

**EFFECT OF FEEDING AZOLLA MEAL ON GROWTH
PERFORMANCE IN OSMANABADI KIDS.**

T H E S I S

Submitted

in partial fulfillment of the requirements for the degree of

**MASTER OF VETERINARY SCIENCE
IN
LIVESTOCK PRODUCTION AND MANAGEMENT**

**BY
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Enrolment No.-V/12/138

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2019

DECLARATION OF STUDENT

I hereby declare that the experimental research work and interpretation of the thesis entitled “**Effect of feeding Azolla meal on growth performance in Osmanabadi kids.**” or part thereof has not 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 materials used and all assistance received during the course of investigation have been duly acknowledged.

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This is to certify that the thesis entitled “**EFFECT OF FEEDING AZOLLA MEAL ON GROWTH PERFORMANCE IN OSMANABADI KIDS.**” submitted by Shri. **PANDHARE KHANDU SOMA** to the Maharashtra Animal and Fishery Sciences University in partial fulfillment of the requirement for the degree of **MASTER OF VETERINARY SCIENCE** has been approved by the Student’s Advisory Committee after oral examination in collaboration with the External Examiner.

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ACKNOWLEDGEMENT

*It gives me a great pleasure to express my deepest sense of profound respect and whole hearted gratitude towards my honorable research guide **Dr. A. V. Khanvilkar**, Associate Professor and Head, Department of Livestock Production and Management, KNP College of Veterinary Science, Shirwal, for his invaluable guidance, execution and pursuance of the present research project. I shall forever remain an admirer of his interest in work, his deep knowledge and his approach to the subject, his confidence, his love for his students and department and his constant invaluable guidance, constructive counsel, parental kindness and unreserved help throughout my entire research work and post-graduation studies, all of which make him unforgettable personality. I will forever remain proud of him for his continuous encouragement and appreciation.*

*I thank **Dr. S. T. Hande**, Assistant professor, Department of Livestock Production and Management, from the bottom of my heart for his keen interest, critical evaluation, constructive suggestion and painstaking efforts as member of advisory committee. His valuable guidance has made a great difference to my performance.*

*I am very much thankful to **Dr. S. U. Digraskar**, Associate Dean for his cooperation in providing the facilities required, which helped me a lot to complete my research work.*

*I am thankful to my advisory committee members **Dr. V. R. Patodkar** Department of Veterinary Physiology, **Dr. S. M. Bhalerao**, Assistant Professor, Department of Animal Nutrition, **Dr. G. S. Sonawane** SMS, (AGB) and I/C DDR, ILFC, for their timely advice, constant encouragement, valuable guidance and indispensable help in the completion of my work.*

*I would like to express my heartfelt thanks to **Dr. M. Amle**, **Dr. S. Lambate**, **Dr. D. M. Khandagale**, **Degloorkar sir** for the help they have rendered to me during my research work.*

Throughout my life I will cherish the beautiful memories of the days in the

department with my colleagues **Dr. Ranjeet Vedpathak, Dr. Shubham Raut**, for helping me in completion of my research work and supporting me in daily endeavors in the college.

I am profoundly thankful to my beloved seniors, **Dr. Pravin Bodare, Dr. Santosh Pichad, Dr. Ashwini Gaikwad, Dr. Mayur Redekar, Dr. Ajay Jadhav, Dr. Krutika Tarmale, Dr. Atul Walunj** for their guidance, help, support and whole hearted co-operation.

I would like to extend my heartiest thanks to my friends and batchments, **Shrikant, Karan, Udaysir, Aboli, Surekha, Sayali, Bhawna, Mukekar Balkrushna, Shraddha, Aditya, Nitin, Satish, Dhondiram, Rushikesh, Abhijeet, Vitthal, Atul, Kaustubh, Akshay** who have helped me from time to time in every possible way. I will always recollect golden memories of their company during the remarkable two years of my life.

At this point, special mention must be made about **Shri. Hindurao Liman**, owner of the farm where this trial has been conducted who give lot of help for the successful completion of my work. Also **Kaku and Abhay Liman** for helping me to conduct this work successfully.

In this perspective, I wish to exert my eulogy and whole hearted endearment to my respective **Smt. Chaudhari Mavshi** for her commendable help.

I bow my head in front of my parents. I do not have proper words to express gratitude and respect to my beloved parents, **Mother, Father, Grandmother, Late Grandfather**, my **Brother, Sister** and who took pains to bring me up to this stage. Their love, sacrifice, extra-ordinary patience, inspiration and blessings encouraged and inspired me and because of them I am at such a great stage of life.

Last but not least, I am thankful to all those to whom could not mention but, who helped me directly or indirectly during my study at this jubilant institute.

Place: Shirwal

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(PANDHARE KHANDU SOMA)

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LIST OF ABBREVIATIONS

ABBREVIATIONS	FULL FORM
%	Per cent
/	Per
C	Degree Celsius
>	Greater than
ADF	Acid detergent fiber
ADG	Average daily gain
AMG	Average monthly gain
AWG	Average weekly gain
Ad. lib.	Ad. Libitum
ANOVA	Analysis of variance
AZM	Azolla meal
BGA	Blue green algae
BUN	Blood Urea Nitrogen
BW	Body weight
Ca	Calcium
CF	Crude fiber
Cm	Centimeter
DM	Dry matter
DMI	Dry matter intake
DWG	Daily weight gain

EE	Ether extract
ET	Enterotoxemia
<i>et.al.</i>	Ethically all
FAO	Food and Agriculture Organization
FBW	Final body weight
FCE	Feed conversion efficiency
FCR	Food conversion ratio
Fig.	Figure
FMD	Foot and Mouth Disease
G	Gram
GDP	Gross domestic product
GOI	Government of India
Hrs.	Hours
ICAR	Indian Council of Agricultural Research
i.e.	That is
ILFC	Instructional Livestock Farm Complex
IU	International Unit
KFT	Kidney function tests
Kg	Kilograms
LFT	Liver function tests
Lit.	Liters
Min.	Minutes

M.S.	Maharashtra State
MS	Mean sum of squares
NDF	Neutral detergent fibre
NFE	Nitrogen free extract
NRC	National Research Council
NS	Non significant
Rs.	Rupees
SD	Standard deviation
SE	Standard error
SGOT	Serum Glutamate Oxalo Acetate Transferase
SGPT	Serum Glutamate Pyruvate Acetate Transferase
SS	Sum of squares
SV	Source of variation
TA	Total ash
TMR	Total mixed ration
TP	True protein
Viz.	Namely
Wk	Weekly

CHAPTER I

INTRODUCTION

Indian rural people, for their income generation and livelihoods directly depend on the livestock as well as agriculture sectors. Agriculture sector and animal husbandry sector are best sector for Indian economy. Livestock sector is one of the most important sector for Indian economy and providing livelihood support to the rural people for employment and income generation. Animal provides milk, wool, skin, meat and manure to the people.

Goat (*Capra hircus*) is the poor man's cow and first domesticated ruminant around 9000 to 7000 B.C., and is an important livestock species of India, which plays pivotal role in the livelihood, commonly in small, marginal farmers and landless farmers by supplementing family incomes and generating gainful employment. In rural areas most of the families, small and marginal farmers derives their livelihood from goats and due to their multipurpose use like milk, meat, hide, skin and fibre and require low cost for rearing. Hence, it plays important role in the national economy. For achieving the objectives of poverty alleviation, availability of food, employment creation and improvement in rural income, goat farming is the best option. (FAO)

India is the second largest developing country in the world and predominantly an agricultural country with 70% human population is engaged in agriculture. Livestock sector of India is one of the largest sector in the world and has 135.2 million goat. (During 2015-16) Total livestock population was 512.1 million which comprised of 25.6% of the agricultural GDP, while 4.11% of the total GDP. (19th Livestock Census-2012).

In case of goat population, India has second rank in the world. It contributes with 135.17 million goats. (Livestock Censuses, Ministry of Agriculture, GOI, 2012). 'Osmanabadi goat' is a breed of Marathwada region of Maharashtra state. (Motghare *et. al.* 2004). 'Osmanabadi goat' name is given due to their distribution area in Osmanabad district of Maharashtra. Meat production is an important characteristic of

this breed. Therefore these goats are reared mainly in three southern states of India, Maharashtra, Andhra Pradesh and Karnataka, respectively.

The reason behind low productivity in livestock are traditional husbandry practices, improper health care, management and sanitation with the indiscriminate breeding, intermixing of breeds and inadequate health cover, inadequate feed and fodder resources. (Singh and Karim, 1997). Besides that, malnutrition and low genetic potential responsible for low productivity. Green fodder is not available in summer season due to lack of irrigation. Many regions, areas of India, natural pastures and grasses are used as feed for livestock without addition of cultivated fodders and supplementation of concentrate ration which are poor in quality. On the other side, high cost of concentrate feed, gap between demand and supply of feed and fodder is also increasing. One of the major constraint in maintaining livestock is shortage of feed and fodder due to the lack of land availability for growing fodder for animals. To achieve the goal of improving productivity of livestock; a major step would be the Azolla cultivation. Azolla has nutrient accumulation is amazing. Therefore, cultivation of the *Azolla pinnata* will be the best source of substitute feed for livestock industry.

'Azolla' is an important free floating water fern, rapidly growing aquatic plant on water surface which belongs to the family Azollaceae (*Azolla Pinnata*). Azolla can be grown easily, naturally in stagnant water with a simple technology in low cost and it carries both photosynthesis and nitrogen fixation in the leaves. Due to the nitrogen fixing bacteria, an Azolla known as "Live-Nitrogen Manufacturing Factory." Azolla is a small and highly productive wonderful water plant. Azolla is found to be very nutritive, less expensive, economical and efficient organic feed supplement for livestock. Azolla consist of different kinds of species viz., *Azolla pinnata*, *A. nilotica* and *A. maxicana*. Apart from that *Azolla pinnata* is an important variety. Use of Azolla was initially limited as green manure, but now a days it is used as mosquito inhibitor, herbicide, water saver, water purifier and nitrogen fertilizer. Azolla is commonly found in tropical, sub tropical and temperate fresh water

ecosystems. Azolla has greater growing ability with good source of protein and contains almost all essential amino acids, minerals viz., Iron, Ca, P, Fe, Cu, Mn, and Mg. Apart from that, Azolla contains vitamins like vitamin A and vitamin B₁₂. From the observations, Azolla has greater potential source of proteins, vitamins, minerals than other tree leaves. Among them, Azolla contains growth promoters, probiotics and biopolymers (Pillai *et. al.* 2002).

On dry weight basis, it contains 25-35% protein, 7-10% amino acids, 10-15% minerals and 15% of total ash, respectively. (Kamalasanana *et al.* 2002). Azolla makes association with BGA, “Anabaena azollae.” Due to its high nutritive value and fast growth, some research workers also called it as '*Green gold mine or super plant*'. (Wagner, 1997). Azolla improves nutritive value, productivity, cultivation and yield. (Lumpkin and Pluck Nett, 1982, Van Hove and Lopez, 1983) '*Azolla pinnata*' was used as feed in goats (Tamang and Samanta, 1992) and buffalo calves (Indira *et al.* 2009). Azolla meal is an ideal organic cheapest and most abundant potential, rich source of proteins, maintains the soil fertility and biodiversity, also reduces water loss by evaporation, and helps to decrease the global CO₂ levels, while providing high protein livestock feed, or nitrogen rich fertilizer. In a similar way, Azolla used as biofertilizer for wetland rice crops and one of the most economic sustainable efficient feed substitutes for livestock especially for dairy cattle, piggery, sheep, goat, poultry and fishes. Due to increasing cost and heavy deficit of concentrate ingredients, Azolla has been used successfully as a protein supplement for animals and we can save the concentrate feed by 20 to 25% which is very costlier. Because of easy cultivation, production, high productivity and high nutritive value, it is used as a beneficial fodder supplement. Hence, Azolla meal could be unconventional potent feed source and it fulfills the nutrient requirement of livestock. In this context, following objectives will be assessed in Osmanabadi kids pertaining to their growth performance.

OBJECTIVES:

1. To study the proximate analysis of Azolla meal.
2. To study the growth performance of Osmanabadi kids.
3. To assess the effect of different levels of Azolla meal on feed and water intake in growing Osmanabadi kids.
4. To study the biochemical parameters (LFT and KFT) in Osmanabadi kids.
5. To study the farm feeding economics.

CHAPTER II

REVIEW OF LITERATURE

2.1. Chemical composition and nutritive value of Azolla:

Singh, (1977) stated that, due to high CP and mineral content of Azolla, it can be used as feed substitute as forage for cattle.

Buckingham *et al.* (1978) worked on the proximate composition of *Azolla* and reported that, it contains TP, EE, ADF, NDF, cellulose, lignin to be 23.42, 5.05, 15.5, 39.16, 15.19 and 9.27 per cent, respectively.

Reddy and Reddy, (1979) investigated the proximate composition of water hyacinth meal to be 15.39, 14.93, 1.41, 52.59, 15.68, 2.50 and 0.92 per cent of CP, CF, EE, NFE, Total ash, Calcium and Phosphorous, respectively.

Singh *et al.* (1983) worked on nutritive value of a water fern (*Azolla anabaena*) and he reported that, the CP, NDF, and total ash on dry matter basis in *Azolla* were 29.2, 41 and 23.6 per cent, respectively.

Lumpkin, (1984) reported that, *Azolla* is a good source of protein and the total protein content is about 25-30%. Also, he analysed that it contained vitamins, minerals, amino acids, chlorophyll and nitrogen with best feed source for livestock.

Tamang *et al.* (1992) analysed nutritive value of *Azolla* (*Azolla pinnata*) and its well potentially of feeding goats and reported that, sun dried Azolla was rich in crude protein (25.87 %) and the total ash content (15.32%) but, high in lignin (17.48%) and acid insoluble ash (10.00%).

Becerra *et al.* (1995) analysed *Azolla* and reported that, the DM content to be 5.6 per cent, crude protein 26.7per cent , crude fibre 11.0 per cent, ether extract 4.6 per cent, Calcium 0.8 per cent and Phosphorous 0.4 per cent, respectively.

Van Hove and Lejune, (1996) stated that, *Azolla* is very rich in proteins, vitamins, (vitamin A, vitamin B₁₂ and beta-carotene), minerals like Ca, P, K, Mg, Cu and growth promoter intermediaries etc. Due to its nutrient composition it is easily digested feed for livestock. For centuries, it has been recognized as useful plant in southern china and northern Vietnam, where it has been used as a biofertilizer and green manure for rice crop due to its N- fixing abilities.

Sanginga and Van Hove, (1998) observed that, all strains of *Azolla* contain similar proportion of essential (55%) and non-essential (45%) amino acids. like leucine, lysine, arginine, phenylalanine and tyrosine were mostly observed. While sulphur containing amino acids such as methionine and cystine are negligible in amount.

Gevrek, (2001) reported that, on dry-weight basis *Azolla* has a high protein nearly about 23-37%.

Basak *et al.* (2002) reported from experiment that, the chemical composition of *Azolla meal* which found that moisture, crude protein, crude fibre, ether extract, nitrogen free extract and total ash on dry matter basis to be 90.8%, 25.78%, 15.71%, 3.47%, 30.08% and 15.76%, respectively.

Kamalasanana *et al.* (2002) reported that, on a dry weight basis *Azolla* has 25-35% protein content, 10-15% mineral content and 7-10% comprising a combination of amino acids, bio-active substances and biopolymers. *Azolla* is the most economic and efficient feed substitute for livestock and it can be fed to sheep, goat, pig and rabbits, chicken as feed substitute.

Pillai *et al.* (2002) were reported that, *Azolla* is a free floating water fern contain very rich in protein, essential amino acids, vitamin A, B₁₂, B-carotene and minerals like calcium, phosphorous, iron, copper, potassium, manganese with growth promoters.

Rastogi, (2005) studied *Azolla*, then reported that, *Azolla meal* contains 25 per cent protein and also reported to be ideal feed substitute for cattle, pigs and poultry.

Alalade and Iyayi, (2007) reported that, *Azolla* contains 21.4 per cent crude protein, 12.7 per cent crude fibre, 2.7 per cent ether extract, 16.2 per cent ash and 47.0 per cent nitrogen free extract. The concentration of calcium and phosphorous in *Azolla* feed was 1.16 per cent and 1.29 per cent, respectively.

Aziz, (2006) revealed that, *Azolla* is good feed for poultry, fish and livestock due to its balanced amino acids, CP 20.4-31.4 per cent, CF 11-21 per cent.

Dhage *et al.* (2007) concluded that, the total gain in body weight were 3.55, 3.93, 4.05 and 2.38 kg by feeding *Azolla meal* with the level of 0, 15, 25 and 35 per cent of the ration, respectively and concluded that, the *Azolla meal* in concentrate and can be included up to 25% level without any adverse effect on growth performance of Osmanabadi goat.

Ebrahim *et al.* (2007) reported that, the chemical composition of *Azolla meal* with dry matter basis contained moisture about CP 20-34 per cent, CF 9.1 per cent, EE 3-3.3 per cent, and total ash about 10.5 per cent, respectively.

Wadhvani *et al.* (2007) studied feed efficiency on experimental lambs grouped under TMR-1, TMR-2 and TMR-3 containing 0, 10 and 20 per cent *Azolla meal* to be 8.10%, 10.90%, 13.16% respectively. They also stated that, the feed cost

per kg dressed weight during the experimental period to be Rs. 47.64, 31.02 and 28.35 in TMR-1, TMR-2 and TMR-3 groups, respectively.

Balaji *et al.* (2009) observed that, the sun dried ground *Azolla meal* contained CP, CF, EE, NFE and total ash to be 24.5, 14.9, 3.7, 39.90 and 17 per cent, respectively.

Pascal Leterme *et al.* (2010) reported that, on dry matter basis *Azolla* contained protein 25.35 percent, amino acids 10.15 percent and biopolymers. *Azolla* can be easily digestible by the livestock, due to high protein and low lignin content.

Gouri *et al.* (2012) evaluate the chemical composition of sun dried *Azolla* on dry matter basis and reported that, it contains crude protein 15.4, crude fibre 14.1, nitrogen free extract 47.4, ether extract 2.7 and total ash 20.4 per cent, respectively.

Giridhar and Rajendra, (2012) estimated the *Azolla* nutritive value on dry matter basis, it contained 19 per cent crude protein, 4.8 per cent fat and dry matter about 5.3 per cent.

Cherryl *et al.* (2014) experimented on the nutritive value of *Azolla pinnata* as a feed and he reported that, it is a good source of protein with contains almost all essential amino acids, minerals such as iron, calcium, phosphorous, magnesium and manganese with good source of vitamin A, vitamin B₁₂. Sundried *Azolla meal* contained 89.73 per cent DM, CP 23.49 per cent, CF 14.7 per cent, EE 3.7 per cent, total ash 24.26 per cent, acid insoluble ash 7.94 per cent, Ca 2.58 per cent and P 0.26 per cent, respectively.

Bhilawade *et al.* (2015) analyzed the chemical composition of *Azolla meal* and he noticed that, the DM, CP, CF, EE, NFE, and Ash content in *Azolla meal* were 90.20, 24.18, 17.65, 3.90, 45.84 and 8.43 per cent, respectively.

Rawat *et al.* (2015) studied the chemical examination of sun-dried, ground Azolla which contained 24.1% CP, 3.75% EE, 15.1% CF, 40.25% NFE, 16.8% Ash, 2.18% Calcium and 0.47% Phosphorous, respectively.

Anitha *et al.*, (2016) studied the nutritive potential of *Azolla pinnata* as an animal feed with containing, dry matter 4.7 per cent, crude protein 22.48 per cent, ether extract 4.5 per cent, crude fibre 14.7 per cent, nitrogen free extract 40.98 per cent, total ash 17.34 per cent, calcium 1.64 per cent, phosphorous 0.34 per cent and potassium 2.71 per cent, respectively.

Debashis *et al.* (2016) reported that, sun-dried *Azolla meal* rich in protein (32.05 per cent) and total ash 18.25 per cent with less contained fibre.

2.2. Effect of feeding Azolla meal on growth performance:

Shinde *et al.* (2000) conducted experiment on eighteen Osmanabadi kids with feeding value of ber leaves for their growth performance. These kids were three months of age and divided into two groups with given a standard feed (T₁) or Ber leaves (T₂) as a sole feed for a period of three months. The DM, DCP and TDN intake were significantly higher in T₂ group than T₁. Similarly, the digestibility also higher in T₂. DCP and TDN were 55.54 and 57.90 per cent and 7.47, 8.01 in T₁ and T₂, respectively. They found that, weight gain was higher in T₂.

Das and Satapaty, (2006) revealed that, growth and feeding performance were better in goat fed guinea grass due to its higher protein content. Besides that, average daily weight gain, average daily DM intake and DM intake/100 kg body weight were non-significantly higher in goat reared on 70 per cent green roughage than that on 100 per cent roughages feeding.

Dhage *et al.* (2007) investigated that, the total gain in body weight was 3.55, 3.93, 4.05 and 2.38 kg by feeding *Azolla meal* at the level of 0, 15, 25 and 35 per cent of the ration, respectively and suggested that *Azolla meal* in concentrate can be included up to 25 per cent level without any adverse effect on growth performance of Osmanabadi goat.

Wadhvani *et al.* (2007) concluded that, the feed efficiency in experimental lambs treated under TMR-1, TMR-2, and TMR-3 groups containing 0, 10, and 20 per cent *Azolla meal* to be 8.10, 10.90 and 13.16 per cent, respectively. They additionally reported that, the cost per kg dressed weight during the experimental period to be Rs. 47.64, 31.02 and 28.35 for TMR-1, TMR-2 and TMR-3 groups, respectively.

Kale *et al.* (2009) reported that, the eighteen weaned kids with similar age were offered to three groups of ration. The rations were T₀ grown jowar straw 60% + concentrate 40%, T₂ group fed with jowar straw 30% + soybean straw 30% + concentrate 40% and T₃ with 60% soybean straw + concentrate 40% on dry matter basis. It indicated that, the total body weight gain was significantly higher in T₂ group followed by T₁ and T₀.

Roy *et al.* (2010) revealed that, the live weight gain of the goat was 73.48, 75.59, 74.45, 81.24 and 87.50 g/d in groups CBP, SBP, LBP, respectively. The daily weight gain and feed conversion efficiency was better for the legume based pellets followed by the grass based pellet. The lowest feed conversion ratio was found in LBP group followed by GBP groups. Therefore, they concluded that, legume based pellet diet has maximum effect on growth performance of Black Bengal goat.

Shital *et al.* (2012) conducted research trial on eighteen Osmanabadi kids of three months age and grouped into three treatments. T₁ (control), T₂ (15% concentrate replaced with *Azolla meal*), T₃ (25% concentrate was replaced with *Azolla meal*). They reported that, on DMI basis, body weight during the

experimental period were found significantly superior in T₂ treatment. Also the apparent digestibility was higher in treatment T₁ followed by T₂, T₃. With live weight gain having total cost per kg for T₁, T₂, and T₃ were found to be Rs. 40.49, 39.27 and 81.68, respectively. The results showed that, Azolla meal can be included up to 15 per cent of total concentrate requirement of growing kids.

Adake, (2015) studied the body weight of kids as T₁, T₂ and T₃ treatment groups to be 14.69, 14.82 and 15.72 kg, respectively. At the end of experimental trial final body weight was an about 16.97, 19.82 and 21.25 kg, respectively in T₁, T₂, and T₃ treatments group. The weekly gain in body weight per kids were 0.75, 1.66 and 1.83 kg in treatment group.

Ahmed *et al.* (2015) conducted experiment, the performance of growing sheep on Azolla based diets. 20 male Corridale sheep (3 months of age) were divided into five equal groups viz, T₁, T₂, T₃, T₄ and T₅ and fed on measured quantity of concentrate mixture containing 0, 6, 12, 18 and 24% Azolla replacing 0, 25, 50, 75 and 100% linseed cake respectively. Measured quantity of good quality oat hay was offered to all the groups as per their body weight to meet their requirement. They observed the significant difference in body weight, DM digestibility, FCR and Cost of feeding and concluded that, azolla can be added in the diet of growing sheep at 6% level replacing linseed cake without any adverse effect on the performance of the animals.

Kumari Jyoti and Kumar Sanjay (2014) conducted feeding trial for 90 days on eighteen growing male kids of 3-4 months of age, divided into three groups and six kids in each group, having average body weight was 5.72 ± 0.88 kg. They fed graded level of Azolla meal (0, 20 and 40%) mixed in concentrate mixture with green fodder berseem. In these study different parameters such as feed conversion efficiency, body weight gain were 7.49 ± 0.041 , 7.04 ± 0.06 , 8.93 ± 0.05 (Feed/gain), and 4.53 ± 0.08 kg, 5.43 ± 0.01 kg, 4.11 ± 0.03 kg in T₁, T₂, T₃ groups of goat, respectively.

Debashis *et al.* (2016) concluded that, body condition score (BCS), body weight and dry matter intake were not affected by dietary supplementation of *Azolla pinnata*. It is replaced with concentrate mixture and improved ($P < 0.01$) fortnightly weight gain, average daily gain (ADG) and feed conversion efficiency. (FCE)

Bansode *et al.* (2017) observed that the growth performance of Osmanabadi kids under conventional and loose housing. All the experiment was conducted up to 16th week with daily recording of growth rate during experiment period from 01.06.2016 to 31.09.2016. The mean weekly body weight recorded for conventional and loose housing system was 6.97 ± 0.14 and 7.81 ± 1.77 kg, respectively.

Toradmal *et al.* (2017) conducted 60 days feeding trial with growth performance on Osmanabadi kids. They divided twenty kids into four groups of 3-4 months of age on the basis of weight. The feeding treatment consisted of T₁ i.e. Extensive feeding + Conc. (As per thumb rule) + Control, T₂ with extensive feeding + Conc. + 100 gm green *Azolla*, T₃ with extensive feeding + Conc. + 200 gm green *Azolla* and T₄ with extensive feeding + Conc. + 300 gm green *Azolla* respectively. He concluded that, maximum growth rate (weight gain) was obtained in T₄ with more dry matter intake and improving health of goat kids.

2.3. Effect of feeding Azolla meal on feed intake:

Patnayak, (1983) observed that, the nutrients intake by feeding Azolla meal was more than the requirement for maintenance in Indian goat and sheep.

Parnekar *et al.* (1986) studied on sheep feed on sun dried *Azolla* and reported that, they could consume on an average 3 kg DM/100 kg body weight in a week time. Thus, palatability was not problem for sheep they reported that the daily DM intake of sun dried *Azolla* was 60- 67 g/kg body weight.

Arieli *et al.* (1990) concluded that, the *Ulva lactuca* an aquatic plant could be

supplemented as a low-energy high-nitrogen feed in the diet of lambs.

Tamang and Samanta, (1993) conducted an experiment digestibility coefficient of all nutrients except NFE, EE, cellulose in feeding value of Azolla an aquatic fern in Black Bengal goats. Sundried Azolla replaced 0, 10, 20 and 50 per cent in a standard diet in a 90 days growth trial. At 50 per cent replacement, the goats showed profuse diarrhoea and this diet was discontinued. The remaining group showed, no significant difference in DM intake/100 kg body weight and weight gain. The production of total volatile fatty acids in the rumen was highest with 20 per cent Azolla ($P < 0.01$). The results suggested that, up to 20 per cent Azolla can be incorporated in concentrate for goat without any adverse effect.

Verma *et al.* (1995) reported that, the average DM intake of Casuarinas leaves feed to goat was 5.340 ± 28 kg/100 kg body weight

Ventura *et al.* (1998) reported that, Seaweed (*Ulva lactua*) organic matter, crude protein digestibility of goat to be 51.2, 14.7 per cent, respectively.

Rajmane and Deshmukh, (2000) reported that, three complete ration containing sorghum straw (CR I), soybean straw (CR II) and corn cobs (CR III) each at 60% level and concentrates mixture at 40% level were evaluated for their nutritive value in Osmanabadi goat. The DMI was 615, 924 and 782 gm/day, respectively for CR I, to CR III. There were significant differences in apparent digestibility of all nutrients except CP among rations. The per cent DCP and TDN of CR I, CR II and CR III were 6.85 and 47.94, 8.32 and 57.89 and 7.18 and 63.58; respectively.

Jadhav *et al.* (2005) reported that, nutritional value of Gliricidia (*Gliricidia maculate*) tree leaves while fed to six Osmanabadi male kids for period of 29 days and reported that, the goats on an average consumed 4.07 ± 0.24 kg DM for 100 kg body weight on sole feeding indicating that, Gliricidia fodder was palatable to the goat.

Dhumal *et al.* (2009) observed non-significant differences in weekly feed consumption between control, 2.5 and 5 per cent Azolla feed groups.

Wadhvani *et al.* (2007) fed Marwari and Merino with Patanwadi weaner lambs of 4 months. Utilization of non-conventional ingredients including sun-dried azolla at 10 per cent and 20 per cent in the diets. Lower dry matter and protein digestibility but higher DM and protein intake was reported. Azolla had no effects on carcass traits and cost of feed was lower.

Reddy *et al.* (2011) studied the nutrient utilization of Azolla and sheanut cake in Nellore sheep under different management systems. The sheep were fed control ration (T₁), concentrate diet with replacement of 30 parts of GNC with Azolla (T₂), concentrate diet replacement of 16 parts of Rice bran with Sheanut cake (T₃) and concentrate diet containing replacement of 30 parts of GNC with Azolla and 16 parts of Rice bran with Sheanut cake (T₄). Significantly ($P < 0.05$) higher dry matter intake (kg) per day was recorded for experimental concentrate mixtures T₂ and T₃ compared to T₄ in both the system of management. The dry matter intake/100 kg body weight was significantly ($P < 0.01$) higher in semi intensive system than intensive system.

Shital *et al.* (2012a) concluded that, the effect of different levels of Azolla meal on feed intake of Osmanabadi kids *viz*; T₁ (control), T₂ (15% concentrate was replaced with Azolla meal), T₃ (25% concentrate was replaced with Azolla meal). They reported that, the average daily dry matter intake per kid was higher in treatment T₂ (0.35 kg) followed by T₁ and T₃ (0.34 and 0.33 kg), respectively.

Shital *et al.* (2012b) fed adult Nellore sheep, 12-14 months, replacement of 30% of the groundnut meal with dried azolla. Better nutrient digestibilities observed

but lower intake was reported.

Bhilawade, (2015) studied the average daily dry matter intake per 100 kg body weight in T₁, T₂ and T₃ treatment group were 3.07, 3.28 and 3.53 kg, respectively. The corresponding figure of per day dry matter intake of the treatment groups T₁, T₂ and T₃ were 0.562, 0.608 and 0.662 kg, respectively. The difference among different treatment groups were statistically significant ($P < 0.05$) the dry matter intake was noticed more in T₃ followed by T₂ and T₁. It indicates the influence of supplementation of roughages, Azolla meal and concentrate mixture improves the dry matter intake.

Kumar *et al.* (2012) studied the average dry matter intake (gm/day) during whole period of experimental feeding was similar in control (1539.28) and treatment group (1708.92) This shows that the incorporation of Azolla in the place of concentrate mixture had no adverse effect on the palatability of the pellet.

Das *et al.* (2017) studied the eighteen Jalauni lambs (n=18, average BW 22.43 kg) of similar sex and age were divided in to three groups of 6 animals each to study the effect of Azolla meal as a replacer for mustard cake protein on nutrient intake and utilization. In control group (T₁), the animals were fed ad lib. green chaff of MP chari (a variety of Sorghum bicolor) with concentrate mixture as per requirement (ICAR, 1998) whereas in groups T₂ and T₃ the CP of mustard cake was replaced @ 25% and 50% with Azolla meal protein in the concentrate mixtures C₁ and C₂, respectively. Average DMI was 3.90, 3.77 and 3.49% of the live BW in groups T₁, T₂ and T₃, respectively. Digestibility of DM and OM was comparable in T₁ (61.43, 64.98%) and T₂ (59.91, 62.97%), however that, it was higher than in T₃ (51.57, 56.51).

Toradmal *et al.* (2017) conducted 60 days feeding trial with growth performance on Osmanabadi kids. He divided twenty goat kids into four groups of 3-6 months of age on the basis of weight. The feeding treatment consisted of T₁ i.e. Intensive feeding + Conc. (As per thumb rule) +Control, T₂ with intensive feeding + Conc. + 100 gm green *Azolla*, T₃ with intensive feeding + Conc. + 200 gm green *Azolla* and T₄ with intensive feeding + Conc. + 300 gm green *Azolla*, respectively. In intensive feeding dry, green and conc. was provided as per thumb rule (ICAR, 1985) to all groups. The average daily dry matter intake per kid per day was higher in treatment T₄ (0.64kg) followed by T₃ (0.62kg), T₂ (0.58kg) and T₁ (0.57kg), respectively.

2.4. Effect of feeding Azolla meal on Water intake:

Ludri and Singh, (1987) reported that, water consumption rates were directly correlated with maximum ambient temperature and not with the dry matter (DM) intake.

Qinisa and Boomker, (1998) studied feed selection and water intake of indigenous goat. Six indigenous (Ped) goat wethers (18 months old) with an average body mass of 25.1 kg were fed five diets, consisting of a mixture of Lucerne (*Medicago sativa*) and teff (*Eragrostis teff*) in a cafeteria style arrangement (trial1). The diets were formulated to be iso- caloric with crude protein levels of 7, 9, 11, 13 and 15 per cent. In trial2, the 15 per cent CP diet was excluded. Intake of DM was highest on the highest CP diet and declined rapidly on the diets where the CP content was lower. Water was available *ad-lib.* leading to an average daily water intake of 1.4 ± 0.4 litres in both trials. It was concluded that goats have the ability to select for a higher protein diet and can utilize less water than sheep.

Srinivasulu *et al.* (1998) studied the feeding experiment in sheep and goat, the water intake (kg/kg DMI) in sheep and goats was 3.34 ± 0.76 and 1.96 ± 0.37 , respectively.

Pailan and Singhal, (2000) studied the effect of dietary protein sources on water metabolism in lactating goat. The average total intake of water from all the

sources in group I was 5.524 ± 0.257 kg and in group II 5.516 ± 0.199 kg. The value for total water excretion was 1.649 ± 0.073 and 1.678 ± 0.147 kg for group I and II, respectively. Insensible water loss was 3.875 ± 0.197 kg in group I and 3.838 ± 0.118 kg in group II. The result indicated that dietary sources of protein did not affect water metabolism in lactating goat.

Giger *et al.* (2011) studied that water intake of dairy goat were scare, especially in temperate climates. Total water intake (TWI) was directly proportional to DMI (3.32l/kg) as well as to the water drunk (2.49l/kg). There was a substitution between water drunk and water taken in with the feed. Dietary crude protein content and percentage of hay are positively correlated to the ratio of TWI/DMI, but the dietary NDF content was not correlated with this ratio. These data pointed out the ability of goats kept in temperate climates to use water more efficiently than other ruminants.

Tsado *et al.* (2013) investigated water intake and influence of ambient temperature on carcass characteristics of Savannah Brown goat fed graded levels of maize cob diets. The result showed that, ambient temperature had significant ($P < 0.05$) correlations with water intake and feed intake.

Adake, (2015) studied the average daily water intake per 100 kg body weight was 5.93, 5.80 and 5.81 liters in treatments groups T1, T2 and T3, respectively. The differences in water intake were statistically non significant and water intake per 100 kg body weight were also found non-significant. It was observed that there was no any significant difference in water intake when Osmanabadi kids were fed Azolla, wheat straw and concentrate mixture.

Bhilawade, (2015) studied the average daily water intake per 100 kg body weight was 4.96, 5.43 and 6.14 litres in treatment groups T1, T2 and T3, respectively. The corresponding figure of per day water intake was 0.821, 0.954 and 1.110 litres in treatment groups T1, T2 and T3, respectively. The

difference among different treatment groups were statistically significant ($P<0.05$). The water intake was noticed more in T₃ followed by T₂ and T₁ when Osmanabadi kids were fed lucerne green, jowar straw and concentrate mixture with Azolla meal.

Wagh, (2015) studied the average daily water intake per 100 kg body weight was 5.69, 6.15 and 6.54 litres in treatment groups T₁, T₂ and T₃, respectively. The corresponding figure of per day water intake was 0.720, 0.780 and 0.830 litres in treatment groups T₁, T₂ and T₃, respectively. The difference among different treatment groups were statistically significant ($P<0.05$). The water intake was noticed that more in T₃ followed by T₂ and T₁ when kids were fed Berseem green, jowar straw and concentrate mixture with probiotic supplementation.

Jadhav, (2016) studied the average daily water intake per 100 kg body weight was 6.94, 7.33 and 6.82 litres in treatment groups T₁, T₂ and T₃, respectively. The difference among different treatment groups were statistically significant ($P<0.05$) the water intake was noticed more in T₂ followed by T₃ and T₁ when crossbred heifers were fed lucerne green, jowar straw and concentrate mixture with Azolla meal.

2.4.1. Body Condition Score:

Debashis *et al.* (2016) concluded that, body condition score (BCS), body weight and dry matter intake were not affected by dietary supplementation of *Azolla pinnata*. It is replaced with concentrate mixture and improved ($P<0.01$) fortnightly weight gain, average daily gain (ADG) and feed conversion efficiency. (FCE)

Toradmal *et al.* (2017) conducted 60 days feeding trial with growth performance on Osmanabadi kids. They divided twenty goat kids into four groups of 3-6 months of age on the basis of weight. The feeding treatment consisted of T₁ i.e. Intensive feeding + Conc. (As per thumb rule) +Control, T₂ with intensive feeding +

Conc. + 100 gm green *Azolla*, T₃ with intensive feeding + Conc. + 200 gm green *Azolla* and T₄ with intensive feeding + Conc. + 300 gm green *Azolla*, respectively. The average daily gain in body weight of experimental kids was more in T₄ (0.098kg) followed by T₃ (0.087 kg), T₂ (0.069 kg) and less in T₁ (0.068kg). The average total gain in body measurement (chest girth, body length and body height) of kids which received green *Azolla* treatments showed significant effect with conc. mixture. They concluded that, supplementation of green *Azolla* (*Azolla pinnata*) and concentrate in the diet is beneficial to increase body weight gain and improving health of kids.

2.5. Effect of feeding Azolla meal on blood serum biochemical parameters:

Reddy *et al.* (2010) reported that, the blood biochemical profiles of the experimental Nellore sheep were within the normal range in all dietary treatment fed *Azolla* and shenut cake but serum albumin level of weaner were significantly higher in T₂ diet (concentrate with replacement of GNC with *azolla*) in intensive system and in semi-intensive system.

Kumari Jyoti Kumar Sanjay, (2014) conducted feeding trial for 90 days on eighteen growing Black Bengal male kids, of 3-4 months age. They had divided these kids into three groups and six kids in each group, they fed graded level of *Azolla* meal (0, 20 and 40 per cent) mixed in concentrate mixture with green fodder berseem and reported the blood biochemicals parameters like glucose level varied in T₁(60.98) and T₂ (64.50) groups. However, 20% *Azolla* meal supplemented group had higher glucose level than control group. Also the total protein, albumin, globulin level with albumin globulin ratio higher in T₂ group as compared to control group. However, blood urea nitrogen (BUN) level in blood serum was lower in T₂ and T₁ groups as compared to T₃.

Kotresh *et al.* (2017) experiment was carried out on Malabari male kids, to study the response of broiler goat concentrate diet on haemato-biochemical profiles. Pre-weaned male kids (14) were randomly allocated to two groups. Kids of T₁ group

were allowed to suckle their does till 12 weeks. Kids of T2 group were weaned at the age of two weeks and were reared intensively till 12th week by feeding semisolid concentrate diet. Though Hb, PCV, RBC and TLC were not significantly different at 2nd week, at 12th week there was significant difference between all the parameters. MCV differed significantly ($P<0.01$) between groups at 12th week. The glucose and total protein levels differed significantly ($P<0.01$) at 12th week. The levels of BUN at 2nd and 12th week significantly ($P<0.05$) higher in T2 group. It was concluded that, the broiler goat production system had significant influence on the haemato-biochemical profiles of Malabari goat kids.

Kumar *et al.* (2016) studied the effect of Azolla supplementation on semen quality, haematology and rumen metabolites in Barbari bucks under the intensive management system. Ten bucks were randomly divided into control (n=5) and treatment (n=5) groups. Both the groups were fed concentrate pellet @ of 400 g daily and adlibitum Bengal gram straw. In the treated group fresh green Azolla was supplemented @ of 100 g/buck daily for 120 days. Blood samples from each buck were collected after 90 days of experimental feeding. Without affecting the haematology and rumen metabolites, supplementation of fresh Azolla improved the reaction time and progressive motility of spermatozoa in Barbari bucks.

2.6. Effect of feeding Azolla meal on farm economics:

Wadhvani *et al.* (2007) studied that, the feed efficiency in experimental lambs reared under TMR-1, TMR-2 and TMR-3 groups containing 0, 10 and 20 percent Azolla meal to be 8.10, 10.90 and 13.16, respectively. He further reported that the feed cost per kg dressed weight during the experimental period to be Rs. 47.64, 31.02 and 28.35 in TMR-1, TMR-2 and TMR-3 groups, respectively.

Shital *et al.* (2012) reported that, the total cost per kg live weight gain for T1, T2 and T3 were found to be Rs. 40.49, 39.27 and 81.68, respectively. Hence, the use of Azolla meal comparatively profitable when included up to 15 per cent of total

concentrate requirement of growing Osmanabadi kids.

Kumari Jyoti and Kumar Sanjay, (2014) Economics of production is concerned total feed cost of T1, T2 and T3 are Rs. 614.06, Rs.635.00 and Rs.599.55, respectively. Initial body weight(kg) of goat of T1,T2 and T3 are 5.76, 5.73 and 5.66 respectively and Net body weight(kg) gain of goat of T1, T2 and T3 are 4.54,5.48 and 4.12, respectively. Thus Cost of production/kg body weight (Rs.) are 135.37, 115.87 and 145.50, respectively. Hence, economically also (20% Azolla) is beneficial.

Adake, (2015) studied the cost of the feed per goat kid for the experimental period of 63 days was Rs. 265.23, Rs. 217.35 and Rs. 193.91 treatments groups T1, T2 and T3, respectively. The cost of feeding/day/goat was lowest in T3 as compare to T2 and T1 indicated that the higher amount of Azolla used in goat kids feeding decreased the cost of feeding. The cost of feeding was lowest in T3, which can be beneficial to goat owners by getting higher monetary returns by selling of animals due to higher growth rate.

Bhilawade, (2015) studied the cost of the feed per kid per day was Rs. 6.55, Rs. 6.02 and Rs. 5.73 in treatment group T1, T2 and T3 respectively. The cost of feeding/day/kid was less in T3 as compared to T2 and T1 indicated that lower proportion of concentrate mixture used with Azolla meal in goat kid feeding lowered the cost of feeding. As the cost of feeding is lower in T3, which can be beneficial to goat owners by getting higher monetary return by selling of animals due to higher growth rate.

Ahmed *et al.* (2016) reported that, lowest cost of feeding per kg of gain was observed in (Corridale sheep) T2 group and it had significant difference with T3, T4 and T5 group but not with T1 group (control). No significant difference was also observed among T3, T4 and T5 group but significantly higher cost of feeding

per kg of gain than T1 (control) group was observed in T3, T4 and T5 group.

Toradmal *et al.* (2017) reported that, the total cost per day per kid for T1, T2, T3 and T4, were found to be Rs.6.98, 11.21, 15.11 and 19.01, respectively, but cost of feeding per kg body weight was found Rs.105.62, 106.46, 87.07 and 77.30, respectively. The cost of feeding /day /treatment were lowest in T1 as compare to T2, T3 and T4 indicated that, higher proportion of Azolla used in goat kid feeding, increased the cost of feeding.

CHAPTER III

MATERIALS AND METHODS

3.1. Place of research work:

The present research work entitled, "Effect of feeding Azolla meal on growth performance in Osmanabadi kids" was carried out at "Pancharatna Goat Farm", Khandala, Tal. Khandala. Dist. Satara of Maharashtra for the period of 90 days, during the month of April to June 2019. Whereas, feed analysis were undertaken in the Department of Animal Nutrition and blood samples were analysed at Central Instrumentation Facility (CIF) of KNP College of Veterinary Science, Shirwal, Tal. Khandala, Dist. Satara. (M. S.)

3.2. Environmental Conditions:

The climatic condition in and around Khandala is hot and dry, except during the monsoon season. From later half of February month, temperature increases gradually till the first week of June. During this period maximum temperature was around 34-40° celsius and the corresponding relative humidity was maximum 55%. The average rainfall varies between 500-800 mm.

3.3. Selection of Experimental animals:

The present research work entitled "Effect of feeding Azolla meal on growth performance in Osmanabadi kids". were undertaken with 18 healthy and growing Osmanabadi kids which were of 03 to 06 months age of either sex with uniform body size and weight (8 to 10kg) were selected. They were randomly divided into 3 groups like T₀, T₁ and T₂ as treatments involving six kids in each group. (T₀) was the control group, (T₁) and (T₂) were the treatment groups. Deworming of all the experimental kids were done before the start of experiment and were given 15 days adaptation period to avoid errors due to stress before the actual work. Kids were maintained in the Pancharatna Goat Farm, Khandala for the period of three months.

Table no. 3.1. Details of experimental Osmanabadi kids.

Groups	Tag Nos.	Initial bodyweight(kg)	Average body wt.
T0	01	11.7	10.36
	08	10.0	
	10	8.8	
	03	9.2	
	13	10.5	
	17	12	
T1	07	9.3	10.55
	02	9.9	
	16	12	
	12	10.5	
	05	10.9	
	14	10.7	
T2	04	8.8	10.43
	09	9.1	
	60	10.6	
	11	12	
	15	10.8	
	18	11.3	

3.4. Azolla meal preparation:

Azolla was procured from 'Azolla unit' of Instructional Livestock Farm Complex, Krantisinha Nana Patil College of Veterinary Sciences, Shirwal and were sundried. Simultaneously, the nutritional composition of prepared Azolla meal and concentrate mixture were subjected for proximate analysis in the Department of Animal Nutrition, Krantisinha Nana Patil College of Veterinary Sciences, Shirwal, Khandala, Dist. Satara. (M. S.)

The blood samples of all the eighteen experimental kids were collected fortnightly for blood biochemical analysis by standard procedure. At the end of

experimental trial, farm economics were calculated. The details of treatments will be as, follows:

Table no. 3.2: Details of feeding management (treatment) schedule for the experimental animal groups.

Sr. No.	Experimental Groups	No. of experimental animals	Experimental (prepared) Diet	Period of experiment (days)
1.	T₀	06	Dry+ Green + Concentrate Mixture	90
2.	T₁	06	Dry+ Green+ Azolla meal (15%) + Concentrate Mixture (85%)	90
3.	T₂	06	Dry+ Green+ Azolla meal (20%) + Concentrate Mixture (80%)	90

3.5. Experimental details:

3.5.1. Feeding Management of kids

All the selected kids were dewormed and vaccinated against FMD and ET. Feeding trial of three months duration (From April, 2019 to June, 2019) were conducted by providing required amount of nutrients as per ICAR, (1985) through the prepared experimental feeds of different treatment combinations and keeping the roughages part as constant for all the treatment groups.

Readymade concentrate mixture was used at the farm. The Azolla meal,

concentrate mixture and roughages fed to kids were analyzed for proximate constituents. The kids were fed at four per cent DM of their body weight. The roughages to concentrate ratio while feeding was considered as 67:33 and the feeding details were as below.

Table no. 3.3: Details of feeding trial for allotted experimental groups

Treatments	Details
T0	Extensive feeding +Conc.(As per Thumb rule)+Control
T1	Extensive feeding +Conc.(As per Thumb rule)+150 gm Azolla meal
T2	Extensive feeding +Conc.(As per Thumb rule)+200 gm Azolla meal

3.5.2. Feeding of Osmanabadi kids

Alloted feeds for every kids were offered daily, respective quantity of concentrate and roughages were fed at 6:00 am clock in the morning and at 5:00 pm clock in evening.

The requirement of concentrate feed and fodder of kids were calculated fortnightly by considering initial body weights. The residues were collected and weighed next day by offering feed and fodder to the Osmanabadi kids and to find out daily feed intake by differences among them.

3.5.3. Watering of Osmanabadi kids

Fresh and clean drinking water was provided to the Osmanabadi kids throughout the experimental period. Kids were offered adlibitum drinking water through measuring troughs twice daily. Daily water intake of each kids were recorded throughout the experimental period.

3.5.4. Housing, health and sanitation

The experimental Osmanabadi kids were housed in disinfected, well ventilated permanent shed covered with cement sheet roofs. The stalls, where kids were housed during the period of experiment were cleaned daily. The experimental feed and clean drinking water was provided separate in feeders and waters. The shed was cleaned and disinfected by disinfectants weekly. The kids were kept in open paddock from 8:00 to 11:00 am daily. All the necessary care was taken to keep the kids healthy.

3.5.5. Estimation of proximate principles of Azolla meal

Estimation of chemical composition (CP, CF, EE, Total Ash, NFE, DM) of concentrate mixture and Azolla meal were determined as per standard procedures of AOAC (1995), carried out by standard laboratory method at the beginning of experiment in the Animal Nutrition Department of KNP College of Veterinary Science, Shirwal. Dist. Satara. (M. S.)

3.5.6. Parameters recorded:

Following parameters were recorded at the time of experiment:

3.5.6.1. Growth performance: Body weight gain / Weekly live body weights (kg)

The experimental kids were weighed individually at weekly interval up to 90 days on electronic weighing balance. Before feeding and watering, the weight was taken in morning hours i.e. between 7 to 8 am for accurate body weight. The data of body weight gain was maintained.

3.5.6.2. Average Daily Weight Gain (ADG):

Average daily weight gain were calculated for knowing the growth rate in different groups by the following formulae:

$$\text{Average daily weight gain (gm/day)} = \frac{\text{Total weight gain in experimental period}}{\text{No. of days of experiment}}$$

3.5.6.3. Body measurements: (Chest girth, Height of the wither point, Body length)

The following measurements were recorded in centimetres (cm) by using standard tape to know the increase in growth.

a. Chest girth (cm):

Chest girth of Osmanabadi kids were measured by a circumference of chest and measured just behind the elbow point passing through the wither point.

b. Height of the wither point (cm):

Height of wither point of Osmanabadi kids were recorded as the perpendicular distance between the ground level and wither point. During measuring height, the goat kids make to stand easily on four legs on levelled ground.

c. Body length (cm):

Body length of Osmanabadi kids were measured by the straight line distance between the point of shoulders and the pin bone.

3.5.6.4. Body condition score / (BCS)

As per 1 to 5 point scale the body condition score of experimental kids were studied at fortnightly intervals, (Lauhman, 1985).

3.5.6.5. Feed conversion efficiency: (Weekly and cumulative feed efficiency)

Weekly feed efficiency of feed was calculated by using following formulae,

$$\text{Feed efficiency} = \frac{\text{Feed consumption (g) during the week}}{\text{Gain in body weight (g) during the week}} \times 100$$

3.5.6.6. Daily feed intake of Osmanabadi kids.

The daily feed intake of Osmanabadi kids were recorded by the amount of feed consumed and left over in the next day morning. Record of each kid was kept separately and then daily feed intake was calculated. Feed intake record was maintained regularly both in control and treatment groups of Osmanabadi kids.

3.5.6.7. Daily water intake of Osmanabadi kids.

The daily water intake of each Osmanabadi kids during 24 hours was calculated. Kids were offered measured adlibitum quantity of clean fresh drinking water daily in the morning, afternoon, evening hours and measuring the left over of water in the troughs.

3.5.6.8. Blood Biochemical parameters: (LFT, KFT)

The blood samples were collected fortnightly from each kid during the feeding experiment. Blood was collected in one set of vial without anticoagulant from the jugular vein using disposable syringes. Then blood allowed to clot and centrifuged for 15 min at 1500 rpm to separate the serum. The serum sample were stored at -20° C for the analysis of serum for total protein, bilirubin, blood urea nitrogen, creatinine, serum glutamate oxalo-acetate transferase (SGOT) and serum glutamate pyruvate transferase (SGPT).

Blood Biochemical parameters (LFT viz. Bilirubin, Serum Total Protein, SGOT (AST), SGPT (ALT) and KFT viz. BUN and Creatinine) were analyzed using commercial kits on auto analyzer (Model FALCON- 260) at fortnightly intervals.

3.5.6.9. Statistical analysis:

Statistical analysis of the data was carried out by the Completely Randomized Design (CRD) as per standard procedure laid down by (Snedecor and Cochran,1994).

CHAPTER IV

RESULTS AND DISCUSSION

The present study entitled “**Effect of feeding Azolla meal on growth performance in Osmanabadi kids**” was carried out at "Pancharatna Goat Farm." Tal. Khandala, Dist. Satara. For a period of three months to assess the growth performance of Osmanabadi kids fed with Azolla meal as partial replacement to concentrate.

4.1. Chemical composition of AZM:

Proximate analysis Azolla meal and concentrate mixture were used in experiment period for feeding the Osmanabadi kids is given in Table no. 4.1

Table no. 4.1. Chemical composition of concentrate mixture and Azolla meal.

Sr. No.	Attributes	Concentrate mixture%	Azolla meal%
1	DM	90.80	94
2	CP	18.30	24.20
3	CF	12	11.54
4	EE	7.92	3.29
5	NFE	50.40	40.34
6	Ash	8.32	26.4

It was observed that the from Table no. 4.1 DM, CP, CF, EE, NFE and Ash content in Azolla meal were 94, 24.20, 11.54, 3.29, 40.34, 26.4 per cent, respectively. The DM, CP, CF, EE, NFE and T o t a l Ash from the concentrate mixture were 90.80, 18.30, 12, 7.92, 50.40, 8.32 per cent, respectively. As per result, from the Table no. 4, CP content of the concentrate mixture and Azolla meal was 18.30 and

24.20 %, respectively. Hence, CP content of Azolla meal was significantly higher than the concentrate mixture.

Gouri *et al.* (2012) work was done to examine the chemical composition of Azolla, on dry matter basis. They reported that, Azolla meal present CF, CP, lignin, silica, EE, NFE, DM, Ca, P and Total Ash 14.1, 15.4, 17.5, 16.0, 2.7, 47.4, 90.1, 1.54, 0.35 and 20.4 per cent, respectively.

Cherryl *et al.* (2014) studied on the nutritive value of Azolla for the feeding of livestock. According to him, Azolla contains CP, CF, EE, Total Ash and NFE like 23.49, 14.7, 3.7, 24.26 and 33.84 per cent, respectively. After he noticed that, Azolla is a good as well as rich source of proteins containing nearly all the essential amino acids, minerals such as iron, Ca, P, Mg, Mn. She also observed that, it is a best source of vitamin A, (beta-carotene) and vitamin B₁₂.

Ahmed *et al.* (2015) concluded that there was an about 19.65 Total Ash and CP, EE, CF, NFE were 20.0, 2.65, 14.25, 46.25 per cent in azolla feed, respectively.

Rawat *et al.* (2015) conducted an experiment to assess the nutritive value of Azolla. They noted that, on the dry matter basis Azolla meal present CP, EE, CF, NFE, Total Ash, Ca and P were 24.1, 3.75, 15.1, 40.25, 16.8, 0.47 and 2.18 per cent, respectively.

Anitha *et al.* (2016) reported that, Azolla can be used as an animal feed. Because of it presents DM, CP, CF, EE, NFE and Total Ash 4.70, 22.48, 14.70, 4.50, 40.97 and 17.34 per cent, respectively.

Debashis *et al.* (2016) studied the chemical composition of Azolla pinnata for animals. He concluded that, Azolla meal on dry matter basis contains CF, CP, NFE, EE and organic matter, 10.22, 32.05, 38.03, 1.51, 81.75 per cent, respectively.

Kumari Jyoti and Kumar Sanjay, (2014) revealed that the chemical composition of Azolla meal on dry matter basis as black Bengal goat kids feed containing DM, OM, CP, EE, CF, NFE and Total Ash were 90.31, 84.30, 26.35, 2.85, 15.16, 36.38, 15.70 per cent, respectively.

Toradmal *et al.* (2017) studied the nutritive value of green Azolla for the animal feeding which containing CP, DM, CF, EE, NFE and Total Ash were 24.18, 90.2, 17.65, 3.90, 17.65, 45.85, 8.43 per cent, respectively.

4.2. Feed intake of Osmanabadi kids (gm)

Feed intake was measured by offering weighed quantity of readymade concentrate mixture mixed with Azolla meal and roughages to the Osmanabadi kids. Data obtained on the average daily feed intake basis. Feed is one of the most important components for growth and production of Osmanabadi kids. The average feed intake (g/day/head) from each group (weekly) are presented in Table no.4.2 and graphically shown in Fig. no. 4.1.

During first week total feed intake was calculated as 433.283 ± 3.613 , 440.504 ± 2.657 and 439.495 ± 3.079 (gm/day) in groups (T0), (T1), (T2), respectively. Besides that, average final week total feed intake was 657.552 ± 2.887 , 662.481 ± 3.784 , 707.002 ± 2.854 (gm/day/head) in treatment groups (T0), (T1) and (T2), respectively. Similarly, during the entire period of study found high feed intake in treatment groups. Average total feed intakes were 479.285 ± 20.242 , 592.086 ± 19.139 and 507.505 ± 23.619 (g/day) in treatment group (T0), (T1) and (T2), respectively.

In this feed intake parameter observed that, average weekly feed intake was significantly better ($P < 0.05$) in (T1) and (T2) groups as compared to the control (T0) group. In present experiment Osmanabadi kids are fed 15% Azolla meal in (T1) group, 20% Azolla meal in (T2) group along with concentrate mixture. It showed that, feed intake in growing Osmanabadi kids is improved and present research work was in agreement with following researchers.

Tamang and Samanth, (1993) conducted an experiment on forty Black Bengal male kids were divided into four groups. Each group was replaced 0, 10, 20, 50 percent concentrate mixture by Azolla. They noted that, 50% replacement showed

profuse diarrhea, but 20% of azolla meal had no any adverse effect.

Wadhawani *et al.* (2007) performed an experiment on lambs and concluded the addition of 20% Azolla meal in the feed for lambs had no any adverse effect.

Table no. 4.2. Average weekly feed intake of Osmanabadi kids (gm).

Weeks	Treatment Group			
	T0	T1	T2	CD
1	433.283 ± 3.613	440.504 ± 2.657	439.495 ± 3.079	NS
2	451.793 ± 3.410	458.995 ± 2.742	461.794 ± 3.050	NS
3	470.93 ± 3.304 ^b	477.492 ± 2.829 ^{ab}	484.076 ± 3.036 ^a	9.230
4	489.207 ± 3.221 ^b	495.992 ± 2.919 ^b	506.373 ± 3.019 ^a	9.208
5	504.307 ± 5.336 ^b	514.493 ± 3.010 ^b	528.512 ± 2.933 ^a	11.819
6	526.623 ± 3.065 ^b	533.046 ± 3.112 ^b	550.953 ± 2.976 ^a	9.196
7	545.325 ± 3.003 ^b	551.488 ± 3.198 ^b	573.281 ± 2.968 ^a	9.216
8	564.031 ± 2.954 ^b	569.987 ± 3.292 ^b	595.538 ± 2.939 ^a	9.240
9	582.734 ± 2.916 ^b	588.485 ± 3.389 ^b	617.833 ± 2.919 ^a	9.291
10	601.440 ± 2.891	606.987 ± 3.487	606.793 ± 3.531	NS
11	620.143 ± 2.877 ^b	625.508 ± 3.593 ^b	662.419 ± 2.886 ^a	9.452
12	638.845 ± 2.875 ^{ab}	610.647 ± 3.995 ^b	684.711 ± 2.869 ^a	9.544
13	657.552 ± 2.887 ^b	662.481 ± 3.784 ^b	707.002 ± 2.854 ^a	9.656
Mean ± SE	479.285±20.242 ^b	592.086±19.139 ^a	507.505±23.619 ^b	65.471

Note: ^{a, b, ab,} means with different superscript in a row differ significantly (P<0.05)

Shital *et al.* (2011) performed an experiment on eighteen Osmanabadi kids. These kids were divided into three groups, from that she had replaced 15% and 25% concentrate mixture by Azolla meal. During the experiment she observed an average daily DMI was 0.35 kg, 0.33 kg/osmanabadi kids in treatment groups. From the observations she reported that the 15% concentrate can be replaced with Azolla meal without any adverse effect.

Kumari Jyoti and Kumar Sanjay, (2014) reported from an experiment that the average DMI in Black Bengal kids of T1, T2, T3 groups were 458.12, 449.54, 494.66 gm/day, respectively.

Ahmed *et al.* (2015) carried Azolla meal feeding trial on growing sheep to know the growth performance. As per result obtained, he reported that average DMI in T5, T4, T3, T2 and T1 were 4.17, 4.27, 4.19, 4.00, 3.86% of body weight, respectively.

Debashis *et al.* (2016) studied the effects of feeding Azolla meal on feed intake and growth performance in Haryana heifers. According to observations, he noted that the average DMI in control (4.51kg) and in treatment (4.20 kg) groups, respectively.

Akhud *et al.* (2017) conducted feeding trial with the various levels of concentrate feed replaced by Azolla meal in buffalo calves. From the observation he found that, average DMI in T1, T2, T3 group were 3.18, 3.19, 3.33 kg, respectively.

Das *et al.* (2017) conducted feeding trial on Jalauni lambs to know the nutrient intake and its utilization. He reported that the average daily DMI in T2, T3 groups was 3.77, 3.49 per cent of body weight, respectively.

Toradmal *et al.* (2017) studied experiment on twenty osmanabadi goat kids with the supplementation of green Azolla through concentrate mixture. He reported that there was an average daily DMI in T4, T3, T2 and T1 were 0.64, 0.62, 0.58, 0.57 kg, respectively, with treatment groups.

4.3. Feed conversion efficiency of Osmanabadi kids.

The feed efficiency was calculated from the observations recorded in present study with regard to the feed intake and weight gain during weekly intervals and is presented in Table no. 4.3, with graphically shown in Fig. no. 4.2.

The average feed conversion efficiency were 3.885 ± 0.051 , 3.998 ± 0.016 and 3.997 ± 0.016 in control and treatment group (T0), (T1) and (T2), respectively. Besides that, it was higher in the treatment groups than control one. The mean ratio indicated that feed conversion efficiency was statistically non-significant. This is in accordance with the following scientist.

Table no. 4.3. Feed conversion efficiency of Osmanabadi kids.

Weeks	Treatment			CD
	T0	T1	T2	
1	3.997±0.002	3.998±0.002	3.993±0.002	NS
2	3.995±0.002	3.997±0.002	3.995±0.002	NS
3	3.995±0.002	3.995±0.002	3.995±0.002	NS
4	3.995±0.002	3.995±0.002	3.993±0.002	NS
5	3.332±0.002	4.000±0.000	3.998±0.002	NS
6	3.998±0.002	3.997±0.002	3.993±0.002	NS
7	3.997±0.002	3.997±0.002	3.997±0.002	NS
8	3.997±0.021	3.995±0.002	3.995±0.002	NS
9	3.997±0.002	3.995±0.002	3.998±0.002	NS
10	4.000±0.000	4.000±0.000	3.792±0.208	NS
11	3.998±0.002	3.995±0.002	3.997±0.002	NS
12	3.997±0.002	3.790±0.206	3.998±0.002	NS
13	3.998±0.002	3.997±0.002	3.995±0.002	NS
Mean ± SE	3.885±0.051	3.998±0.016	3.997±0.016	NS

NS: Non-significant.

Shital *et al.* (2011) performed an experiment on eighteen Osmanabadi kids. Such kids divided into three groups, from that she had replaced 15% and 25% concentrate mixture by Azolla meal. They were observed average FCR in groups like, T3, T2, T1 were 10.07, 19.83, 20.46 per cent, respectively. The FCR was better in T1 and T2 group. It showed that Azolla meal can be added upto 15% in the diet of kids.

Kumari Jyoti and Kumar Sanjay, (2014) reported that the average feed conversion efficiency in T1, T2, T3 treatments were 7.49, 7.04, 8.93 per cent, respectively.

Ahmed *et al.* (2015) concluded Azolla meal feeding trial on growing sheep to know the growth performance. According to him feed conversion efficiency in T5 (12.97) treatment was higher than other treatment groups. However, in T4, T3, T2 and T1 treatment group's sheep were 11.67, 11.09, 9.55, 9.50 per cent, respectively.

Debashis *et al.* (2016) studied the effects of feeding Azolla meal supplementation on feed intake, FCR and revealed that the average feed conversion efficiency in control and treatment groups were 0.12, 0.15 per cent, respectively.

4.3. Water intake of Osmanabadi kids. (lit.)

Average daily water intake of Osmanabadi kids were measured on daily basis in liters. Daily water intake was presented in Table no.4.4 and graphically shown in Fig. no. 4.3.

Table no. 4.4. Average daily water intake (lit.) of Osmanabadi kids.

Days	Group-T0	Group-T1	Group-T2	CD
Mean± SE	0.801±0.009 ^c	0.858±0.010 ^b	0.883±0.003 ^a	0.023

During the entire period of feeding trial, all the kids were provided three times fresh, clean drinking water in water troughs. On the period of experiment observed that, water intake/kids/day was varied. Mostly it is depend on age, body

weight and body size. Besides, type of feed, feed intake, season, weather, environments, managerial practices and health status of the animals. Average water intake/day/ kid were 0.801, 0.858, 0.883 lit. in (T0), (T1) and (T2) groups, respectively. Due to the Azolla meal addition in concentrate mixture of Osmanabadi kids, significant difference was found in water intake. Water is an essential nutrients and fundamental components for all animals. These findings are in accordance with following research workers.

Singh *et al.* (1987) concluded the drinking water requirement for livestock was very low than the feed and fodder production. In this way they revealed that ratio of water intake were directly correlated with maximum ambient temperature.

Srinivasulu *et al.* (1998) conducted the feeding trial on sheep, goat and reported that, in sheep and goat water intake was 3.34 ± 0.76 , 1.96 ± 0.37 lit./kg, respectively.

Tsado *et al.* (2013) reported that, average daily water intake of Savannah Brown goats. Due to the ambient temperature, significant ($P < 0.05$) difference found in water and dry matter intake.

Wagh, (2015) noted that average water intake/day/kids were 0.720, 0.830, 0.780 lit., respectively.

4.4. Growth performance of Osmanabadi goat kids

Generally the growth performance of Osmanabadi kids by feeding Azolla meal replaced by concentrate mixture recorded at weekly interval. It was measured on the basis of feed intake, body weight and body measurement. Growth performance is an important component of such feeding trial. The data given with the respect are in the following manner.

4.4.1: Body weight (kg)

The body weight of Osmanabadi kids from different groups were recorded during the experimental period at every week. Weekly body weight gain of Osmanabadi kids is presented in Table no.4.5 and showed graphically in Fig. no. 4.5.

Table no. 4.5 Weekly body weight gain of Osmanabadi kids (kg/week).

Week	Treatment			CD
	T0	T1	T2	
1	10.82 ± 0.088	11.01 ± 0.066	10.98 ± 0.077	NS
2	11.29 ± 0.085	11.47 ± 0.068	11.54 ± 0.077	NS
3	11.76 ± 0.082 ^b	11.93 ± 0.071 ^{ab}	12.09 ± 0.076 ^a	0.230
4	12.22 ± 0.079 ^b	12.39 ± 0.073 ^b	12.65 ± 0.076 ^a	0.229
5	12.60 ± 0.133 ^b	12.86 ± 0.075 ^b	13.21 ± 0.075 ^a	0.296
6	13.16 ± 0.076 ^b	13.32 ± 0.077 ^b	13.76 ± 0.075 ^a	0.229
7	13.62 ± 0.074 ^b	13.78 ± 0.080 ^b	14.32 ± 0.074 ^a	0.230
8	14.09 ± 0.74 ^b	14.24 ± 0.082 ^b	14.88 ± 0.074 ^a	0.231
9	14.58 ± 0.079 ^b	14.70 ± 0.085 ^b	15.44 ± 0.073 ^a	0.238
10	15.03 ± 0.073 ^b	14.99 ± 0.204 ^b	15.99 ± 0.073 ^a	0.398
11	15.49 ± 0.073 ^b	15.63 ± 0.089 ^b	16.55 ± 0.072 ^a	0.236
12	15.96 ± 0.072 ^b	16.09 ± 0.092 ^b	17.11 ± 0.072 ^a	0.238
13	16.43 ± 0.072 ^b	16.55 ± 0.094 ^b	17.67 ± 0.071 ^a	0.241
Mean ± SE	11.975 ± 0.506 ^b	14.795 ± 0.496 ^a	12.682 ± 0.602 ^b	1.636

Note: ^{a, b} means with different superscript in a row differ significantly (P<0.05)

Initial body weight at first week in the treatment groups as 10.82 ± 0.088 , 11.01 ± 0.066 , 10.98 ± 0.077 and at last week was 16.43 ± 0.072 , 16.55 ± 0.094 , 17.67 ± 0.071 in (T0), (T1) and (T2) groups, respectively. Average body weight were recorded as 11.975 ± 0.506 , 14.795 ± 0.496 , 12.682 ± 0.602 in the groups of (T0), (T1) and (T2), respectively. Average daily body weight gain of Osmanabadi kids in grams were 66.300 ± 0.263 , 65.800 ± 0.404 , 79.167 ± 0.167 in (T0), (T1) and (T2) groups, respectively. The mean ratio indicated that, body weight gain was statistically significant. This is in accordance with the following scientists.

Table no. 4.6 Average daily weight gain of Osmanabadi kids. (gm)

Days	Group-T0	Group-T1	Group-T2	CD
Mean ± SE	66.300 ± 0.263^b	65.800 ± 0.404^b	79.167 ± 0.167^a	0.888

Tamanag and Samanta, (1993) studied the replacement of concentrate mixture up to 50% with sundried Azolla in Black Bengal Goats. Inclusion of sun- dried Azolla up to 50% shows the profuse diarrhea and 20% inclusion has no adverse effects. Due to the significant effect of body weight gain he stated that, 20% dried Azolla meal can be added into the concentrate feed of kids.

Shital *et al.* (2012) studied the growth rate and feed intake of goat kids. They observed that the average daily weight gain, total body weight gain was 0.074kg, 6.70 kg in the animals given with 15 per cent level of Azolla meal through concentrate mixture.

Ahmed *et al.* (2015) carried Azolla meal feeding trial on growing corridale sheep to know the growth performance. From the observations he reported that 6% Azolla meal can be incorporated with the replacement of linseed cake which has no any adverse effect.

Debashis *et al.* (2016) studied the effects of feeding Azolla meal supplementation on feed intake, growth performance, FCR and revealed that average

daily gain and fortnightly weight gain in treatment groups were 643.52gm, 9.61kg, respectively.

Toradmal *et al.* (2017) studied experiment on twenty Osmanabadi goat kids with supplementation of green Azolla through concentrate mixture. They reported that there was body weight gain of experimental Osmanabadi kids was more in T3, T1, T4, T2 treatments were 0.087 kg, 0.068 kg, 0.098 kg and 0.069 kg, respectively.

4.2. Body measurements:

As per the observations and data presented in terms of the body chest girth, body height and body length of the Osmanabadi kids were interpreted and given in Table no. 4.7, 4.8 and 4.9.

4.2.1. Chest girth (cm)

All three experimental groups of Osmanabadi kids showed that there is increased in the body chest girth. The initial chest girth of Osmanabadi kids vary in between treatments being 51.433 ± 0.163 , 51.653 ± 0.159 and 52.470 ± 0.664 cm under (T0), (T1) and (T2), respectively, which reached to the level of 57.237 ± 0.169 , 58.942 ± 0.079 and 59.090 ± 0.077 at the end of the experiment. The total mean body chest girth was recorded as 54.437 ± 0.90 , 55.431 ± 1.119 and 55.754 ± 1.008 cm in treatment group (T0), (T1) and (T2), respectively. As a result obtained, the total gain in chest girth of Osmanabadi kids during the experimental period worked out as 7.058, 8.541 and 7.94 cm under (T0), (T1) and (T2), groups respectively. Maximum gain in chest girth of the Osmanabadi kids was obtained as feeding of (T2) and followed by (T1) treatment group. At the end of experiment, overall total gain in body chest girth was significantly higher in (T2) groups over (T1), and (T0). The mean ratio indicated that, body chest girth was statistically non-significant.

Shital *et al.* (2012) performed feeding trial experiment on Osmanabadi kids. They noted that the average total gain in growth performance parameters like body weight, chest girth, height, length when they offered with Azolla as feed supplement in the treatments shown as 11.79cm, 14.39cm, 12.78cm, respectively.

Table 4.7. Average fortnightly body chest girth gain of Osmanabadi kids (cm).

Fortnights	Treatment			CD
	Control (T0)	Treatment (T1)	Treatment (T2)	
1	51.433 ± 0.163	51.653±0.159	52.470±0.664	NS
2	52.665 ± 0.201	53.242 ± 0.099	53.792 ± 0.540	NS
3	53.895 ± 0.246 ^b	54.662 ± 0.094 ^{ab}	55.112 ± 0.417 ^a	0.858
4	55.037 ± 0.336 ^b	56.582 ± 0.547 ^a	56.302 ± 0.359 ^{ab}	1.280
5	56.357 ± 0.342 ^b	57.502 ± 0.084 ^a	57.755 ± 0.175 ^a	0.684
6	57.237 ± 0.169 ^b	58.942 ± 0.079 ^a	59.090 ± 0.077 ^a	0.351
Mean ± SE	54.437 ± 0.90	55.431 ± 1.119	55.754 ± 1.008	NS

NS: Non-significant. Note: ^{a, b, ab,} means with different superscript in a row differ significantly (P<0.05)

Akhud *et al.* (2017) conducted feeding trial with the various levels of concentrate feed replaced by Azolla meal in buffalo calves and observed that the average gain in chest girth about 5.44 cm, 6.50 cm in T3 and T2 treatments.

Toradmal *et al.* (2017) studied experiment on twenty Osmanabadi goat kids with supplementation of green Azolla through concentrate mixture and reported an average chest girth were 0.097 cm, 0.077 cm, 0.095 cm, 0.113 cm in T3, T1, T2, T4 treatments, respectively.

4.2.2: Body height (cm)

The initial body height of Osmanabadi kids at first fortnight was 51.312±0.090, 51.573±0.188 and 51.550±0.154 cm under (T0), (T1) and (T2), respectively, which reached up to the level 57.112±0.080, 58.173±0.145 and

58.445±0.124 at the end of the experiment. The total mean body height of the Osmanabadi kids were recorded as 54.266±0.893, 54.883±1.007 and 54.973±1.045 cm in treatment group (T0), (T1) and (T2), respectively. Maximum gain in body height of the Osmanabadi kids was obtained as result of feeding of Azolla meal, higher in T2 and followed by (T1), (T0) treatment groups. Significant effect was found in 3rd, 4th, 5th and 6th fortnights. The mean ratio indicated that body height was statistically non-significant.

Table no. 4.8. Average fortnightly body height gain of Osmanabadi kids (cm).

Fortnights	Treatment			CD
	Control (T0)	Treatment (T1)	Treatment (T2)	
1	51.312±0.090	51.573±0.188	51.550±0.154	NS
2	52.503±0.107	52.918±0.174	52.927±0.149	NS
3	53.697±0.129 ^b	54.232±0.167 ^a	54.298±0.143 ^a	0.444
4	54.888±0.155 ^b	55.543±0.158 ^a	55.675±0.138 ^a	0.454
5	56.082±0.183 ^b	56.857±0.152 ^a	56.943±0.097 ^a	0.447
6	57.112±0.080 ^b	58.173±0.145 ^a	58.445±0.124 ^a	0.360
Mean ± SE	54.266±0.893	54.883±1.007	54.973±1.045	NS

NS: Non-significant. Note: ^{a, b} means with different superscript in a row differ significantly (P<0.05)

Shital *et al.* (2012) performed feeding trial experiment on Osmanabadi kids. They noted that there was total gain about 14.39 cm in the experimental kids.

Akhud *et al.* (2017) conducted feeding trial with the various levels of concentrate feed replaced by Azolla meal in buffalo calves and observed the average gain in height about 6.66 cm, 5.80 cm in T3 and T2 treatments, respectively.

Toradmal *et al.* (2017) observed that total average height was found to be

4.67, 5.18, 5.46 and 6.63cm for treatments T₁, T₂, T₃ and T₄, respectively when the Osmanabadi goat kids fed with green Azolla. As per an experiment they found to be maximum body height in T₄ treatment.

4.2.3: Body length (cm)

Table no. 4.9 Average fortnightly body length gain of Osmanabadi kids (cm).

Fortnights	Treatment			CD
	Control (T ₀)	Treatment (T ₁)	Treatment (T ₂)	
1	51.153±0.090	51.210±0.091	51.100±0.082	NS
2	52.408±0.102	52.657±0.089	52.555±0.073	NS
3	53.663±0.115 ^b	54.083±0.080 ^a	54.143±0.118 ^a	0.319
4	54.920±0.127 ^b	55.530±0.078 ^a	55.753±0.123 ^a	0.336
5	56.175±0.140 ^b	56.977±0.077 ^a	57.193±0.154 ^a	0.387
6	57.437±0.155 ^b	58.440±0.080 ^a	58.723±0.173 ^a	0.426
Mean ± SE	54.293±0.960	54.816±1.103	54.911±1.171	NS

NS: Non-significant. Note: ^{a, b} means with different superscript in a row differ significantly (P<0.05)

The initial body length at first fortnight of Osmanabadi kids was 51.153±0.090, 51.210±0.091 and 51.100±0.082 cm under (T₀), (T₁) and (T₂), respectively, which reached up to the level 57.437±0.155, 58.440±0.080 and 58.723±0.173 to the end of experiment.

The total mean body length of Osmanabadi kids were recorded as 54.293±0.960, 54.816±1.103 and 54.911±1.171 cm in treatment group (T₀), (T₁) and (T₂), respectively. During the experimental period, maximum gain in body length of the Osmanabadi kids was obtained as higher in (T₂) group and followed by (T₁), (T₀) treatment groups. Significant effect was found in 3rd, 4th, 5th and 6th fortnights. The mean ratio indicated that the body length was statistically non-significant.

Shital *et al.* (2012) performed feeding trial experiment on Osmanabadi kids and reported that there was total gain in body length about 12.78 cm in the experimental kids fed with Azolla meal.

Akhud *et al.* (2017) conducted feeding trial with the various levels of concentrate feed replaced by Azolla meal in buffalo calves and observed the average gain in length is about 5.97cm, 6.29 cm in T3 and T2 treatments.

Toradmal *et al.* (2017) revealed that the average gain in body length was 5.27, 5.63, 6.20 and 6.20 cm in T1, T2, T3 and T4, respectively, when goat kids fed with green Azolla meal.

4.3: Body condition score

Table 4.10. Average fortnightly body condition score of Osmanabadi kids.

Fortnights	Treatment			CD
	Control (T0)	Treatment (T1)	Treatment (T2)	
1	2.250 ±0.076	2.217±0.075	2.333±0.042	NS
2	2.333±0.049 ^b	2.350±0.062 ^b	2.533±0.033 ^a	0.150
3	2.417±0.048 ^b	2.517±0.070 ^b	2.750±0.043 ^a	0.166
4	2.650±0.043 ^b	2.717±0.060 ^b	2.867±0.042 ^a	0.148
5	2.833±0.042 ^b	2.933±0.049 ^{ab}	3.033±0.042 ^a	0.135
6	3.017±0.060 ^b	3.250±0.062 ^a	3.350±0.043 ^a	0.168
Mean ± SE	2.583±0.123	2.664±0.157	2.811±0.147	NS

NS: Non-significant. Note: ^{a, b, ab} means with different superscript in a row differ significantly (P<0.05)

The mean ± SE body condition score of Osmanabadi kids in (T0), (T1) and (T2) groups is presented in the Table no. 4.10 and graphically shown in Fig. no. 4.9. Body condition score of Osmanabadi kids was measured by 1 to 5 point scale

fortnightly interval. The initial body condition score at first fortnight of Osmanabadi kids were 2.250 ± 0.076 , 2.217 ± 0.075 and 2.333 ± 0.042 (T0), (T1) and (T2) treatment groups, respectively, which was reached to the level of 3.017 ± 0.060 , 3.250 ± 0.062 and 3.350 ± 0.043 at the end of experiment. The mean \pm SE of body condition score of Osmanabadi kids in the group (T0), (T1) and (T2) were 2.583 ± 0.123 , 2.664 ± 0.157 and 2.811 ± 0.147 , respectively. Significant effect was found in 2nd, 3rd, 4th, 5th and 6th fortnights. The mean ratio indicated that the body condition score was statistically non-significant. Body condition score is agreement with the following research works.

Debashis *et al.* (2016) studied the effects of feeding Azolla meal supplementation on feed intake, growth performance, BCS and revealed that, the body condition score in control and treatment groups were 2.98, 3.01, respectively.

4.3: Biochemical values

4.3.1. Serum Total Protein (g/dl)

Observations of serum total protein were recorded at fortnightly intervals by using auto analyzer. At the end of experiment findings of serum total protein (TP) values in the groups are presented in Table no.4.11 and graphically shown in Fig. no. 4.10.

The average serum total protein (g/dl) level in (T0), (T1) and (T2) group was 6.456 ± 0.039 , 6.67 ± 0.050 and 6.906 ± 0.084 , respectively. The mean average value of serum total protein (g/dl) was found to be significant. Non-significant result observed at 2nd fortnight. Significant effect was found in 1st, 3rd, 4th, 5th and 6th fortnights. However, as compare to the control group, 20% and 15% Azolla meal supplemented treatment group has found higher total protein level.

The present study was in agreement with Kumari Jyoti and Kumar Sanjay, (2014) who reported that the serum total protein level was significantly higher in T2 group, supplemented with 20%.

Table no. 4.11. Average fortnightly serum total protein (g/dl) of experimental Osmanabadi kids.

Fortnights	Treatment			CD
	Control (T0)	Treatment (T1)	Treatment (T2)	
1	6.367 ± 0.067 ^b	6.583 ± 0.060 ^a	6.583 ± 0.060 ^a	0.188
2	6.517 ± 0.070	6.667 ± 0.080	6.750 ± 0.134	NS
3	6.517 ± 0.095 ^c	6.783 ± 0.048 ^b	7.000 ± 0.052 ^a	0.205
4	6.367 ± 0.061 ^c	6.717 ± 0.128 ^b	6.983 ± 0.054 ^a	0.264
5	6.383 ± 0.048 ^c	6.783 ± 0.031 ^b	6.950 ± 0.067 ^a	0.153
6	6.583 ± 0.060 ^b	6.467 ± 0.167 ^b	7.167 ± 0.049 ^a	0.320
Mean ± SE	6.456 ± 0.039 ^c	6.667 ± 0.050 ^b	6.906 ± 0.084 ^a	0.184

Note: ^{a, b, c,} means with different superscript in a row differ significantly (P<0.05)

Azolla meal as compare to the control group. They concluded that the average total protein level is varied between T1, T2 and T3 groups as 6.53, 7.12 and 6.92 (g/dl), respectively.

Debashis *et al.* (2016) reported an average total protein level (g/dl) in Haryana heifers fed with *Azolla pinnata* were 7.57, 7.07 of control and treatments groups.

4.3.2. Creatinine (mg/dl)

At the end of experiment result of creatinine level (mg/dl) in blood serum of Osmanabadi kids is presented in Table no. 4.12 and graphically shown in Fig. no. 4.11.

The average creatinine level in blood serum (mg/dl) level in (T0), (T1) and (T2) groups as 1.171 ± 0.071 , 1.241 ± 0.056 and 1.326 ± 0.059 (mg/dl), respectively. Significant effect was found in 5th and 6th fortnights. The mean average value of creatinine (mg/dl) was found to be non-significant.

Table no. 4.12. Average fortnightly creatinine level (mg/dl) of experimental Osmanabadi kids.

Fortnights	Treatment			CD
	Control (T0)	Treatment (T1)	Treatment (T2)	
1	0.867 ± 0.067	1.083 ± 0.101	1.127 ± 0.088	NS
2	1.107 ± 0.043	1.185 ± 0.077	1.223 ± 0.077	NS
3	1.153 ± 0.032	1.252 ± 0.036	1.270 ± 0.068	NS
4	1.248 ± 0.031	1.127 ± 0.172	1.387 ± 0.035	NS
5	1.320 ± 0.031^b	1.358 ± 0.023^{ab}	1.440 ± 0.034^a	0.089
6	1.328 ± 0.028^b	1.443 ± 0.028^a	1.508 ± 0.027^a	0.084
Mean \pm SE	1.171 ± 0.071	1.241 ± 0.056	1.326 ± 0.059	NS

NS: Non-significant. Note: ^a, ^b, ^{ab}, means with different superscript in a row differ significantly (P<0.05)

Kumari Jyoti and Kumar Sanjay, (2014) who reported that the average creatinine level (mg/dl) was significantly higher in (T1) control group, as compare to the treatments group. They concluded that the average creatinine level is varied between (T1), (T2) and (T3) groups as 1.37, 1.14 and 1.05 (mg/dl), respectively.

4.3.3: Blood Urea Nitrogen (mg/dl)

Results of blood urea nitrogen (BUN) were recorded at fortnightly intervals. The level of blood urea nitrogen in blood serum in Osmanabadi kids is presented in Table no.4.13 and graphically shown in the Fig. no. 4.12. The average level of blood

urea nitrogen (BUN) (mg/dl) in blood serum in (T0), (T1) and (T2) groups as 12.063±0.154, 12.475±0.183 and 12.328±0.224, respectively. The mean average value of blood urea nitrogen (mg/dl) was found to be non-significant. Significant effect was found in 2nd, 5th and 6th fortnight. BUN level was lower in (T2) and (T1) group as compared to the (T0) (control).

Table 4.13. Average fortnightly BUN (mg/dl) in experimental Osmanabadi kids.

Fortnights	Treatment			CD
	Control (T0)	Treatment (T1)	Treatment (T2)	
1	11.483±0.142	11.650±0.076	11.377±0.140	NS
2	11.828±0.183 ^b	12.342±0.122 ^a	12.082±0.063 ^{ab}	0.398
3	12.018±0.226	12.525±0.127	12.308±0.099	NS
4	12.123±0.243	12.657±0.114	12.568±0.078	NS
5	12.463±0.120 ^b	12.780±0.070 ^a	12.760±0.038 ^a	0.250
6	12.460±0.129 ^b	12.893±0.039 ^a	12.875±0.051 ^a	0.251
Mean ± SE	12.063±0.154	12.475±0.183	12.328±0.224	NS

NS: Non-significant. Note: ^a, ^b, ^{ab}, means with different superscript in a row differ significantly (P<0.05)

Kumari Jyoti and Kumar Sanjay, (2014) reported that an average BUN (mg/dl) level varied between 11.50, 12.10 and 12.20 in T2, T1 and T3 treatment groups of Black Bengal goat kids, respectively.

4.3.4: Bilirubin (mg/dl)

Bilirubin was recorded at fortnightly intervals in Osmanabadi kids. The level of bilirubin in blood serum presented in Table no. 4.14 and graphically shown in Fig. no. 4.13.

The average bilirubin level (mg/dl) in (T0), (T1) and (T2) groups as 0.147±0.005, 0.150±0.000 and 0.144±0.009, respectively. The mean average value of bilirubin (mg/dl) was found to be non-significant.

Table no. 4.14. Average fortnightly Bilirubin level (mg/dl) of experimental Osmanabadi kids.

Fortnights	Treatment			CD
	Control (T0)	Treatment (T1)	Treatment (T2)	
1	0.133±0.021	0.150±0.022	0.117±0.017	NS
2	0.150±0.022	0.150±0.022	0.133±0.021	NS
3	0.167±0.021	0.150±0.022	0.183±0.017	NS
4	0.150±0.022 ^a	0.150±0.022 ^a	0.150±0.022 ^a	0.067
5	0.150±0.022 ^a	0.150±0.022 ^a	0.150±0.022 ^a	0.067
6	0.133±0.021	0.150±0.022	0.133±0.021	NS
Mean ± SE	0.147±0.005	0.150±0.000	0.144±0.009	NS

NS: Non-significant. Note: ^a means with different superscript in a row differ significantly (P<0.05)

4.3.5: SGOT (Serum glutamic oxaloacetic transminase)

The SGOT of blood serum were recorded at fortnightly intervals. The level of SGOT (IU/lit) in blood serum in Osmanabadi kids is presented in Table no.4.15 and graphically shown in the Fig. no. 4.14.

The average SGOT level of blood serum (IU/L) in (T0), (T1) and (T2) treatment groups as 16.202 ± 0.048, 16.050 ± 0.125 and 16.210 ± 0.091, respectively. The mean average value of SGOT was found to be non-significant. This study indicates that, Azolla meal supplementation did not hamper the liver metabolic function of the (T1) and (T2) treatment groups of Osmanabadi kids.

Kumari Jyoti and Kumar Sanjay, (2014) reported non-significantly differences in Black Bengal Goat kids when fed with Azolla meal. The average SGOT (IU/lit) level was varied in T3, T2 and T1 treatment groups 180.25, 182.50 and 178.20, respectively.

Table no. 4.15. Average fortnightly SGOT (IU/L) in experimental Osmanabadi kids.

Fortnights	Treatment			CD
	Control (T0)	Treatment (T1)	Treatment (T2)	
1	16.198±0.236	15.800±0.115	15.885±0.148	NS
2	16.068±0.286	15.770±0.144	16.118±0.232	NS
3	16.335±0.290	15.773±0.186	16.168±0.217	NS
4	16.275±0.203	16.240±0.165	16.348±0.261	NS
5	16.055±0.287	16.238±0.152	16.197±0.228	NS
6	16.283±0.137	16.478±0.191	16.545±0.243	NS
Mean ± SE	16.202±0.048	16.050±0.125	16.210±0.091	NS

NS: Non-significant.

Debashis *et al.* (2016) reported an average SGOT level (IU/L) in Haryana heifers fed with Azolla meal were 68.53, 78.53, of control and treatments groups.

4.3.6: SGPT (Serum Glutamic Pyruvic Transminase)

The SGPT of blood serum in Osmanabadi kids were recorded at fortnightly intervals. The level of SGPT (IU/lit) of blood serum in Osmanabadi kids is presented in Table no.4.16 and graphically shown in the Fig. no. 4.15.

The average SGPT level (IU/L) of blood serum in (T0), (T1) and (T2) treatment groups as 15.565 ± 0.061 , 15.240 ± 0.125 and 15.373 ± 0.178 , respectively.

The mean average value of SGPT was found to be non-significant. The present study shows that Azolla meal supplementation did not affect the liver metabolic function of the (T1) and (T2) treatment groups of Osmanabadi kids. The SGPT level was lower in (T1) and (T2) group as compared to the (T0) group.

Table no. 4.16. Average fortnightly SGPT (IU/L) in experimental Osmanabadi kids.

Fortnights	Treatment			CD
	Control (T0)	Treatment (T1)	Treatment (T2)	
1	15.523±0.410	15.405±0.436	14.693±0.315	NS
2	15.645±0.368	15.102±0.267	15.162±0.243	NS
3	15.320±0.334	15.213±0.273	15.755±0.359	NS
4	15.693±0.296	14.718±0.332	15.842±0.423	NS
5	15.492±0.340	15.423±0.276	15.585±0.399	NS
6	15.717±0.368	15.578±0.406	15.200±0.352	NS
Mean ± SE	15.565±0.061	15.240±0.125	15.373±0.178	NS

NS: Non-significant.

Kumari Jyoti and Kumar Sanjay, (2014) reported the non-significant difference in Black Bengal Goat kids when fed with Azolla. The average SGPT (IU/lit) level was varied in T1, T2 and T3 treatment groups 12.21, 15.50 and 14.20, respectively.

Debashis *et al.* (2016) reported an average SGPT level (IU/L) in Haryana heifers fed with Azolla meal as feed supplement were 26.87, 31.72, of control and treatments groups.

4.4: Effect of feeding different level of Azolla meal on farm economics

The total feed cost of treated experimental Osmanabadi kids were analyzed and presented in Table no. 4.17.

Table no. 4.17. Farm Economics of Osmanabadi kids feeding with different dietary level of Azolla meal.

Sr. No.	Particulars	T0	T1	T2
1	Cost of concentrate mixture (Rs./ kg)	25.6	21.76	20.48
2	Cost of roughages (Rs./ kg)	6.00	6.00	6.00
3	Cost of azolla meal (Rs./ kg)	-----	40.00	40.00
4	Average concentrate consumed (kg) / kids	16.65	16.72	17.38
5	Average roughages consumed (kg) / kids	33.069	33.456	34.790
6	Average azolla meal consumed (kg) / kids	-----	2.509	3.476
7	Cost of concentrate mixture consumed (Rs./ kids)	426.24	363.827	361.504
8	Cost of roughages consumed (Rs./ kids)	198.414	200.736	208.74
9	Cost of azolla meal consumed (Rs./ kids)	-----	100.36	139.04
10	Feeding cost (Rs.) / osmanabadi kids	624.654	664.923	709.284
11	Body weight gain (kg) of osmanabadi kids	5.98	6.05	7.17
12	Feeding cost / kg body weight gain (Rs.) of osmanabadi kids	104.457	109.904	98.923

The total feed cost of (T0), (T1) and (T2) treatment groups as (Rs.) 624.654, 664.923 and 709.284, respectively. So, the cost of production/kg body weight are (Rs.) 104.457, 109.904 and 98.923, respectively. Feeding cost/day/Osmanabadi kid was higher in (T2) treatment group as compared to the (T1) and (T0) groups. It shows

that the concentrate feeding without Azolla meal reduce the feeding cost. But in case of feeding cost/kg body weight gain were as 104.457, 109.904 and 98.23 for the treatment of (T0), (T1) and (T2) groups, respectively. Hence economically (15% and 20%) Azolla meal feeding is beneficial.

Shital *et al.* (2012) reported that as per feeding trial treatment, the cost of feeding for Osmanabadi kids were reduced (Rs.39.27) when Azolla meal was added at 15% level in concentrate mixture.

Cherryl *et al.* (2013) reported the Azolla meal can be added in concentrate at 10% and 20% level. From the observation cost of feed per kg body weight gain were 71.91, 65.42 for T2 and T3 treatment groups, respectively.

Kumari Jyoti and Kumar Sanjay, (2014) concluded that concerned with economics of production cost /kg body weight (Rs.) were 135.37, 115.87, 145.50 in the T1, T2 and T3 treatments groups, respectively.

Toradmal *et al.* (2017) studied experiment on twenty Osmanabadi goat kids with supplementation of green Azolla meal through concentrate mixture and total cost of feeding/kg body weight gain were found to be Rs. 105.62, 106.46, 87.07, 77.30 in respective treatments.

CHAPTER V

SUMMARY AND CONCLUSION

The present research work was carried out on "Effect of feeding Azolla meal on growth performance in Osmanabadi kids." The experiment was conducted to know the effects of dietary Azolla meal on body weight gain, body measurements like Chest girth, Height of the wither point, Body length, body condition score, feed intake, feed conversion efficiency, water intake, biochemical parameters (Bilirubin, Serum Total Protein, SGOT, SGPT, Blood urea nitrogen and Creatinine). The farm economics of feeding Azolla meal with concentrate mixture to growing Osmanabadi kids was also studied.

The present research work was conducted on eighteen healthy and growing Osmanabadi kids which are of 03 to 06 months age of either sex with uniform body size and weight (8 to 10 kg) were selected and carried out at "Pancharatna Goat Farm." Khandala, Tal. Khandala. Dist. Satara, (M. S.) for the period of 90 days during the month of April to June 2019. They were allotted into three groups such as (T₀), (T₁) and (T₂) as treatments consisting of six kids in each group. (T₀) was the control group, (T₁) and (T₂) were the treatments groups. The Azolla meal, concentrate mixture and roughages fed to kids were analyzed for proximate constituents. The experimental Osmanabadi kids were offered roughages, Azolla meal with concentrate mixture as per Thumb rule. Azolla meal with concentrate mixture was offered at morning hours. Roughages given at afternoon and evening time. The control group (T₀) Osmanabadi kids were fed with concentrate mixture and roughages. In treatments groups (T₁) 15% Azolla meal was offered with 85% concentrate mixture. In treatments groups (T₂) 20% Azolla meal was offered with 80% concentrate mixture. Whereas, feed analysis were undertaken in the Department of Animal Nutrition and blood samples were analysed at Central Instrumentation Facility (CIF), of KNP College of Veterinary Science, Shirwal, Tal. Khandala, Dist. Satara. (M. S.) During the experimental period of 90 days, the observations of feed consumption were recorded on daily basis. After that feed efficiency of experimental animals was

calculated. The body weight gain, body measurement and body condition score of experimental Osmanabadi kids were recorded at fortnightly intervals. The blood samples of all the experimental Osmanabadi kids were collected at fortnightly intervals for biochemical analysis. The serum collected from these blood samples were analysed for biochemical values of bilirubin (mg/dl), creatinine (mg/dl), Blood urea nitrogen (mg/dl), Serum Total Protein(g/dl), SGOT (IU/lit), SGPT (IU/lit). At the end of feeding trials in Osmanabadi kid farm economics were also studied.

The proximate analysis of Azolla meal observed that the percent DM, CP, CF, EE, NFE and Ash content in Azolla meal were 94, 24.20, 11.54, 3.29, 40.34, 26.4 per cent, respectively. The chemical composition of concentrate mixture of DM, CP, CF, EE, NFE and Total Ash from were 90.80, 18.30, 12, 7.92, 50.40, 8.32 per cent respectively. As compare to the concentrate mixture, Azolla meal was noticed with high crude protein.

The mean of feed intake (gm/day/kids) of each group were (weekly) calculated. During first week total feed intake was calculated as 433.283 ± 3.613 , 440.504 ± 2.657 and 439.495 ± 3.079 (gm/day) in treatment groups T0, T1, T2, respectively. During final week total feed intake was recorded as 657.552 ± 2.887^b , 662.481 ± 3.784^b , 707.002 ± 2.854^a (gm/day/head) in treatments groups (T0), (T1) and (T2) respectively. The mean of total feed intake was 479.285 ± 20.242^b , 592.086 ± 19.139^a and 507.505 ± 23.619^b g/day in treatment groups (T0), (T1) and (T2), respectively. The feed intake was higher in (T1) group as compared to (T0) and (T2) groups. In the present experiment Osmanabadi kids were fed 15% Azolla meal in (T1) group, 20% Azolla meal in (T2) group along with concentrate mixture. It showed that, feed intake in growing Osmanabadi kids were improved.

The average feed conversion efficiency were 3.885 ± 0.051 , 3.998 ± 0.016 and 3.997 ± 0.016 in treatment group (T0), (T1) and (T2), respectively. The mean values showed that the feed conversion ratio was statistically non-significant. From the observations, average water intake/day/kids were 0.801, 0.858, 0.883 lit. of (T0),(T1) and (T2) groups, respectively.

From the observations of daily feed intake per Osmanabadi kids it was revealed that the body weight gain at the end of 90th day were 11.975 ± 0.506^b , 14.795 ± 0.496^a and 12.682 ± 0.602^b kg, respectively. Average daily body weight gain of Osmanabadi kids in grams were 66.300 ± 0.263^b , 65.800 ± 0.404^b , 79.167 ± 0.167^a in (T0), (T1) and (T2) groups, respectively. The means of weekly and daily body weights of growing Osmanabadi kids were found to be significant. It was indicated that the partial replacement of concentrate mixture with Azolla meal improves the body weight gain.

All three experimental groups of Osmanabadi kids observed that, there was increase in the body chest girth. The initial chest girth of Osmanabadi kids vary in between treatments being 51.433 ± 0.163 , 51.653 ± 0.159 and 52.470 ± 0.664 cm under (T0), (T1) and (T2), respectively, which reached to the level of 57.237 ± 0.169^b , 58.942 ± 0.079^a and 59.090 ± 0.077^a at the end of the experiment. The total mean body chest girth was recorded as 54.437 ± 0.90 , 55.431 ± 1.119 and 55.754 ± 1.008 cm in control and treatment groups (T0), (T1) and (T2), respectively. As result obtained, the total gain in chest girth of Osmanabadi kids during the experimental period as 7.058, 8.541 and 7.94 cm under T0, T1 and T2, groups, respectively. Maximum gain in chest girth of the Osmanabadi kids was obtained as result of feeding of (T2) and followed by (T1) and (T0) treatments groups. At the end of experiment, overall total gain in body chest girth was significantly higher in (T2) groups over (T1), and (T0). The mean ratio indicated that the body chest girth was statistically non-significant.

The initial body height of Osmanabadi kids at first fortnight was 51.312 ± 0.090 , 51.573 ± 0.188 and 51.550 ± 0.154 cm under (T0), (T1) and (T2), groups, respectively, which was reached up to the level of 57.112 ± 0.080^b , 58.173 ± 0.145^a and 58.445 ± 0.124^a at the end of the experiment. The total mean body height of Osmanabadi kids were recorded as 54.266 ± 0.893 , 54.883 ± 1.007 and 54.973 ± 1.045 cm in treatment group (T0), (T1) and (T2), respectively. Maximum gain in body height of the Osmanabadi kids was obtained as result of

feeding of Azolla meal, higher in (T2) and followed by (T1) and (T0) treatments groups. Significant effect was found in 3rd, 4th, 5th and 6th fortnights. The mean ratio indicated that body height was statistically non-significant.

The initial body length at first fortnight of Osmanabadi kids was 51.153±0.090, 51.210±0.091 and 51.100±0.082 cm under (T0), (T1) and (T2), groups, respectively, which was reached up to the level of 57.437±0.155^b, 58.440±0.080^a and 58.723±0.173^a cm to the end of experiment. The total mean body length of Osmanabadi kids were recorded as 54.293±0.960, 54.816±1.103 and 54.911±1.171 cm in treatment group (T0), (T1) and (T2), respectively. During the experimental period, maximum gain in body length of the Osmanabadi kids was obtained as higher in (T2) group and followed by (T1) and (T0) treatment groups. Significant effect was found in 3rd, 4th, 5th and 6th fortnightst. The mean ratio indicated that the body length was statistically non-significant.

Body condition score of Osmanabadi kids was measured by 1 to 5 point scale fortnightly intervals. The initial body condition score at first fortnight of Osmanabadi kids were 2.250±0.076, 2.217±0.075 and 2.333±0.042 (T0), (T1) and (T2) treatment groups, respectively, which was reached to the level of 3.017±0.060^b, 3.250±0.062^a and 3.350±0.043^a at the end of experiment. The mean ± SE of body condition score of Osmanabadi kids from April to July in the group (T0), (T1) and (T2) were 2.583±0.123, 2.664±0.157 and 2.811±0.147, respectively. Significant effect was found in 2nd, 3rd, 4th, 5th and 6th fortnights. The mean ratio indicated that the body condition score was statistically non-significant.

Blood samples were collected at fortnightly intervals for the estimation of biochemical parameters. i.e. bilirubin (mg/dl), creatinine (mg/dl), Blood urea nitrogen (mg/dl), Serum Total Protein(g/dl), SGOT (IU/lit), SGPT (IU/lit). The average serum total protein (g/dl) level in (T0), (T1) and (T2) group was 6.456±0.039^c, 6.67±0.050^b and 6.906±0.084^a, respectively. The mean average value of serum total protein (g/dl)

was found to be significant. Non-significant result was observed at 2nd fortnight. The average creatinine level in blood serum (mg/dl) level in (T0), (T1) and (T2) groups as 1.171 ± 0.071 , 1.241 ± 0.056 and 1.326 ± 0.059 , respectively. Significant effect was found in 5th and 6th fortnights. The mean average value of creatinine (mg/dl) was found to be non-significant.

The average level of blood urea nitrogen (BUN) (mg/dl) in blood serum in (T0), (T1) and (T2) group was 12.063 ± 0.154 , 12.475 ± 0.183 and 12.328 ± 0.224 , respectively. The mean average value of blood urea nitrogen (mg/dl) was found to be non-significant. Significant effect was found in 2nd, 5th and 6th fortnights. BUN level was lower in (T2) and (T1) groups as compared to the (T0) (control) groups. The average bilirubin level (mg/dl) in (T0), (T1) and (T2) group as 0.147 ± 0.005 , 0.150 ± 0.000 and 0.144 ± 0.009 , respectively.

The average SGOT level of blood serum (IU/L) in (T0), (T1) and (T2) treatment group was 16.202 ± 0.048 , 16.050 ± 0.125 and 16.210 ± 0.091 , respectively. The mean average value of SGOT was found to be non-significant. Such study indicates that Azolla meal supplementation did not hamper the liver metabolic function of the (T1) and (T2) treatment groups of Osmanabadi kids. The average SGPT level (IU/L) of blood serum in (T0), (T1) and (T2) treatment group as 15.565 ± 0.061 , 15.240 ± 0.125 and 15.373 ± 0.178 , respectively. The mean average value of SGPT was found to be non-significant. The present study shows that the Azolla meal supplementation did not affect the liver metabolic function of the (T1) and (T2) treatment groups of Osmanabadi kids. The SGPT level was lower in (T1) and (T2) groups as compared to the (T0) group.

The total feed cost of (T0), (T1) and (T2) groups were 624.654, 664.923 and 709.284, respectively. So, cost of production/kg body weight are 104.457, 109.904 and 98.923, respectively. Feeding cost/day/Osmanabadi kid was higher in (T2) treatment group as compared to the (T1) and (T0) groups. It shows that, the concentrate feeding without Azolla meal reduces the feeding cost. But in case of

feeding cost/kg body weight gain were as 104.457, 109.904 and 98.23 for the treatment of (T0), (T1) and (T2) groups, respectively. Hence, economically (15% and 20%) Azolla meal feeding was shown the beneficial effect.

Conclusions-

From the present study, following conclusions were drawn:

1. From the observations, feed intake was significantly higher in (T1) group followed by (T0) and (T2) groups. It showed that the addition of Azolla meal with concentrate mixture improves the feed intake of Osmanabadi kids.
2. The feed conversion efficiency was better in (T0) group followed by (T1) and (T2) treatment groups, respectively. It revealed that, Azolla meal can be added upto 20% in the feed of Osmanabadi kids.
3. As per observations, weekly and average daily body weight gain of Osmanabadi kids received significant effect.
4. Body measurement including chest girth, height and length of the Osmanabadi kids were statistically significant in 3rd, 4th, 5th and 6th fortnights but mean ratio indicates the non-significant effect.
5. Body condition score of Osmanabadi kids showed significant effect during 2nd, 3rd, 4th, 5th and 6th fortnights.
6. Blood biochemical parameters (Total protein, Creatinine, BUN, Bilirubin, SGOT and SGPT) average values indicates non-significant effect in all groups. On the basis of results, Azolla meal supplementation did not affect the kidney and liver metabolic functions.
7. During the entire period of experiment, Azolla meal supplementation showed feeding cost was higher in (T2) group followed by (T1) and (T0) groups of Osmanabadi kids, respectively.

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APPENDIX-1

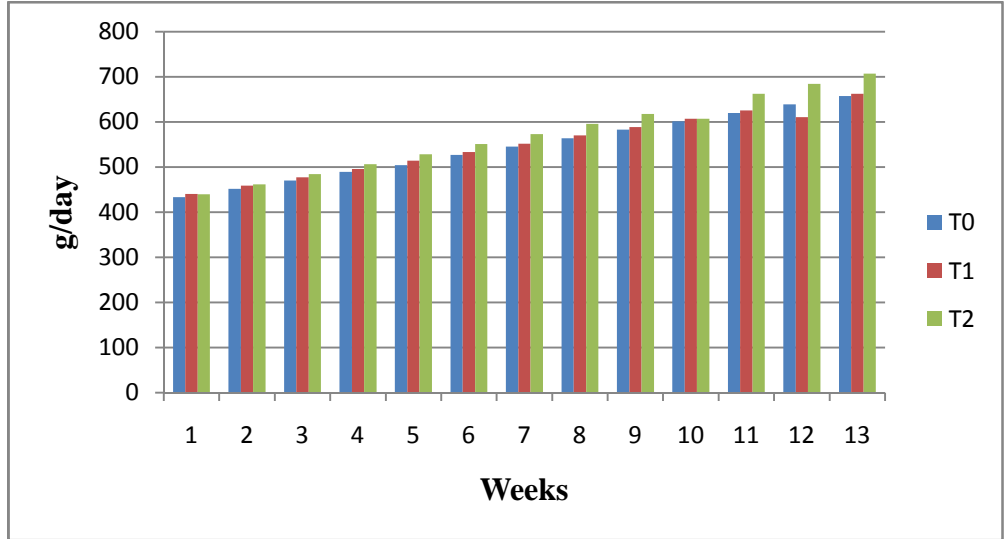


Fig. no. 4.1: Average weekly feed intake of Osmanabadi kids. (gm/day)

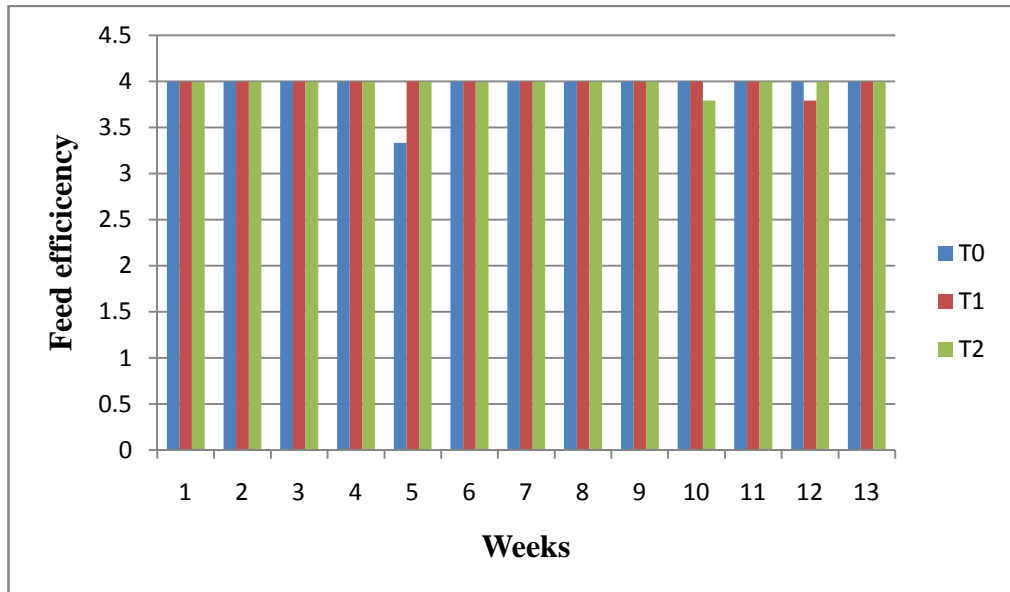


Fig. no. 4.2: Average weekly feed efficiency of Osmanabadi kids.

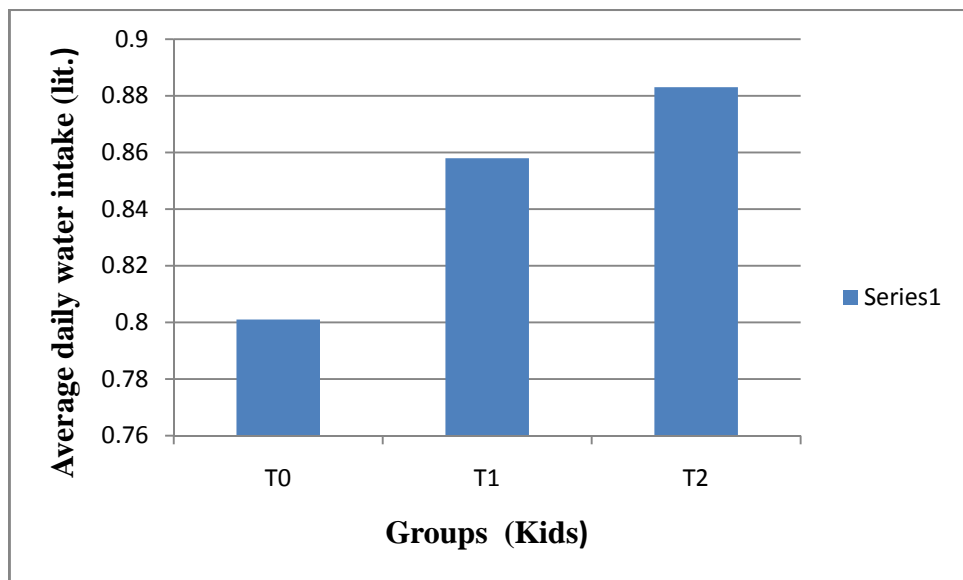


Fig. no.4.3: Average daily water intake of Osmanabadi kids. (lit.)

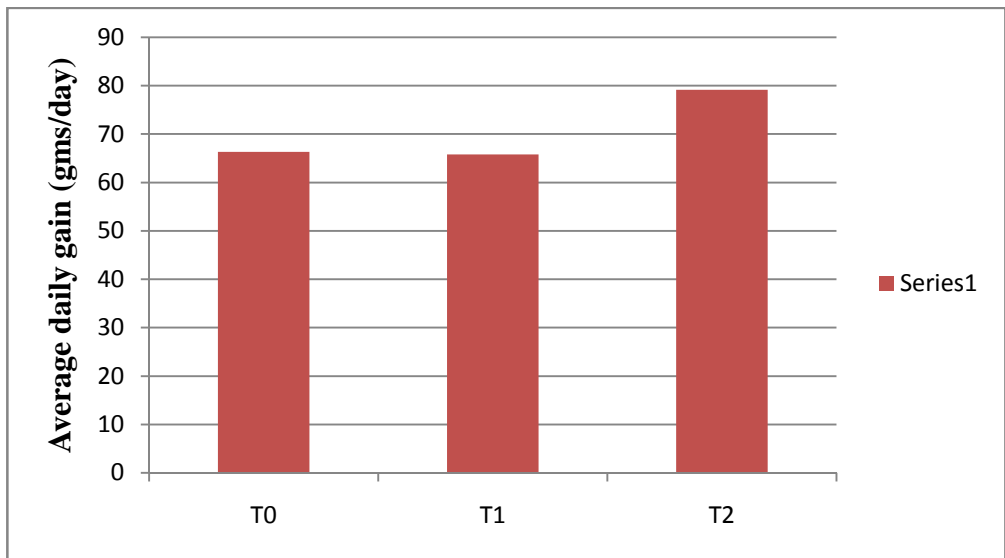


Fig. no. 4.4: Average daily weight gain of Osmanabadi kids. (gms /day)

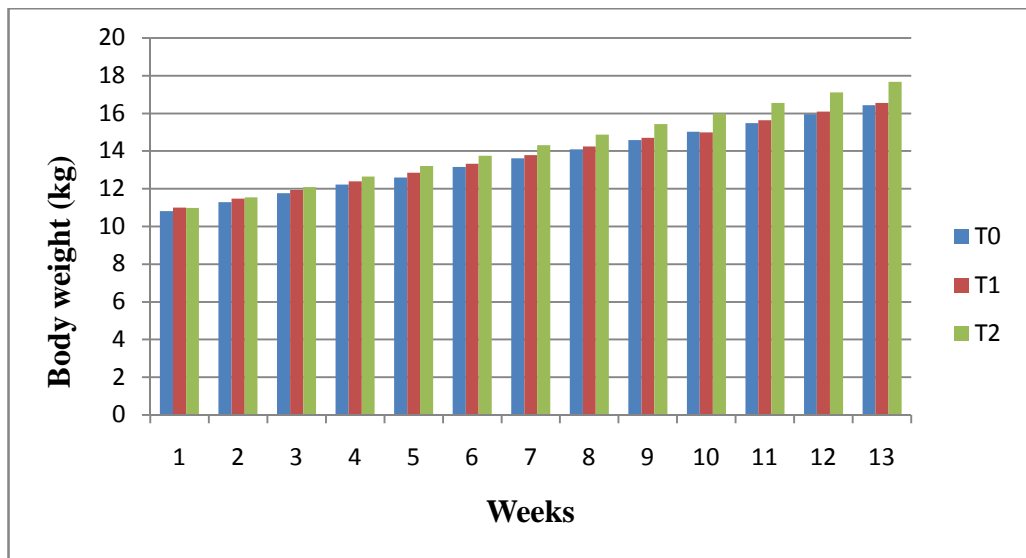


Fig. no. 4.5: Average weekly body weights (kg) gain of Osmanabadi kids.

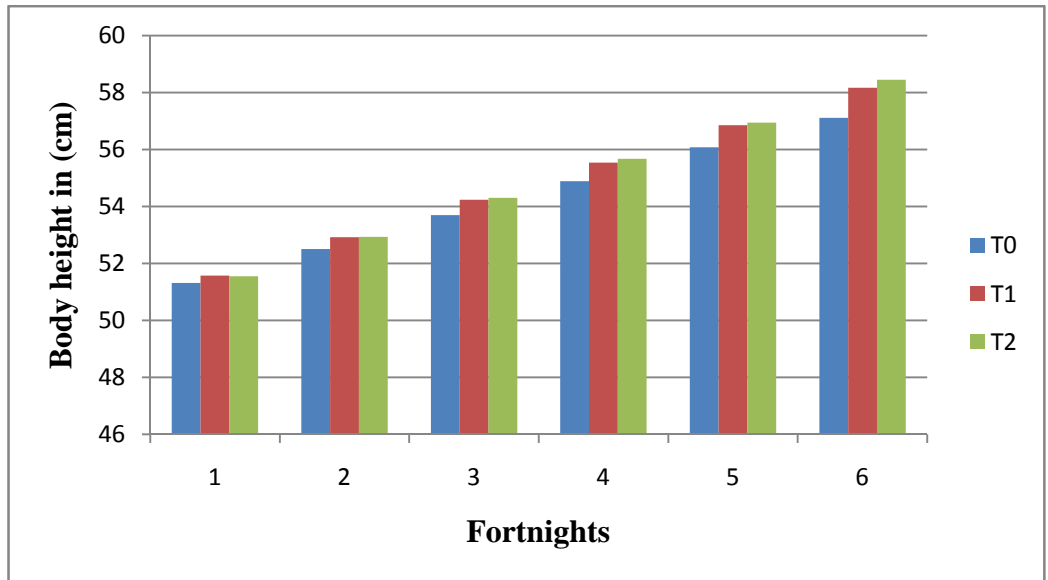


Fig. no. 4.6: Average fortnightly body height gain of Osmanabadi kids. (cm)

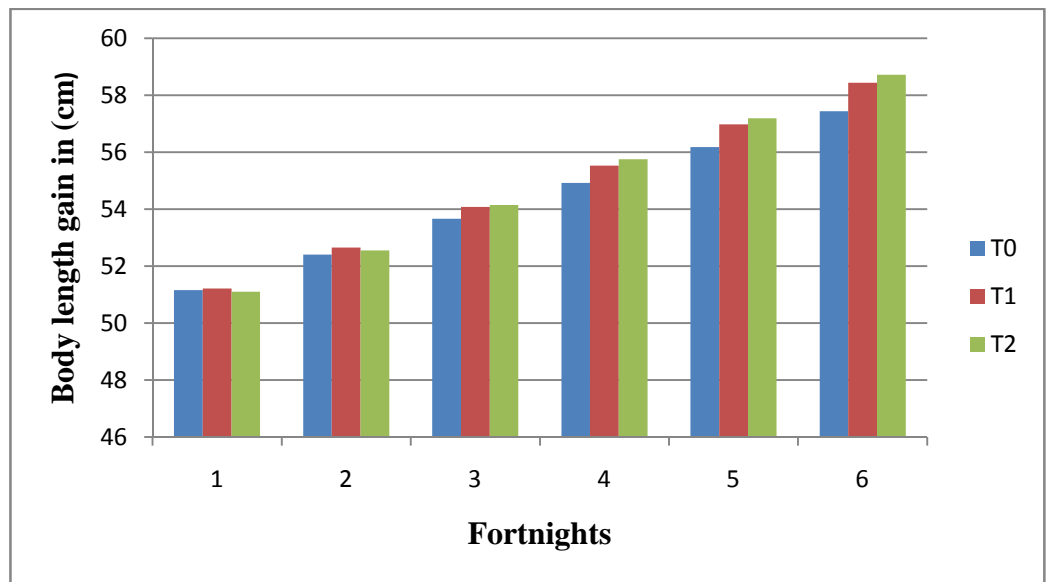


Fig. no. 4.7: Average fortnightly body length gain (cm) of Osmanabadi kids.

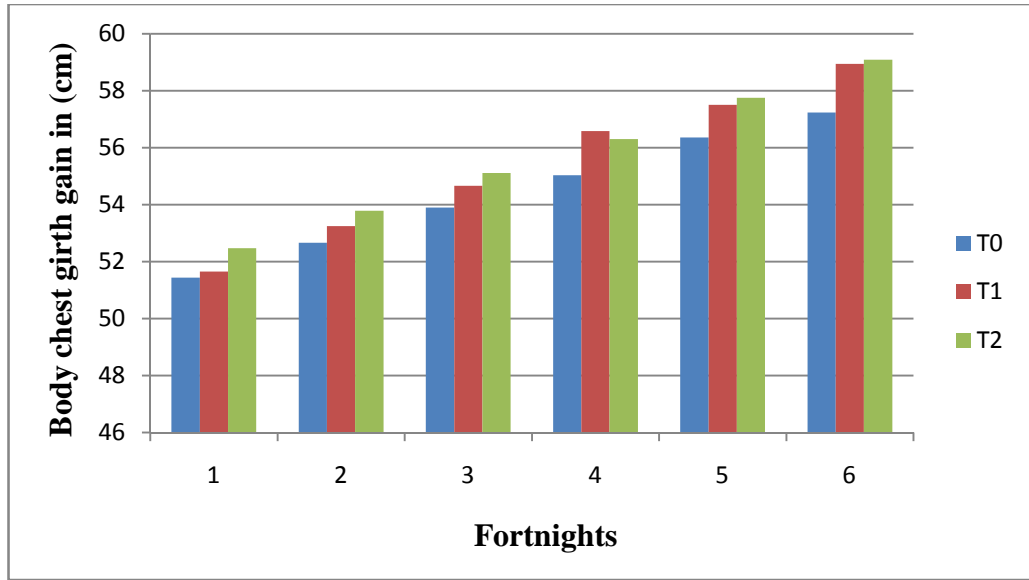


Fig. no. 4.8: Average fortnightly chest girth gain of Osmanabadi kids. (cm)

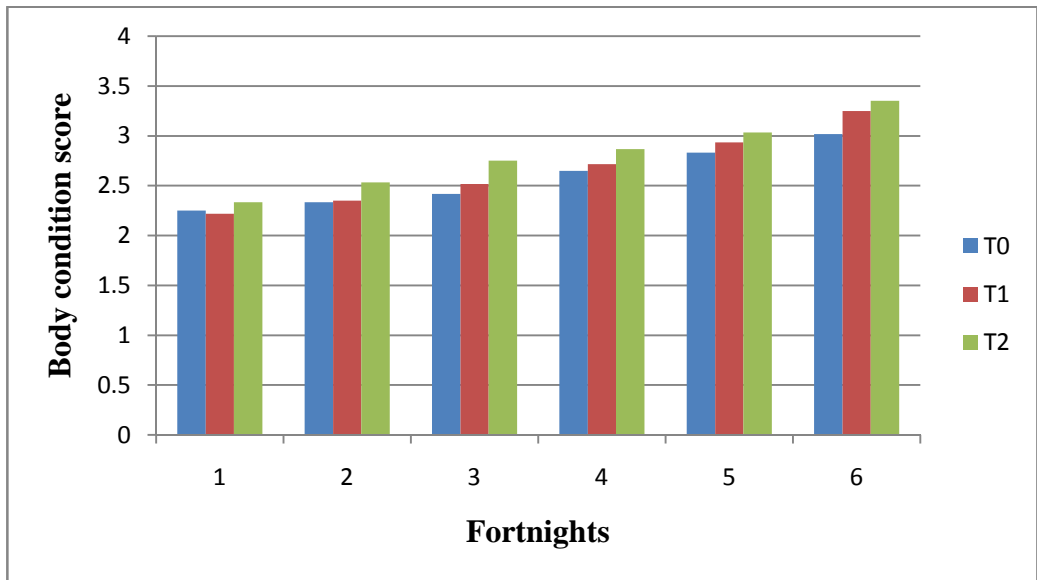


Fig. no. 4.9: Average fortnightly body condition score of Osmanabadi kids.

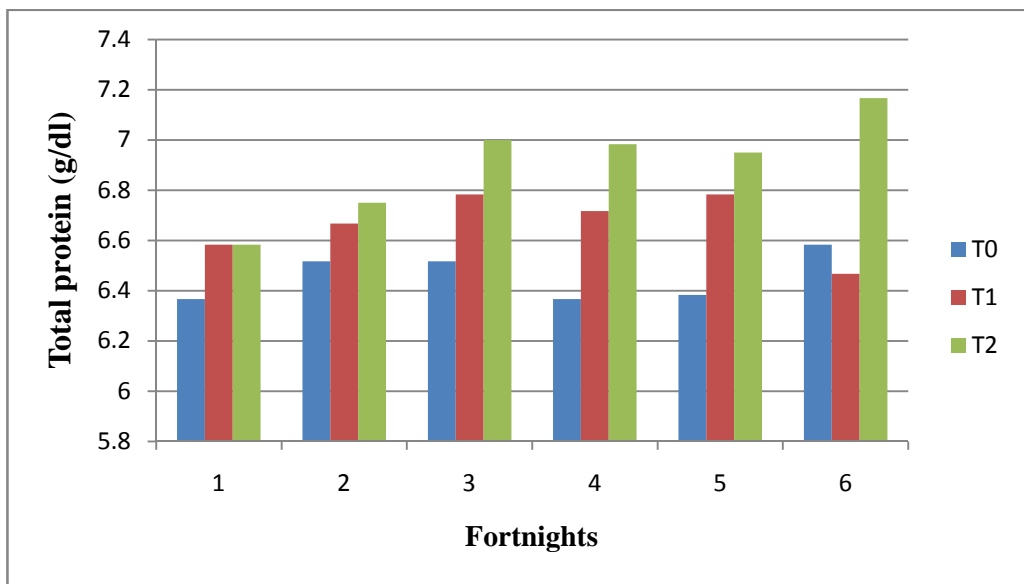


Fig. no. 4.10: Average Fortnightly Total Protein Concentration (g/dl) of Osmanabadi kids.

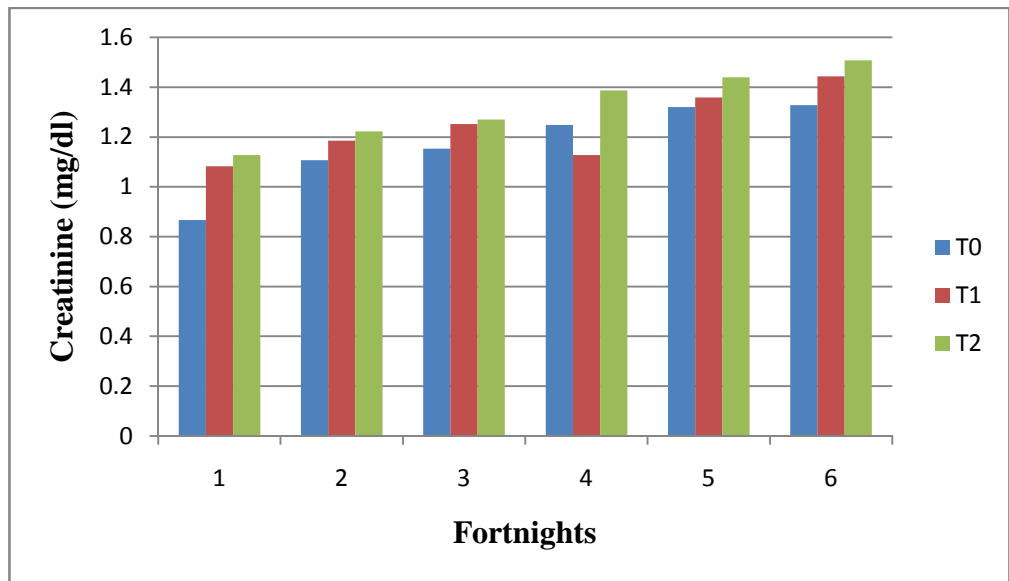


Fig. no. 4.11: Average Fortnightly Creatinine Concentration (mg/dl) Of Osmanabadi kids.

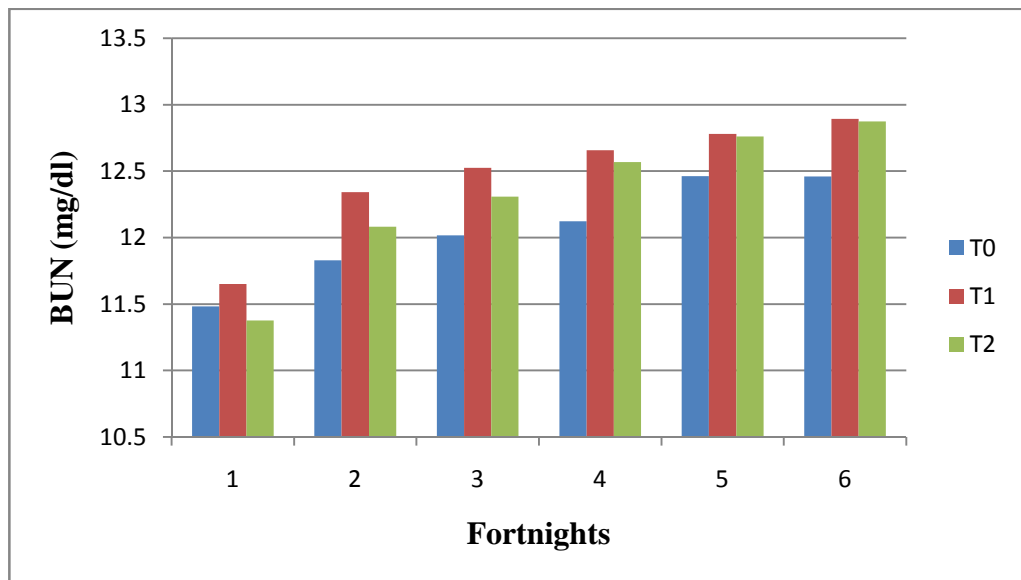


Fig. no. 4.12: Average Fortnightly BUN Concentration (mg/dl) of Osmanabadi kids.

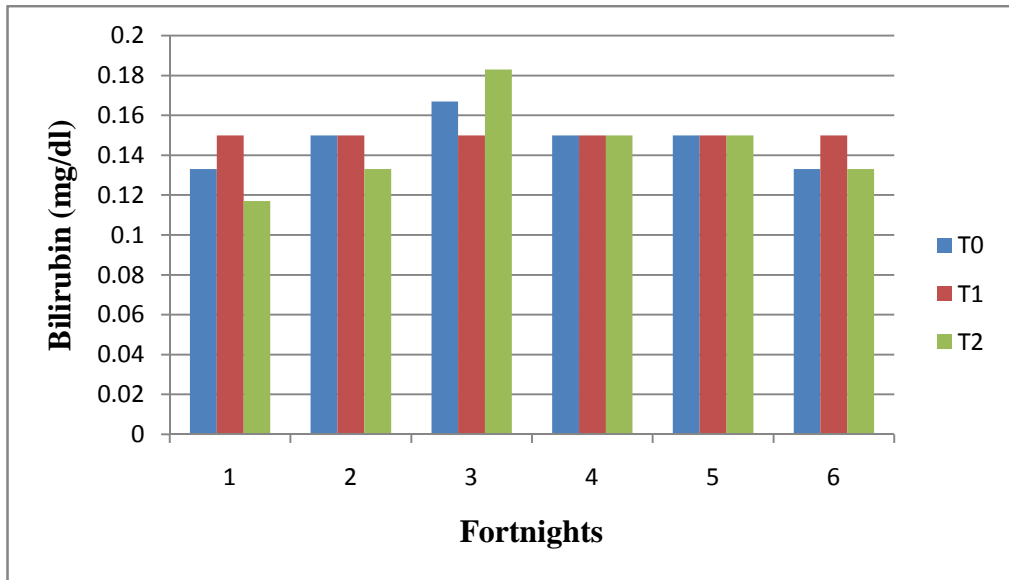


Fig. no. 4.13: Average fortnightly Bilirubin concentration (mg/dl) of Osmanabadi kids.

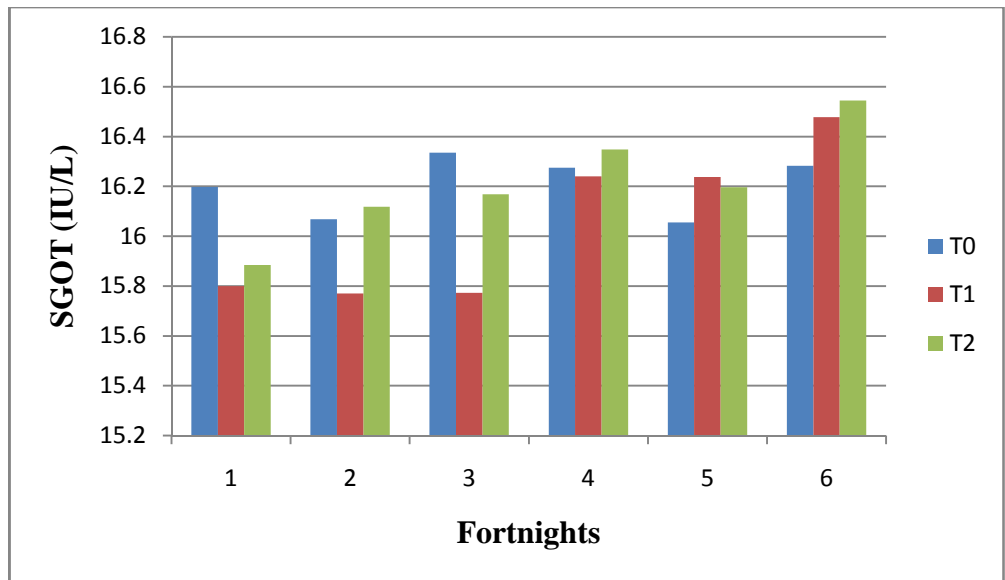


Fig. no. 4.14: Average Fortnightly SGOT concentration (IU/L) of Osmanabadi kids.

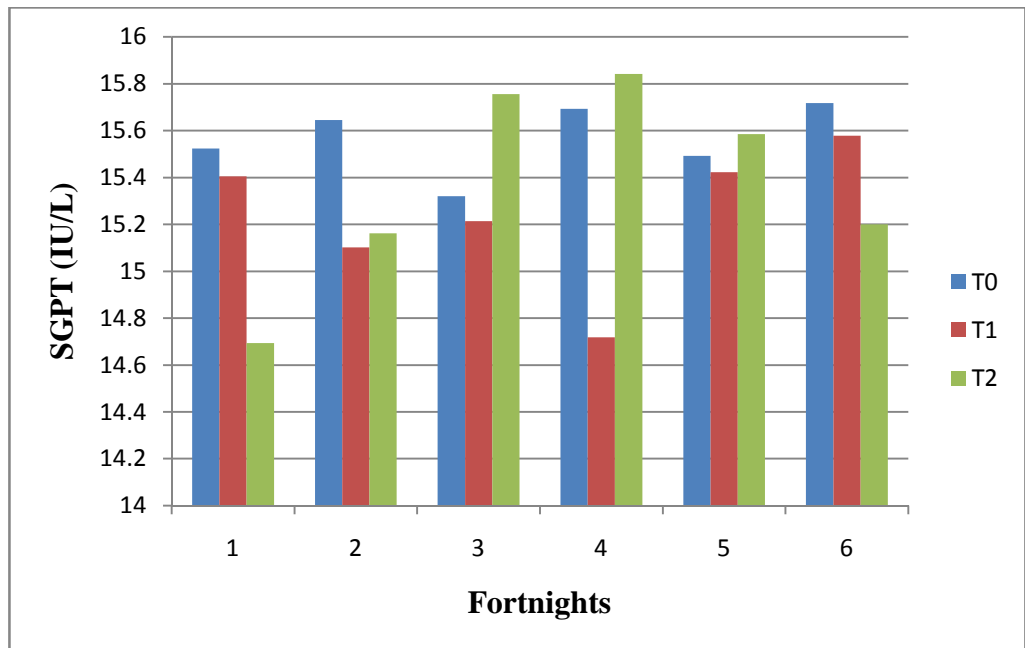


Fig. no. 4.15: Average fortnightly SGPT concentration (IU/L) of Osmanabadi kids.

APPENDIX-2



Plate no. 3.1: Azolla cultivation unit at ILFC, KNPCVS, Shirwal.



Plate no. 3.2: Collection of Azolla. (*Azolla pinnata*)



Plate no. 3.3: Grouping of Osmanabadi kids.



Plate No. 3.4



Plate No. 3.5



A. Concentrate feed.

B. Sun dried Azolla meal.



C. Green Azolla pinnata.

Plate no. 3.6: Experimental feed of Osmanabadi kids.



Plate no. 4.1: Estimation of Crude Protein of feed.



Plate no. 4.2: Weighing of feed sample for estimation of Ether Extract.



Plate no. 4.3: Feeding of Osmanabadi kids.



Plate no. 4.4: Watering of Osmanabadi kids.



Plate no. 4.5: Weighing of Osmanabadi kids.



Plate no. 4.6 : Body measurements of Osmanabadi kids.



Plate no. 4.7: Body measurement of Osmanabadi kids.



Plate no. 4.8 : Collection of blood samples for biochemical parameters



Plate no. 4.9 : Serum auto analyzer FALCON- 260.

VITA

Mr. Pandhare Khandu Soma was born on 13th Jan. 1992 at Ratanwadi, (Mutkhel), Tal.Akole Dist. Ahmednagar from Maharashtra state. He did his education up to S.S.C. at Anudanit Prathamik va Madhyamic Ashram School, Shendi, (Bhandardara) Tal. Akole, Dist. Ahmednagar. He passed H.S.C. examination Madhyamic va Uchha Madhyamic Vidyalaya, Shendi, (Bhandardara) Tal. Akole, Dist. Ahmednagar. He joined Bombay Veterinary College, Mumbai, as student of B.V. Sc. & A.H. in the year 2012 and completed his under-graduate degree programme in the year 2017. During the course of graduation the study of Livestock Production and Management aroused his interest and subsequently he sought admission for post-graduate studies (M.V.Sc.) in the Department of Livestock Production and Management at Krantisinh Nana Patil College of Veterinary Science, Shirwal.

He actively participated in the N.S.S., Sports, Cultural events and Animal Health Camps during his under graduation. He is well conversant with computer application. In future, he wants himself to be one amongst the successful veterinary professionals in the field of Livestock Production and Management.

THESIS ABSTRACT

- a) Title of the thesis : **EFFECT OF FEEDING AZOLLA MEAL ON GROWTH PERFORMANCE IN OSMANABADI KIDS.**
- b) Full name of student : **Pandhare Khandu Soma**
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- d) Degree to be awarded : **M. V. Sc.**
- e) Year of award of degree : **2019**
- f) Major subject : **Livestock Production and Management**
- g) Total number of pages in the thesis : **59**
- h) Number of words in the abstract : **299**
- i) Signature of Student :
- j) Signature, Name and Address of forwarding Authority (HOD/SH) : **Dr. A. V. Khanvilkar**
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ABSTRACT

The research work was undertaken on eighteen Osmanabadi kids for period of 90 days to study the "Effect of feeding Azolla meal on growth performance in Osmanabadi kids." On the basis of growth parameters, 3-4 months of age Osmanabadi kids were selected and subdivided into three groups i.e. (T₀), (control) and (T₁), (T₂) as treatment groups with six kids in each group. (T₀) group were fed with concentrate and roughages. Whereas in (T₁) and (T₂) group 15%, and 20% concentrate was replaced by Azolla meal. Crude protein percent of concentrate and Azolla meal was 18.30 and 24.20%, respectively. Average feed intake was 479.285, 592.086, 507.505 (g/day) in (T₀), (T₁), (T₂), respectively. Average feed efficiency 3.885, 3.998, 3.997 in (T₀), (T₁), (T₂) groups, respectively. From the observations, average water intake/day/kids were 0.801, 0.858, 0.883 (lit) of (T₀), (T₁), (T₂) groups, respectively. Average weekly, daily body weight gain were 11.975, 14.795, 12.682 (kg) whereas 66.300, 65.800, 79.167 (gm) in (T₀), (T₁), (T₂) groups, respectively. Body measurement showed, average body chest girth, body height, body length as 54.437, 55.431, 55.754 (cm), 54.266, 54.883, 54.973 (cm) and 54.293, 54.816, 54.911 (cm) in T₀, T₁ and T₂, respectively. Mean body condition score from group T₀, T₁ and T₂ were 2.583, 2.664 and 2.811, respectively. Blood biochemistry analysis revealed the total protein (g/dl), creatinine, BUN, bilirubin level (mg/dl) in (T₀), (T₁), (T₂) group is 6.456, 6.67, 6.906 and 1.171, 1.241, 1.326 and 12.063, 12.475, 12.328 and 0.147, 0.150 and 0.144, respectively. Further SGOT, SGPT were found as 16.202, 16.050, 16.210 and 15.565, 15.240, 15.373 in (T₀), (T₁), (T₂) groups, respectively. The cost per kg body weight gain was lower in the treatment groups. Therefore, it is concluded that, Azolla meal can be replace as best protein source up to 20% in concentrate mixture of Osmanabadi kids.

प्रबंध सारांश

प्रबंधाचे नाव	: उस्मानाबादी करडांच्या खुराक खाद्यामध्ये अज्जोलाचा वापर करून वाढीवर होणारा परिणाम अभ्यासणे.
विद्यार्थ्यांचे पूर्ण नाव	: पांढरे खंडू सोमा
मार्गदर्शक	: डॉ. अ. वि. खानविलकर सहयोगी प्राध्यापक व विभाग प्रमुख पशुउत्पादन व व्यवस्थापन विभाग क्रां. ना. पा. पशुवैद्यकीय महाविद्यालय, शिरवळ
प्रदान करण्यात येणारी पदवी	: एम. व्ही .एससी.
पदवी प्रदान करण्यात	: २०१९
येणारे वर्ष	
मुख्य विषय	: पशुउत्पादन व व्यवस्थापन
प्रबंधातील एकूण	: ५९
पानांची संख्या	
सारांशातील शब्दांची संख्या	: २९९
विद्यार्थ्यांची सही	:
सादरकर्ता अधिकाऱ्याचे	: डॉ. अ. वि. खानविलकर
नाव, सही, पत्ता	सहयोगी प्राध्यापक व विभाग प्रमुख पशुउत्पादन व व्यवस्थापन विभाग क्रां. ना. पा. पशुवैद्यकीय महाविद्यालय, शिरवळ

प्रबंध सारांश

सदर अभ्यास हा अझोलाचा खुराक खाद्यामध्ये समावेश करून, १८ उस्मानाबादी करडांच्या वाढीवर होणारा परिणाम अभ्यासण्यासाठी ९० दिवसांच्या कालावधीचे संशोधन कार्य हाती घेण्यात आले. विविध शारीरिक मापदंडांच्या आधारावर (आकार, वजन) ३ - ६ महिने वय असलेली उस्मानाबादी करडे निवडली. त्यांना ३ गटांत विभागले. म्हणजे टी० (नियंत्रण गट), टी१, टी २ (उपचार गट). प्रत्येक गटात ६ उस्मानाबादी करडे होती. सुग्रास खुराक नियंत्रण गट (टी०) ला देण्यात आला. उपचार गट (टी१) मध्ये सुग्रास खुराक मिश्रणात १५% अझोलाचा वापर केला आणि उपचार गट (टी२) मध्ये २०% अझोलाचा बदली म्हणून वापर केला. खुराक आणि अझोला खाद्यात कूड प्रथिनांचे प्रमाण अनुक्रमे १८.३०, २४.२० टक्के इतके होते. विश्लेषणानंतर अझोला खाद्यातील कूड प्रथिनांचे प्रमाण हे खुराक मिश्रणातील प्रथिनांपेक्षा जास्त होते.

सध्याच्या अभ्यासात नमूद केलेल्या निरीक्षणातून असे आढळून आले कि, प्रयोगात्मताक कालावधीत सरासरी आठवड्यात, अनुक्रमे गट (टी०), (टी१), (टी२) मध्ये ४७९.२८५, ५९२.०८६, ५०७.५०५, (ग्रॅम/दिवस) सरासरी खाद्य सेवन केले. सरासरी आठवड्यात खाद्य परिवर्तन अनुक्रमे ३.८८५, ३.८८९, ३.९९७ (ग्रॅम/दिवस) हे गट (टी०), (टी१) (टी२) मध्ये आढळून आले. निरीक्षणातून सरासरी पाणी पिण्याचे प्रमाण/दिवस/करडू अनुक्रमे (टी०), (टी१), (टी२) गटांमध्ये ०.८०१, ०.८५८, ०.८८३ (ली.) होते. सरासरी साप्ताहिक व दैनंदिन शारीरिक वजन वाढ अनुक्रमे ११.९७५, १४.७९५, १२.६८२ (किलोग्रॅम), ६६.३००, ६५.८००, ७९.१६७ (ग्रॅम), (टी०), (टी१) (टी२) गटांत आढळली. शारीरिक मोजमाप (छातीचा घेर, शारीरिक उंची, लांबी) अनुक्रमे ५४.४३७, ५५.४३१, ५५.७५४ (सेमी), ५४.२६६, ५४.८८३, ५४.९७३ (सेमी), ५४.२९३, ५४.८१६, ५४.९११ (सेमी), गट (टी०), (टी१) (टी२) मध्ये आढळून आले. शरीरयष्टी सूचक हा अनुक्रमे २.५८३, २.६६४ व २.८८१ गट (टी०), (टी१), (टी२) मध्ये होता. निरीक्षणातून व विश्लेषणाने गट (टी०), (टी१) (टी२) गटांतील प्रथिने (ग्रॅम/डोल) अनुक्रमे, ६.४५६, ६.६७, ६.९०६. क्रीटीनीने, बीयुन, बिलिरुबिन पातळी (मिलिग्रॅम/डोल) अनुक्रमे, ६.४५६, ६.६७, ६.९०६ आणि १.१७१, १.२४१, १.३२६ आणि १२.०६३, १२.४७५, १२.३२८ आणि ०.१४७, ०.१५०, ०.१४४ (मिलिग्रॅम/डोल) आढळून आले. पुढील एसजिओटी, एसजीपीटी (आयउ/ ली.)

अनुक्रमे, १६.२०२, १६.०५०, १६.२१० व १५.५६५, १५.२४०, १५.३७३ हे (टी०), (टी१) (टी२) गटांत आढळले. अझोला खाद्य हे खुराक मिश्रणां दिले जाणाऱ्या उपचार गटांमध्ये प्रतिकिलो शरीर वजन वाढ किंमत कमी होती.

अशाप्रकारे निष्कर्ष काढला जातो कि, उस्मानाबादी करडांच्या खुराक मिश्रणात २०% पर्यंत अझोला खाद्य प्रथिन स्रोत म्हणून बदलले जाऊ शकते.