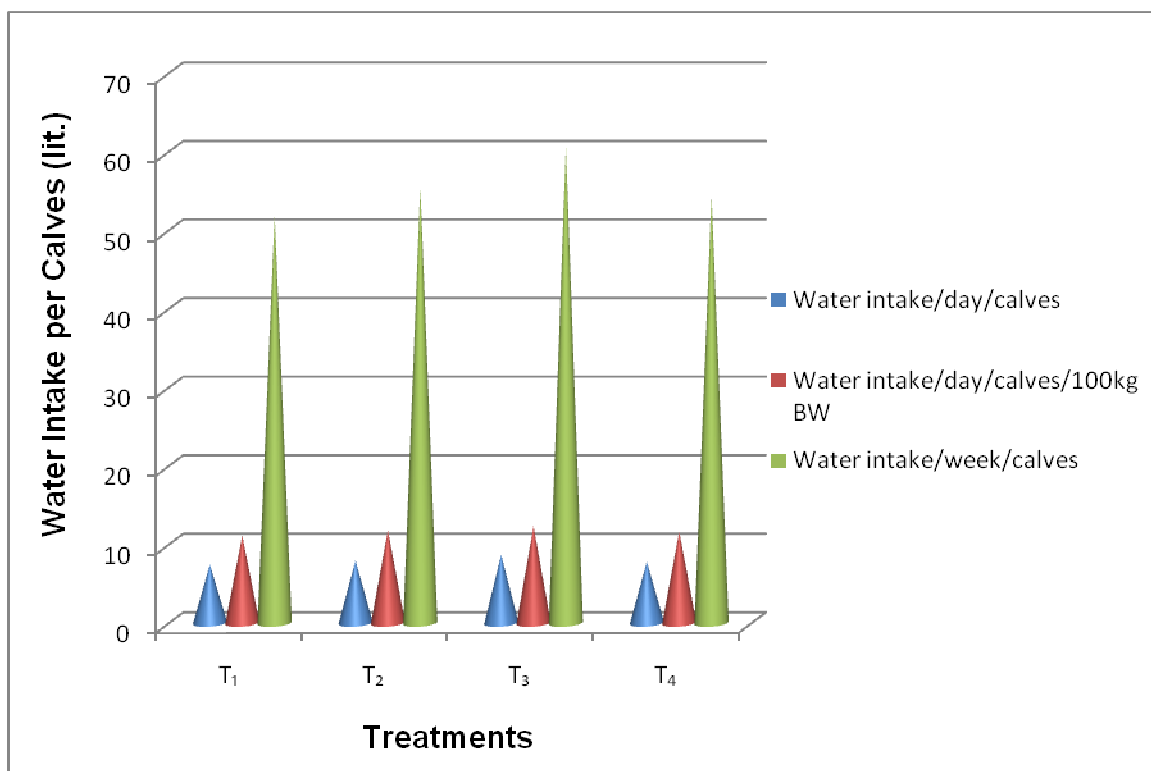
The significant differences was observed at 5% level of significance. The water intake of growing calves per day was observed significantly highest in treatment T<sub>3</sub> (8.65 lit) over the rest of treatment i.e. T<sub>1</sub>, T<sub>2</sub> and T<sub>4</sub>. Also weekly water intake of calves was seen significantly superior in treatment T<sub>3</sub> group of calves than other treatments like T<sub>1</sub>, T<sub>2</sub> and T<sub>4</sub> group of calves. This is might be due to feeding of 40% tamarind crushed seed and soybean straw to the calves and also due to dry matter intake was more than the other treatment.

Similar trend was observed when the water intake was converted to unit body size. The average water intake per 100 kg body weight was 10.93, 11.38, 12.11, and 11.28 litre per calves per day in T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> respectively. As a result of this solution dry matter to water intake ratio was more or less similar in all the groups and it was 1:4.09, 1:4.10, 1:4.24 and 1:4.13 under T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> groups respectively.

The present intake values are nearer to the values reported by past research workers Yazdani and Gupta (2000) studied the difference



**Fig. 3 Effect of feeding crushed tamarind seed on the daily dry matter intake of calves (kg)**



**Fig. 4 Effect of feeding crushed tamarind seed on water intake of calves (lit.)**

in voluntary water intake per kg dry matter intake (6.12, 5.39, 4.27 and 4.03 liters) was also significantly ( $p < 0.05$ ) influenced by the dietary treatments.

Shelar (2004) noticed that the daily water intake of the heifers did not differ significantly between the feeding groups. Jadhav (2016) studied the average daily water intake per 100 kg body weight of heifer was 6.94, 7.33 and 6.82 litres in treatment groups T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> respectively.

#### 4.5 Growth performance of calves

The Growth performance of calves on feeding of crushed tamarind seed was judged on the basis of body weight gain and gain in body measurement. The results obtained in this regard are discussed in the following table 8 and table 9.

It was observed from the Table 8 that there was significant difference in weight gain under different treatments. The highest body weight gain per day per calf in T<sub>3</sub> (0.296) followed by T<sub>2</sub> (0.280), T<sub>4</sub> (0.262) and T<sub>1</sub> (0.238). The highest body weight gain per week per calf in T<sub>3</sub> (2.072) followed by T<sub>2</sub> (1.96), T<sub>4</sub> (1.83) and T<sub>1</sub> (1.67).

**Table 8. Effect of feeding crushed tamarind on daily and weekly body weight gain of calves (kg)**

Treatments	Weight gain/day/calf	Weight gain/week/calf
T <sub>1</sub>	0.238	1.667
T <sub>2</sub>	0.280	1.960
T <sub>3</sub>	0.296	2.072
T <sub>4</sub>	0.262	1.834
"F" test	Sig.	Sig.
SE (M) $\pm$	0.002	0.025
CD at 5%	0.005	0.077

Bansod *et al.* (2008) reported that, the corresponding value for weekly body weight gain and daily growth were  $314.28 \pm 0.01$ ,  $485.0 \pm 0.02$  and  $48.38 \pm 0.25$ ,  $58.92 \pm 0.34$  respectively.

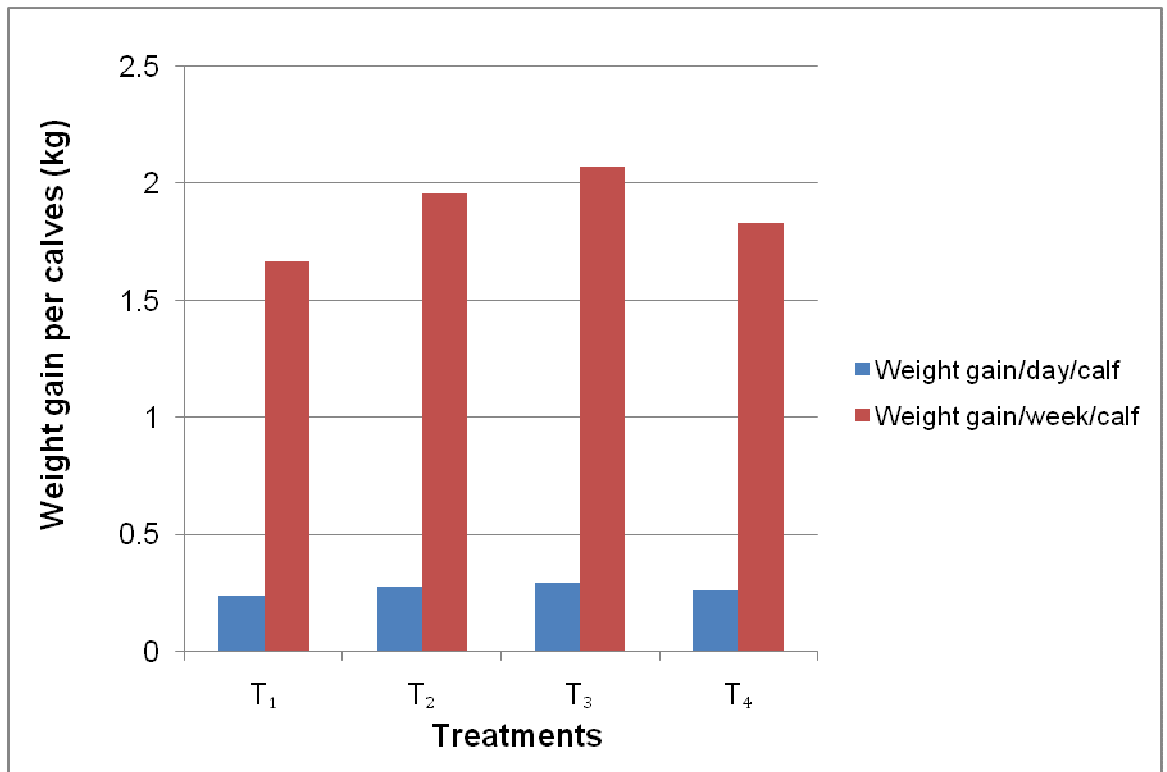
**Table 9. Effect of feeding crushed tamarind seed on average body weight gain in total period (kg)**

Treatments	Average initial body weight (kg)	Average final body weight (kg)	Period total weight gain
T <sub>1</sub>	46.4	67.8	21.4
T <sub>2</sub>	44.4	69.6	25.2
T <sub>3</sub>	44.8	71.4	26.6
T <sub>4</sub>	45.2	68.8	23.6
'F' test	NS	Sig.	Sig.
SE (M) ±	0.920	0.913	0.191
CD at 5%	-	2.181	0.595

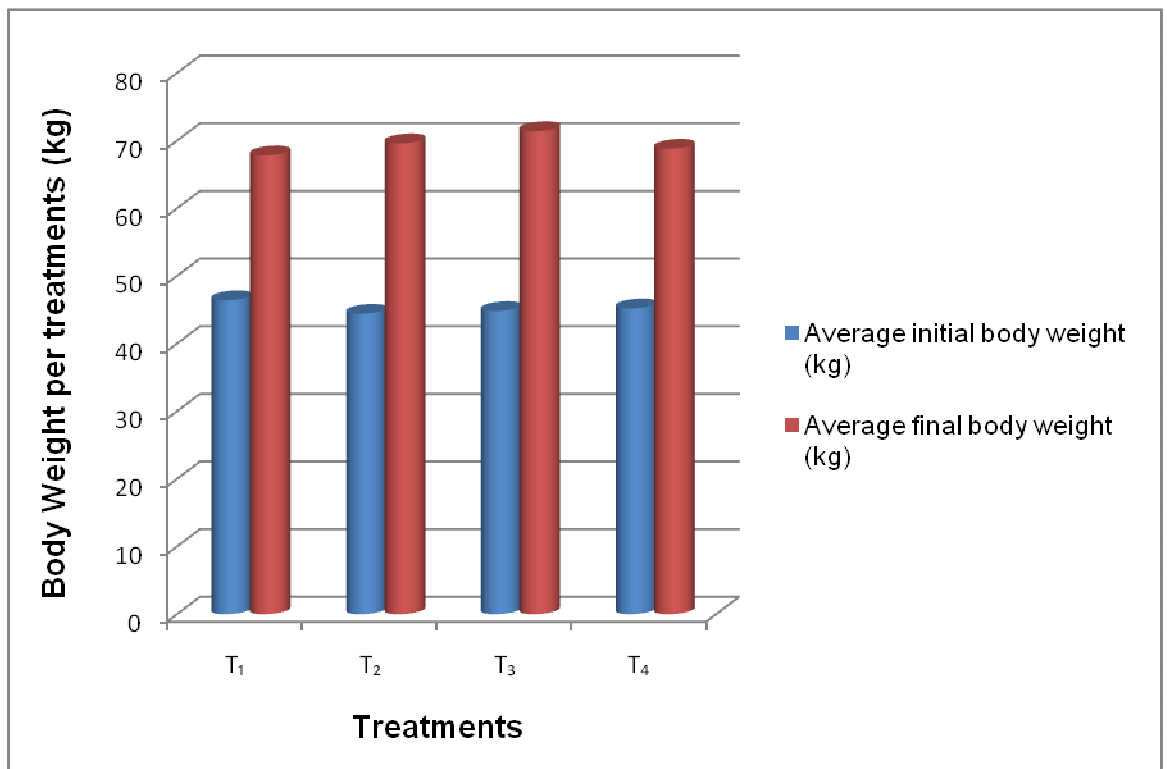
It was observed in Table 9 that, the average final weight gain was highest in T<sub>3</sub> followed by T<sub>2</sub>, T<sub>4</sub> and T<sub>1</sub> significantly lowest weight gain was recorded in T<sub>1</sub> treatment i.e. tamarind seed feeding. Daily intake of DM was highest in the treatment T<sub>3</sub> which has adequate amount of DCP and TDN to calves. This situation might have favoured the growth in calves. The period total weight gain was 21.4, 25.2, 26.6 and 23.6 kg in T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> treatments respectively.

The present values are nearer to the values reported by past research workers Verma *et al.* (2000) reported that the performance of the kids as influenced by dietary Subabul. The live body weight gain (kg) during 180 days feeding were 9.76 + 0.10, 10.28 + 0.33, 9.98 + 0.11 and 7.98 + 0.13 in group I, II, III, and IV, respectively. The highest gain in body weight was recorded in group III followed by group IV, II, I.

Singh and agrawal (2001) showed that the average live weight gain was also significantly higher 370 g/d in T<sub>1</sub> and compared to T<sub>3</sub> 351 g/d. Adangale (2009) observed average daily weight gain of 0.201, 0.210 and 0.204 kg per day in calves by feeding jowar straw with combination of soybean straw. The values of present studies are higher than reported past workers.



**Fig. 5 Effect of feeding crushed tamarind seed on daily and weekly weight gain calves**



**Fig. 6 Effect of feeding crushed tamarind seed on total body weight of calves (kg)**

## 4.6 Body measurement

The average body measurement lengths, body height, chest girth, body weight of the indigenous calves on different feeding treatment are shown in Table 10, Table 11 and Table 12.

### 4.6.1 Body Length

**Table 10. Effect of feeding crushed tamarind seed on body length (cm) of calves under different treatments**

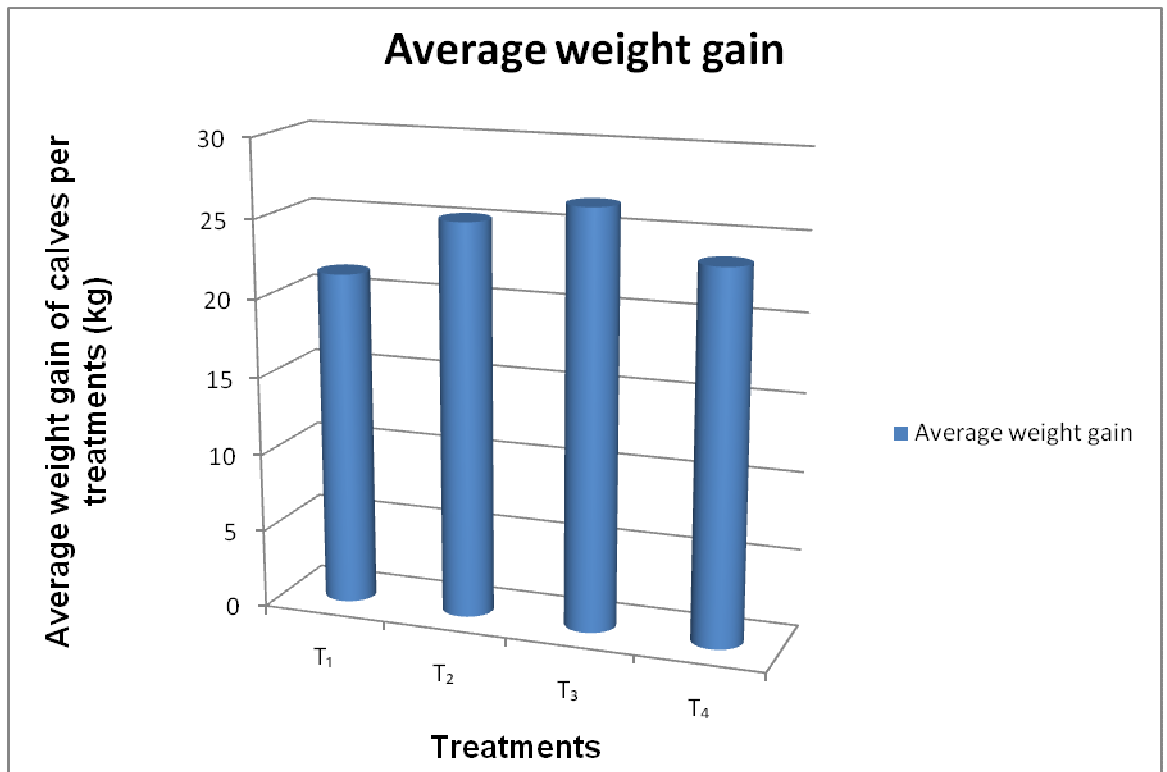
Treatment	Average initial length	Average final body length	Average gain body length
T <sub>1</sub>	50.70	57.45	6.75
T <sub>2</sub>	48.90	57.77	8.87
T <sub>3</sub>	49.30	59.58	10.28
T <sub>4</sub>	49.70	57.65	7.95
"F" test	NS	Sig.	Sig.
SE (M) ±	-	0.186	0.116
C.D at 5%	-	0.580	0.363

It was observed from the Table 10 that the total body length gain over experimental period was 6.75, 8.87, 10.28 and 7.95 in T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> respectively. This mean maximum gain in body length of calves was obtained as a result of feeding 40 % tamarind crushed seed. This trend is get confirmed from the analysis of variance where, the overall average body length over the experimental period was significantly more in T<sub>3</sub> (59.58 cm/calves) over treatment T<sub>1</sub>, T<sub>2</sub>, and T<sub>4</sub> group of calves.

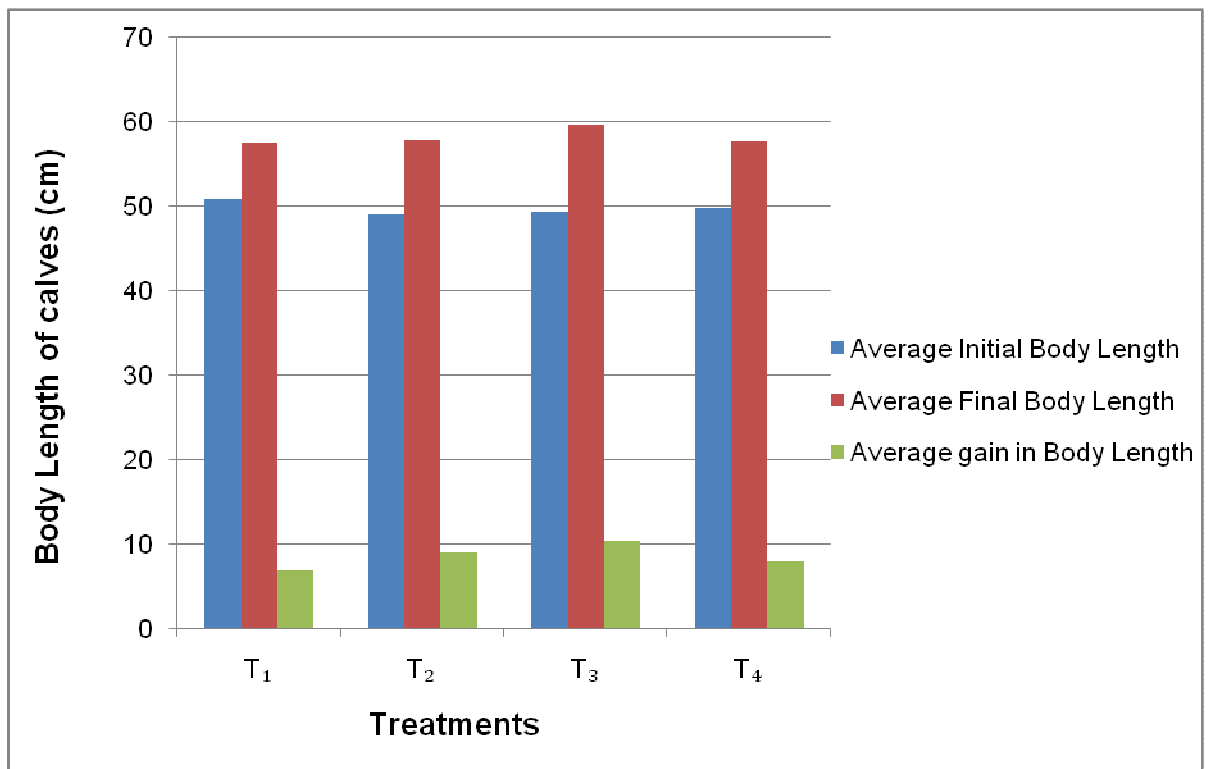
Jabbar *et al.* (2012) reported the heifers fed dietary level of ME 124 per cent of NRC acquired higher body length, height and heart girth as compared to those fed other dietary energy level.

### 4.6.2 Body Height

It was observed from Table 11 that maximum body height of calves was obtained as a result of feeding 60% concentrate and 40% of crushed tamarind seed in treatment T<sub>3</sub>. This trend is get confirmed from the



**Fig. 7 Effect of feeding crushed tamarind seed on the average weight gain of calves (kg)**



**Fig. 8 Effect of feeding crushed tamarind seed on the body length of calves (cm)**

analysis of variance where, the overall average body height over the experimental period was significantly more in T<sub>3</sub> (64.12 cm/calves) over treatment T<sub>1</sub> group of calves. Moreover, the average body height of the calves recorded in T<sub>3</sub> reach the level of significance.

**Table 11. Effect of feeding crushed tamarind seed on body height (cm) under different treatments**

Treatment	Average initial height	Average final body height	Average gain body height
T <sub>1</sub>	52.10	60.30	8.20
T <sub>2</sub>	52.00	61.35	9.35
T <sub>3</sub>	52.20	64.12	11.92
T <sub>4</sub>	52.40	60.76	8.36
F test	NS	Sig.	Sig.
SE(M)±	0.909	0.792	0.208
CD at 5%	-	2.469	0.649

It is also observed that the total body height gain over an experimental period were 8.20, 9.35, 11.92 and 8.36 cm for T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub>, respectively. The variation among different treatment groups was found statistically significant. The total body height of calves was found significantly more in treatment T<sub>3</sub> over the treatment T<sub>1</sub>, T<sub>2</sub> and T<sub>4</sub>.

Jabbar *et al.* (2012) reported the heifers fed dietary level of ME 124 per cent of NRC acquired higher body length, height and heart girth as compared to those fed other dietary energy level.

It was noticed that body measurement such as length, height and chest girth showed increasing trends over an experimental period in all the treatments and variation among different treatment groups was found to be statistically significant.

### 4.6.3 Chest Girth

**Table 12. Effect of feeding crushed tamarind seed to calves on chest girth (cm) under different treatments**

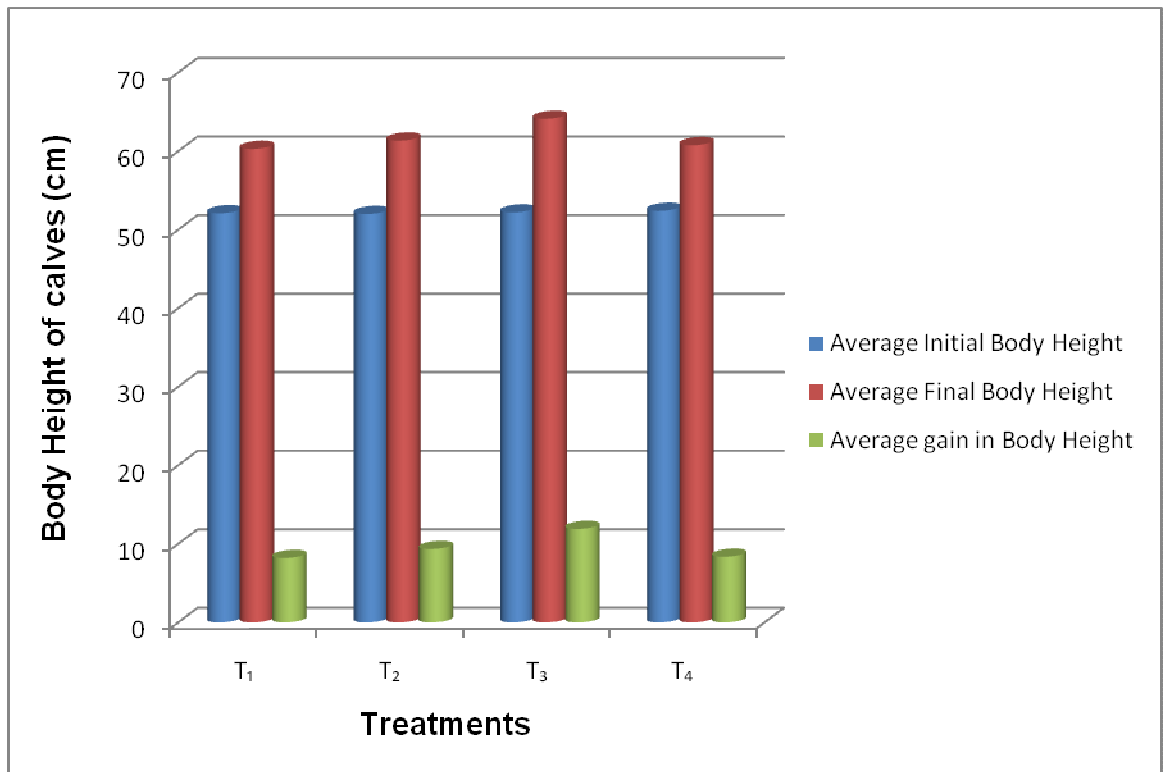
Treatment	Average initial chest girth (cm)	Average final chest girth (cm)	Average gain chest girth (cm)
T <sub>1</sub>	55.00	64.02	9.02
T <sub>2</sub>	54.92	65.08	10.16
T <sub>3</sub>	53.90	66.12	12.22
T <sub>4</sub>	53.60	63.64	10.04
F test	NS	Sig.	Sig.
SE(M)±	0.803	0.364	0.085
CD at 5%	-	1.134	0.265

It was observed from Table 12 that increase in chest girth was 9.02, 10.16, 12.22 and 10.04 cm in treatment T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> in experimental calves, the differences in height did influence significantly. It is evident from table that calves from T<sub>3</sub> group showed more body height as compared to other treatments and lowest in T<sub>1</sub> treatment.

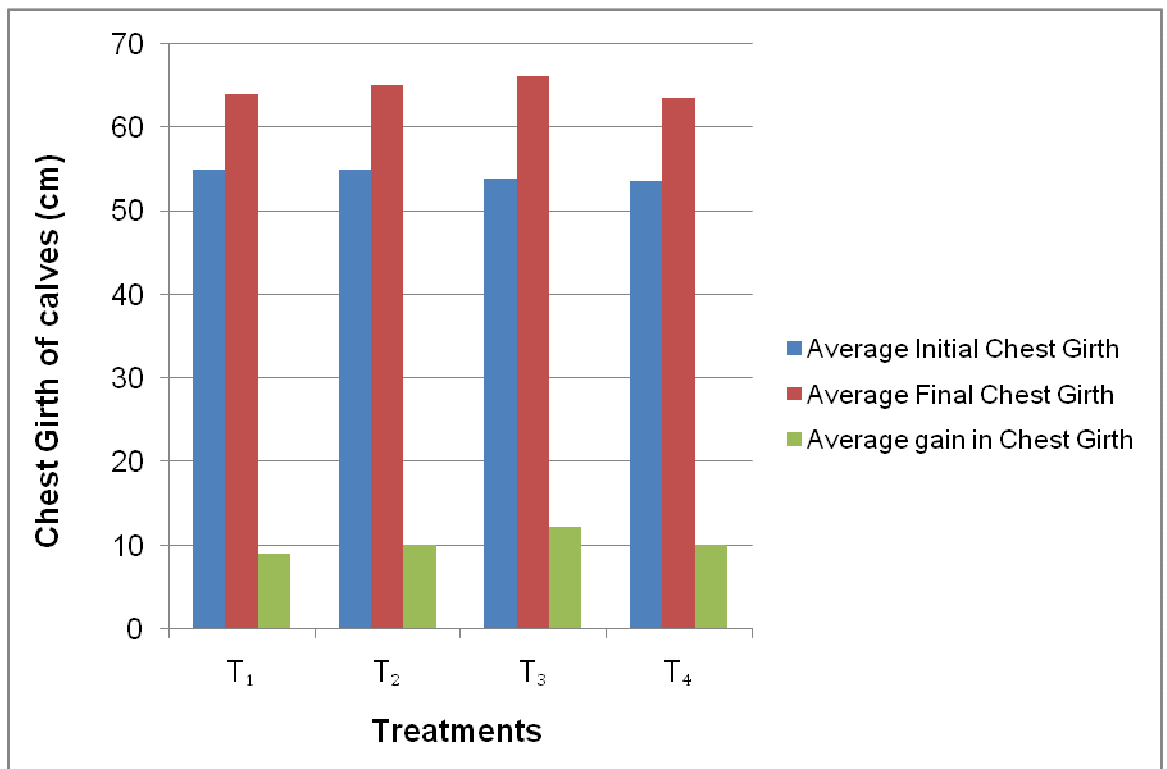
Table 12 revealed that the differences exhibited significant in chest girth among the treatments, while gain in chest girth was higher (12.22 cm) in T<sub>3</sub> treatment, (10.16 cm) in T<sub>2</sub>, (10.04 cm) in T<sub>4</sub> and low in T<sub>1</sub> treatment (9.02 cm).

The performance of calves fed on different diet showed gradual increase in height, length and chest girth. It was noticed that body measurement such as length, height and chest girth showed increasing trends over an experimental period in all the treatments and variation among different treatment groups was found to be statistically significant.

This mean maximum gain in chest girth of calves was obtained as a result of feeding 40% tamarind crushed seed. This trend is get confirmed from the analysis of variance where, the overall average



**Fig. 9 Effect of feeding crushed tamarind seed on the body height of calves (cm)**



**Fig. 10 Effect of feeding crushed tamarind seed on the chest girth of calves (cm)**

chest girth over the experimental period was significantly more in T<sub>3</sub> (66.12 cm/calves) over treatment T<sub>1</sub>, T<sub>2</sub> and T<sub>4</sub> group of calves.

Shelke *et al.* (2011) reported that the feeding of silage prepared from sorghum and gliricidia increases height, chest girth and length of heifers.

#### **4.7 Economics of feeding crushed tamarind seed to calves**

Any feed strategy must be economical so as to make it popular among cattle owners. In view of this feeding economics of the different groups was ascertained. Observations on economics of feeding are shown in Table 13.

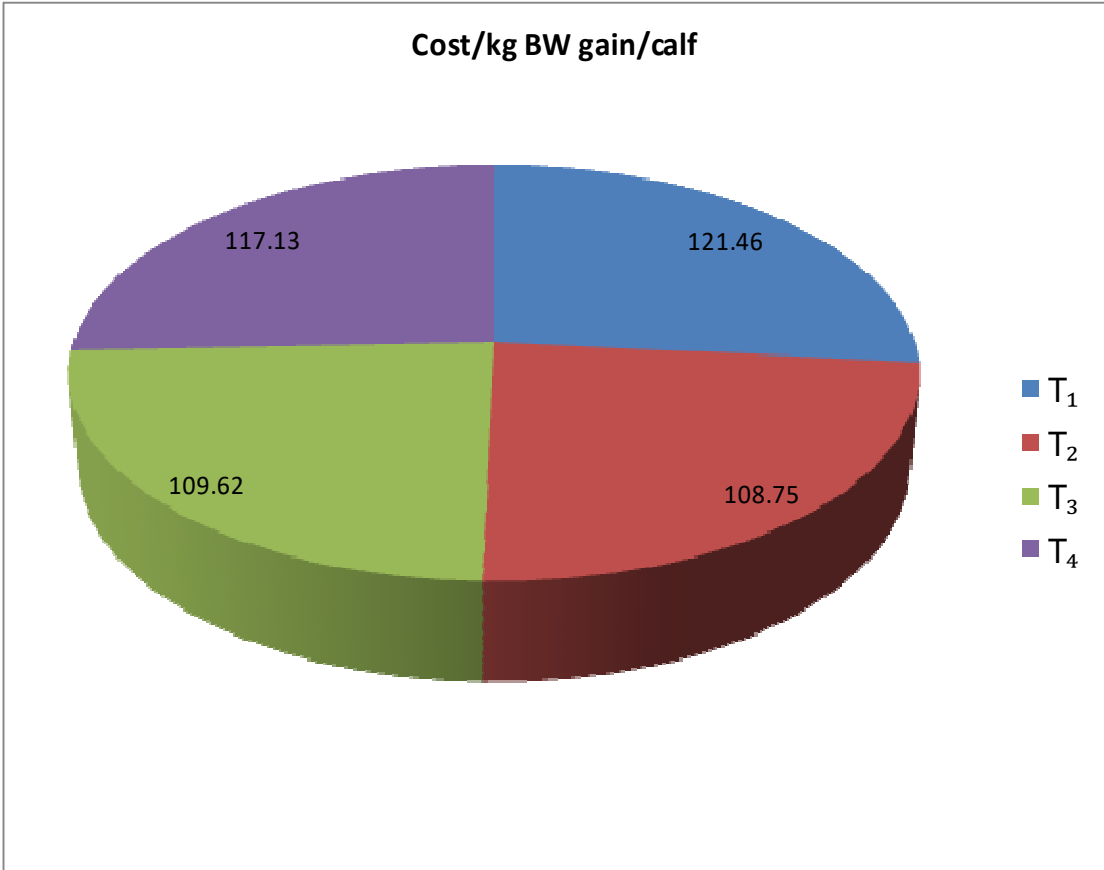
It was observed that the total quantity of soybean straw was 450 kg which was averagely similar for all the treatments and the total quantity of green fodder was 1233, 1269, 1323, 1287 kg for T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, and T<sub>4</sub> group respectively. The total quantity of concentrate was 256.50, 219.60, 178.20 and 101.70 kg for T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, and T<sub>4</sub> group respectively. The total quantity of tamarind seed was 54.90, 118.80, 152.55 kg for T<sub>2</sub>, T<sub>3</sub>, and T<sub>4</sub> group respectively. The quantity of tamarind seed was given by replacing proportionate amount of concentrate as per the treatments.

The total cost of feed observed from the table indicates that, it was more in T<sub>3</sub> group that is Rs. 14,580.00 followed by T<sub>4</sub>, T<sub>2</sub>, and T<sub>1</sub> Rs. 13,821.75, Rs. 13702.50, and Rs. 12996.00 respectively, however total cost / kg body weight gain/treatment was less in T<sub>2</sub> (Rs. 543.75) as compared to T<sub>3</sub> (Rs. 548.12), T<sub>4</sub> (Rs. 585.67), and T<sub>1</sub> (Rs. 607.29) respectively and total cost / calves / kg body weight gain (Rs.) was also low in T<sub>2</sub> (Rs. 108.75) followed by T<sub>3</sub> (Rs. 109.62), T<sub>4</sub> (Rs. 117.13) and T<sub>1</sub> (Rs. 121.46) respectively.

**Table 13. Economics of feeding crushed tamarind seed to calves under different treatments**

Sr. No.	Treatments Particulars	T <sub>1</sub>		T <sub>2</sub>		T <sub>3</sub>		T <sub>4</sub>	
		Quantity (kg)	Cost (Rs)	Quantity (kg)	Cost (Rs)	Quantity (kg)	Cost (Rs)	Quantity (kg)	Cost (Rs)
1	Soybean straw (kg) @300Rs/qt	450	1350	450	1350	450	1350	450	1350
2	Green fodder (Berseem) (kg) @200Rs/qt	1233	2466	1269	2538	1323	2646	1287	2574
3	Concentrate (kg) @20Rs/kg	256.50	5130	219.60	4392	178.20	3564	101.70	2034
4	Tamarind crushed seed @25/kg	-	-	54.90	1372.50	118.80	2970.00	152.55	3813.75
5	Labour charges @180/day	-	4050	-	4050	-	4050	-	4050
6	Total cost		12996.00		13702.50		14580.00		13821.75
7	Total Cost/day/calf (Rs)		28.88		30.45		32.40		30.72
8	Total BW gain (kg)	21.4		25.2		26.6		23.6	
9	Cost/kg BW gain/treatment	-	607.29	-	543.75	-	548.12	-	585.67
10	Cost/kg BW gain/calf109.	-	121.46	-	108.75	-	109.62	-	117.13

It was observed that from above all discussion over experimental results, the treatment T<sub>2</sub> 80% concentrate and 20% tamarind seed and the treatment T<sub>3</sub> 60% concentrate and 40% tamarind seed economically shows almost equally better and desirable result as compared to T<sub>4</sub>, and T<sub>1</sub> treatments. But in all other experimental parameters, treatment T<sub>3</sub> had shown better results over the treatment T<sub>2</sub>. Thus, it was concluded that the treatment T<sub>3</sub> is superior for the whole experiment.



**Fig. 11 Economic of feeding crushed tamarind seed to growing calves**

Ravi *et al.* (2000) studied the utilization on water soaked seed in diet of pregnant crossbred gilt. It was recorded that the cost of feed per kg weight gain was Rs. 406.89 and 332.41 for R<sub>1</sub> and R<sub>2</sub> respectively.

Verma (2001) conducted a trial in crossbred growing heifers fed with complete feed containing crude protein at the level of 12 per cent (Group II) and 14 per cent (Group III) in complete feed I and II, respectively and compared the results with control (Group I). It was found that cost per kg weight gain (Rs.) 39.97, 27.71 and 29.28. Thus, it suggested that the complete feed containing 12 per cent crude protein can be successfully and economically used for feeding.

Lalit vijay *et al.* (2016) also reported that on the tamarind seed meal was used in replace of wheat bran in the concentrated mixture of growing kid up to 1/3<sup>rd</sup> level (w/w) without any adverse effect. It was recorded cost of concentrate mixture per quintal for T<sub>1</sub>, (Rs.1540) was maximum followed by T<sub>2</sub> (Rs. 1529) and T<sub>3</sub> (Rs. 1515).The cost of feed per kg live weight gain remained non-significant among three group.

## CHAPTER V

### SUMMARY AND CONCLUSIONS

The present study entitled “Effect of feeding crushed tamarind seed on the growth performance of growing calves.” was carried out at Department of Animal Husbandry and Dairy Science, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. Twenty calves between 3 to 6 month of age were divided into 4 groups on the nearness of weight. The feeding treatment consisted of Green fodder + Dry fodder + concentrate (T<sub>1</sub>), Green fodder + Dry fodder + 80% concentrate + 20% tamarind seed (T<sub>2</sub>), Green fodder + Dry fodder + 60% concentrate + 40% tamarind seed (T<sub>3</sub>) and Green fodder + Dry fodder + 40% concentrate + 60% tamarind seed (T<sub>4</sub>) during 90 days feeding trial. All calves were offered a fixed quantity of green fodder and concentrate as per thumb rule over the experimental period. While they had liberal opportunity for dry roughage. The feeding trial was conducted under “Randomized Block Design”. A gap of week period was given to eliminate the residual effect of previous treatment, while, shifting over of calves to next treatment.

The feed stuffs were analyzed for their proximate composition. The observations were recorded on feed intake, dry matter intake and change in body weight and measurement of the calves. The results obtained are summarized below.

#### 5.1 Proximate principles of feed stuffs

The chemical composition of soybean straw as DM, CP, EE, CF, NFE and Total ash were 90.04, 7.90, 2.30, 39.19, 40.56 and 10.90 percent respectively. Also berseem contain as DM, CP, EE, CF, NFE and Total ash were 20.90, 5.40, 2.47, 50.44, 25.80 and 15.89 percent respectively. The nutritive value of concentrate and tamarind seed contain as 90.20 and 88.25 DM, 18.55 and 22.20 CP, 6.44 and 7.63 EE, 60.98 and 3.82 NFF, 6.80 and 59.00 CF and 7.23 and 7.35 Total ash percent respectively.

#### 5.2 Feed intake

The daily feed intake was 4.34, 4.43, 4.60 and 4.42 kg per day under T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> treatment respectively. The differences in respect of feed intake among the treatments indicating that all the calves consumed adequate quantity of feed and the incorporation of tamarind seed in the ration of the calves did not influence on the feed intake.

### **5.3 Dry matter intake**

The daily DM intake was differing significantly between the treatments. The calves from T<sub>3</sub> groups consumed more DM than that of T<sub>1</sub> and T<sub>2</sub> and T<sub>4</sub> calves. The average daily intake was 1.96, 2.01, 2.08 and 1.98 kg/day/calves in T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> groups respectively. This trend thus indicates that there was increase in the daily DM intake when tamarind seed was incorporated in the rations of calves.

Thus, the combination of feeding tamarind seed and concentrate fulfil the balance diet. The intake trend indicated that all the animals must have received the feed in adequate quantity to fulfil their appetite.

### **5.4 Water intake**

It is noticed that the daily water intake of the calves was differ significantly between the feeding group, the calves from T<sub>3</sub> group drunk more (8.65 lit) than that T<sub>1</sub> (7.41 lit), T<sub>2</sub> (7.92 lit) and T<sub>4</sub> (7.76). Ratio of dry matter to water intake was 1:4.09, 1:4.10, 1:4.24, 1:4.13 in treatment T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> respectively. This trend indicated that the water intake in treatment T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> were significant indicating that level of tamarind seed had effect on the water consumption of calves.

### **5.5 Body weight and weight gain**

The calves from all the treatments not only maintained their body weight but did indicate increase in body weight over the experimental period. This mean the ration provided to them was adequate to fulfil their nutritional demand.

However, there was more weight gain under different treatments. The average daily body weight gain was 0.238, 0.280 and 0.296 and 0.262 kg per day in T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> and T<sub>4</sub> treatment respectively.

## **5.6 Body measurements**

### **5.6.1. Body length gain**

The gain in body length was 6.75, 8.87, 10.28 and 7.95 cm in T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> respectively. This revealed that the gain in length was significantly highest in T<sub>3</sub> and lowest in T<sub>1</sub> treatment.

### **5.6.2. Body height gain**

It was observed that increase in height was 8.20, 9.35, 11.92 and 8.36 cm in treatment T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> in experimental calves. It is evident from that calves from T<sub>3</sub> group showed more body height as compared to other treatment and lowest in T<sub>1</sub>, T<sub>2</sub> and T<sub>4</sub> treatment.

### **5.6.3. Body chest girth gain**

The differences exhibited significant in chest girth among the treatments, while gain in chest girth was higher (12.22 cm) in T<sub>3</sub> treatment and low in T<sub>1</sub> treatment (9.02 cm).

## **5.7 Economics of feeding**

Total cost/day/calf was 147.98, 156.03, 166.01, 158.01 Rs for T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub> respectively. The total body weight gain was 21.4, 25.2, 26.6, 23.6 Kg for T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> respectively. The cost per kg BW gain per calf was observed 124.46, 111.45, 112.34, and 120.52 Rs. in treatment T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> respectively. The higher weight gain observed in T<sub>3</sub> (26.6 kg), hence it is economical for farmer. The cost per kg BW gain per calf was higher in treatment T<sub>1</sub> (124.46) and lower in treatment T<sub>2</sub> (111.45).

It was concluded that from all above discussion over experimental result the treatment T<sub>3</sub> (60 % concentrate and 40% tamarind seed) shows better and desirable result as compare to T<sub>1</sub>, T<sub>2</sub> and T<sub>4</sub> treatments. In T<sub>3</sub> treatment feeding of soybean straw, green fodder, tamarind seed and concentrate not only fulfilled the nutrient requirement

and growth of calves but also on the basis of weight gain reduces the cost of feeding.

## **CONCLUSIONS**

The following conclusions are drawn :-

1. On the basis of the finding reported into present investigation, it is concluded that the T<sub>3</sub> ingredient green fodder + dry fodder + 60% concentrate+ 40% tamarind seed,used for feeding of experimental calves were found superior as compare to T<sub>1</sub>, T<sub>2</sub> and T<sub>4</sub> treatments.
2. Significantly more dry matter intake was noticed in T<sub>3</sub> followed by T<sub>2</sub>, T<sub>4</sub> and T<sub>1</sub>. It indicates that there was increase in the daily DM intake when 40% tamarind seed was incorporated with 60% concentrate in the rations of calves.
3. Maximum growth rate (weight gain) was obtained by feeding 60% concentrate + 40% tamarind seed.
4. Body measurement (chest girth, body length and body height) of calves under treatment T<sub>3</sub> (60% concentrate with 40% crushed tamarind seed) proved to be statistically significant effect.
5. The cost of feeding /day/ calves was less in T<sub>2</sub> as compared to T<sub>1</sub>, T<sub>3</sub> and T<sub>4</sub>.
6. The cost / kg body weight gain was lowest in T<sub>2</sub> (80% concentrate + 20% tamarind seed) over other feeding.
7. Economic point of view mixing of crushed tamarind seed with concentrate is feasible.

Hence, it is concluded that growing calves can be efficiently raised on feeding of crushed tamarind seeds supplemented diet upto the certain proportion as evident from the increased dry matter intake which resulted into significantly more body weight gain and also improves the health of experimental growing calves.

## **IMPLICATIONS**

In present investigation, the experimental calves significantly gained more weight on influence of supplementation of crushed tamarind seeds with concentrate mixture. This indicated that, crushed tamarind seeds used as feed supplement potentially beneficial to calves by approving the balance of nutrient. As the tamarind seeds are easily available in villages so farmers can easily get that. The present investigation showed that the tamarind seed can be feed to animals as a protein source in combination with concentrate. While feeding during investigation, there was no adverse effect on the health of experimental calves, this crushed tamarind seeds could supplement safely by farmers in scarcity area.

## CHAPTER VI

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