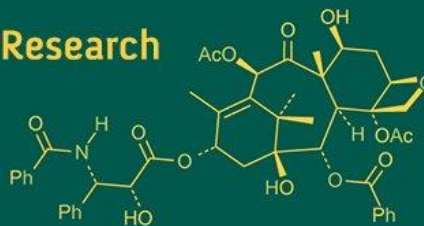


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
 ISSN Online: 2617-4707
 NAAS Rating (2026): 5.29
 IJABR 2026; 10(6): 1020-1023
www.biochemjournal.com
 Received: 01-03-2026
 Accepted: 05-04-2026

Tathagat P Khobragade
 M.V.Sc Scholar, Department of
 Animal Nutrition, College of
 Veterinary Science and Animal
 Husbandry, Junagadh,
 Gujarat, India

MR Chavda
 Assistant Professor,
 Polytechnic in Animal
 Husbandry, College of
 Veterinary Science and Animal
 Husbandry, Junagadh,
 Gujarat, India

HH Savsani
 Associate Professor, Bull
 Mother Farm, Kamdhenu
 University, Amreli, Gujarat,
 India

MR Pandya
 M.V.Sc Scholar, Department of
 Animal Nutrition, College of
 Veterinary Science and Animal
 Husbandry, Junagadh,
 Gujarat, India

Corresponding Author:
Tathagat P Khobragade
 M.V.Sc Scholar, Department of
 Animal Nutrition, College of
 Veterinary Science and Animal
 Husbandry, Junagadh,
 Gujarat, India

Chemical composition of feeds and fodders fed to dairy buffaloes in Amreli district of Gujarat state, India

Tathagat P Khobragade, MR Chavda, HH Savsani and MR Pandya

DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i6m.8813>

Abstract

A field survey was conducted in the Amreli district of Gujarat state to assess the nutritional status of dairy buffaloes and to evaluate the chemical composition of feeds and fodders available in the region. Samples of concentrates, green roughage and dry roughage being offered to the dairy buffaloes were collected from individual farmers. All the samples were processed and analysed for proximate composition as well as calcium and phosphorus content. The proximate composition of the various feedstuffs used in the district was found to be within the acceptable and normal range. The calcium and phosphorus contents of representative feed and fodder samples collected from the district were found to be adequate and above the critical limits. Among all the samples, only gram gotar exhibited phosphorus content below the critical level. Overall, the chemical composition of feeds and fodders fed to dairy buffaloes in the Amreli district was within the normal range, indicating that locally available feed resources were adequate to meet the nutritional requirements of the animals.

Keywords: Amreli district, chemical composition, feed and fodder

Introduction

India's livestock sector is a cornerstone of its agricultural economy, characterized by a vast and diverse animal population. India's milk production has grown remarkably over the years, making it the world's largest milk producer (Anonymous, 2025) ^[1]. Livestock feeding in India largely depends on crop residues and agro-industrial by-products, along with pasture and grasses from common property resources (Dey *et al.*, 2014) ^[4]. The crop residues and agro-industrial by-products which are deficient in protein and minerals form the bulk of the ration resulting in less availability of nutrients to the lactating animals. High-quality feed is essential for a dairy business to be profitable, as it improves animal health and productivity (Verma *et al.*, 2024) ^[21]. Assessment of feed and fodder quality is primarily based on their chemical composition, which serves as a key determinant of both animal productivity and overall health status within a region. Evaluation of proximate composition and fibre fractions provides critical information on the nutritive value of feed resources (Ganai *et al.*, 2004) ^[6]. Minerals play a crucial role in animal nutrition, supporting both production and overall health. They are needed for many digestive, physiological, and biosynthetic processes in the body. Livestock in India do not receive regular mineral supplementation and primarily rely on feed and fodder to meet their mineral requirements (Garg *et al.*, 2002) ^[7]. Mineral deficiencies are frequently encountered in livestock rations in most tropical countries unless the deficient minerals are supplemented. Comprehensive knowledge of micronutrient levels in feeds and fodder of a particular area is essential for balancing dietary mineral supply and formulating area-specific mineral mixtures. Mineral deficiencies in dairy animals are a common occurrence and have been widely reported to reduce milk yield, impair growth, and lead to reproductive failures (Garg *et al.*, 2010) ^[9]. In this context, emphasis on the analysis of macro-minerals, especially calcium and phosphorus present in feeds and fodders of the region, is indispensable for maintaining and enhancing dairy animal productivity.

Materials and Methods

Looking to the above facts, the field survey was conducted in the Amreli district of Gujarat state during the period from March 2025 to May 2025 to estimate the proximate constituents,

calcium and phosphorus contents in feeds and fodders of the district in order to assess the nutritional status of dairy buffaloes. The Amreli district consists of 11 talukas. The survey was conducted in six talukas viz. Amreli, Babra, Dhari, Khambha, Rajula and Savarkundla of Amreli district. Samples of concentrates, green roughage and dry roughage being offered to the dairy buffaloes were collected from the individual farmers selected based on multistage random sampling method. Samples of green fodder were air dried first and stored in airtight polythene bags. Samples were brought to laboratory, dried in hot air oven at 100 ± 5 °C for 6-8 hours, ground and stored in airtight polythene bags for further analysis of proximate constituents. The individual samples from the taluka were pooled to create a composite sample representing the taluka region for the analysis of calcium and phosphorus content. The laboratory analysis of the samples of feeds and fodders collected during the survey was carried out at the Department of Animal Nutrition, College of Veterinary Science and A. H., Kamdhenu University, Junagadh. The proximate constituents of feeds and fodders were estimated as per the methods of AOAC (2023) [2]. Calcium and phosphorus estimation in feeds and fodders were done as per the method of Talapatra *et al.* (1940) [2].

Results and Discussion

Proximate Composition of Feeds and Fodders

The proximate composition (% DM basis) of various feeds and fodders being used in Amreli district are presented in Table 1.

In the study area, buffalo owners predominantly relied on cottonseed cake and commercial concentrate mixtures produced by private feed mills. Additionally, in Babra and Khambha talukas the farmers were using compound cattle feed manufactured by Amreli District Cooperative Milk Producers' Union Limited and Maahi Milk Producer Company Limited, which meet the specification of BIS type II cattle feed.

The proximate analysis of concentrates revealed crude protein (CP) ranged from 8.25 ± 0.00 to $33.22 \pm 1.26\%$; crude fibre (CF) from 7.96 ± 0.00 to $26.29 \pm 0.58\%$; ether extract (EE) from 3.34 ± 0.00 to $17.96 \pm 0.59\%$; nitrogen free extract (NFE) from 35.28 ± 0.77 to $73.29 \pm 0.00\%$ and total ash (TA) from 4.56 ± 0.69 to $16.65 \pm 0.43\%$. The majority of commercial concentrate mixtures from private feed manufacturers contained CF levels above 18% whereas the CP levels were satisfactory. This may be due to the inclusion of cottonseed and cottonseed cake as principal protein supplement.

Farmers in the study area offered green fodders such as lucerne, green jowar, green maize, napier and marvel grass

to their dairy buffaloes. The proximate analysis of these green fodders revealed CP ranged from 7.61 ± 1.70 to $16.78 \pm 0.68\%$; CF from 19.36 ± 1.04 to $34.31 \pm 2.16\%$; EE from 1.38 ± 0.27 to $3.64 \pm 0.43\%$; NFE from 41.08 ± 1.16 to $53.36 \pm 0.93\%$ and TA from 8.16 ± 0.53 to $16.39 \pm 0.64\%$. For dry fodders, farmers in the study area depended on groundnut gotar, jowar hay, toor gotar, wheat straw and gram gotar to feed their dairy buffaloes. The proximate analysis of these dry fodders revealed CP ranged from 2.78 ± 0.03 to $9.80 \pm 0.21\%$; CF from 33.94 ± 4.45 to $36.99 \pm 1.16\%$; EE from 0.81 ± 0.01 to $1.97 \pm 0.07\%$; NFE from 40.63 ± 0.69 to $48.45 \pm 1.42\%$ and TA from 7.55 ± 0.69 to $14.26 \pm 0.33\%$.

The proximate composition of feeds and fodders is generally regarded as a preliminary index for assessing their quality. The proximate composition (% DM basis) of the various feedstuffs used in the district was found to be within the normal range and are in agreement with the earlier reports of Goswami (2005) [11], Dhahi *et al.* (2011) [5], ICAR (2013) [14], Patil *et al.* (2016) [17], Sherasia *et al.* (2016) [19] and Naliyapara *et al.* (2021) [16].

Calcium and Phosphorus Contents of Feeds and Fodders

The values of calcium and phosphorus contents (% DM basis) in various feeds and fodders being used in Amreli district are presented in Table 2.

The average calcium content of the representative samples of feed and fodder collected from the district ranged from 0.36 ± 0.03 to $1.36 \pm 0.04\%$ in concentrates, 0.52 ± 0.04 to $1.88 \pm 0.12\%$ in green fodder and 0.45 ± 0.04 to $1.72 \pm 0.08\%$ in dry fodder. The calcium content of all the samples was observed above the critical limit (0.30%) as recommended by McDowell (1985) [15], ensuring an adequate availability of calcium through feed resources in the study area. Similar observations had also been reported by Garg *et al.* (2003) [8], ICAR (2013) [14], Ramesh *et al.* (2014) [18], Gupta *et al.* (2016) [13], Goswami *et al.* (2017) [10] and Gupta *et al.* (2019) [12].

The average phosphorus content of the representative samples of feed and fodder ranged from 0.25 ± 0.00 to $0.61 \pm 0.00\%$ in concentrates, 0.27 ± 0.03 to $0.37 \pm 0.03\%$ in green fodder and 0.24 ± 0.01 to $0.29 \pm 0.01\%$ in dry fodder. Most the feedstuffs had phosphorus content above the critical limit (0.25%) as recommended by McDowell (1985) [15], expect gram gotar ensuring an adequate availability of phosphorus through feed resources in the study area. The findings of present study are in accordance with the reports of Garg *et al.* (2003) [8], ICAR (2013) [14], Ramesh *et al.* (2014) [18], Bhandari *et al.* (2016) [3], Gupta *et al.* (2016) [13], Patil *et al.* (2016) [17], and Goswami *et al.* (2017) [10].

Table 1: Proximate composition of feedstuffs used in Amreli district (% DM basis) (Mean $\pm$ SE)

Sr. No.	Feedstuffs	CP (%)	CF (%)	EE (%)	NFE (%)	TA (%)
Concentrate						
1	Cottonseed cake (n = 21)	24.20 $\pm$ 0.64	26.29 $\pm$ 0.58	8.10 $\pm$ 0.53	36.44 $\pm$ 0.94	4.97 $\pm$ 0.13
2	Groundnut cake (n = 4)	33.22 $\pm$ 1.26	12.79 $\pm$ 1.09	10.94 $\pm$ 0.96	35.28 $\pm$ 0.77	7.77 $\pm$ 0.37
3	Coconut cake (n = 3)	23.81 $\pm$ 2.17	10.87 $\pm$ 0.11	9.76 $\pm$ 0.43	49.39 $\pm$ 1.76	6.17 $\pm$ 0.13
4	Cottonseed (n = 3)	19.44 $\pm$ 0.50	19.25 $\pm$ 0.99	17.96 $\pm$ 0.59	38.79 $\pm$ 2.12	4.56 $\pm$ 0.69
5	Amar dan (n = 2)	21.04 $\pm$ 0.16	11.60 $\pm$ 0.06	3.35 $\pm$ 0.33	51.49 $\pm$ 0.2	12.52 $\pm$ 0.63
6	Maahi dan (n = 1)	20.37 $\pm$ 0.00	11.67 $\pm$ 0.00	3.43 $\pm$ 0.00	52.62 $\pm$ 0.00	11.91 $\pm$ 0.00
7	Amrut readymade concentrate mixture (n = 1)	20.79 $\pm$ 0.00	23.55 $\pm$ 0.00	3.36 $\pm$ 0.00	42.34 $\pm$ 0.00	9.96 $\pm$ 0.00
8	Balaji readymade concentrate mixture (n = 1)	18.82 $\pm$ 0.00	20.89 $\pm$ 0.00	4.39 $\pm$ 0.00	45.34 $\pm$ 0.00	10.56 $\pm$ 0.00
9	Khedutchhap readymade concentrate mixture (n = 1)	19.72 $\pm$ 0.00	18.88 $\pm$ 0.00	3.75 $\pm$ 0.00	47.82 $\pm$ 0.00	9.83 $\pm$ 0.00
10	Rajmoti readymade concentrate mixture (n = 2)	21.15 $\pm$ 0.38	26.25 $\pm$ 1.02	4.76 $\pm$ 0.14	39.41 $\pm$ 0.10	8.43 $\pm$ 0.40
11	Agrofin readymade concentrate mixture (n = 1)	19.04 $\pm$ 0.00	23.52 $\pm$ 0.00	3.81 $\pm$ 0.00	41.14 $\pm$ 0.00	12.49 $\pm$ 0.00
12	Amul readymade concentrate mixture (n = 2)	20.79 $\pm$ 0.24	18.65 $\pm$ 1.04	4.07 $\pm$ 0.47	44.08 $\pm$ 0.98	12.41 $\pm$ 0.77
13	Rajavadi readymade concentrate mixture (n = 4)	18.63 $\pm$ 0.67	18.59 $\pm$ 0.90	4.21 $\pm$ 0.34	41.92 $\pm$ 0.3	16.65 $\pm$ 0.43
14	Buddhalal readymade concentrate mixture (n = 1)	18.49 $\pm$ 0.00	15.47 $\pm$ 0.00	4.14 $\pm$ 0.00	51.31 $\pm$ 0.00	10.59 $\pm$ 0.00
15	Dairy fresh readymade concentrate mixture (n = 1)	17.33 $\pm$ 0.00	17.04 $\pm$ 0.00	4.17 $\pm$ 0.00	48.32 $\pm$ 0.00	13.14 $\pm$ 0.00
16	Ramkrushna readymade concentrate mixture (n = 1)	20.64 $\pm$ 0.00	16.26 $\pm$ 0.00	4.11 $\pm$ 0.00	52.04 $\pm$ 0.00	6.95 $\pm$ 0.00
17	Girkamdheni readymade concentrate mixture (n = 1)	16.09 $\pm$ 0.00	18.95 $\pm$ 0.00	3.96 $\pm$ 0.00	49.45 $\pm$ 0.00	11.55 $\pm$ 0.00
18	Wheat bran (n = 4)	10.18 $\pm$ 0.47	12.29 $\pm$ 0.92	3.92 $\pm$ 0.21	65.01 $\pm$ 1.83	8.60 $\pm$ 0.96
19	Maize bhardo (n = 1)	8.25 $\pm$ 0.00	7.96 $\pm$ 0.00	3.34 $\pm$ 0.00	73.29 $\pm$ 0.00	7.16 $\pm$ 0.00
Green fodder						
1	Lucerne (n = 9)	16.78 $\pm$ 0.68	27.61 $\pm$ 1.07	2.49 $\pm$ 0.19	41.08 $\pm$ 1.16	12.04 $\pm$ 0.56
2	Napier (n = 12)	8.37 $\pm$ 0.39	32.96 $\pm$ 1.05	1.79 $\pm$ 0.11	44.14 $\pm$ 0.89	12.74 $\pm$ 0.51
3	Green jowar (n = 4)	8.54 $\pm$ 0.79	31.39 $\pm$ 0.29	1.62 $\pm$ 0.18	50.23 $\pm$ 1.01	8.22 $\pm$ 0.40
4	Green maize (n = 9)	8.78 $\pm$ 0.28	29.94 $\pm$ 1.01	1.79 $\pm$ 0.10	51.33 $\pm$ 1.44	8.16 $\pm$ 0.53
5	Green bajra (n = 2)	7.61 $\pm$ 1.70	34.31 $\pm$ 2.16	1.38 $\pm$ 0.27	46.14 $\pm$ 4.39	10.56 $\pm$ 0.25
6	Carrot plant (n = 4)	9.20 $\pm$ 0.62	19.36 $\pm$ 1.04	1.69 $\pm$ 0.22	53.36 $\pm$ 0.93	16.39 $\pm$ 0.64
7	Marvel grass (n = 2)	8.78 $\pm$ 0.19	26.18 $\pm$ 1.81	3.64 $\pm$ 0.43	50.12 $\pm$ 1.77	11.28 $\pm$ 0.57
Dry fodder						
1	Groundnut gotar (n = 23)	9.80 $\pm$ 0.21	35.90 $\pm$ 0.68	1.97 $\pm$ 0.07	40.63 $\pm$ 0.69	11.70 $\pm$ 0.29
2	Jowar hay (n = 10)	7.12 $\pm$ 0.42	34.92 $\pm$ 1.27	1.48 $\pm$ 0.13	48.45 $\pm$ 1.42	8.03 $\pm$ 0.40
3	Toor gotar (n = 2)	9.65 $\pm$ 0.15	33.94 $\pm$ 4.45	1.36 $\pm$ 0.06	47.50 $\pm$ 5.23	7.55 $\pm$ 0.69
4	Wheat straw (n = 2)	2.78 $\pm$ 0.03	36.91 $\pm$ 1.39	0.81 $\pm$ 0.01	45.85 $\pm$ 2.24	13.65 $\pm$ 0.84
5	Gram gotar (n = 3)	5.89 $\pm$ 0.89	36.99 $\pm$ 1.16	0.83 $\pm$ 0.13	42.03 $\pm$ 1.58	14.26 $\pm$ 0.33

Figures in parentheses indicate the number of samples analyzed

Table 2: Calcium and phosphorus contents in feedstuffs of Amreli district (% DM basis) (Mean $\pm$ SE)

Sr. No.	Feedstuffs	Calcium (%)	Phosphorus (%)
*Critical level suggested by McDowell (1985)		0.30	0.25
Concentrate			
1	Cottonseed cake (n = 12)	0.37 $\pm$ 0.02	0.40 $\pm$ 0.02
2	Groundnut cake (n = 3)	0.46 $\pm$ 0.03	0.51 $\pm$ 0.02
3	Coconut cake (n = 2)	0.54 $\pm$ 0.16	0.49 $\pm$ 0.04
4	Cottonseed (n = 3)	0.38 $\pm$ 0.02	0.52 $\pm$ 0.03
5	Amar dan (n = 2)	1.24 $\pm$ 0.06	0.59 $\pm$ 0.01
6	Maahi dan (n = 1)	1.10 $\pm$ 0.00	0.61 $\pm$ 0.00
7	Amrut readymade mix (n = 1)	0.94 $\pm$ 0.00	0.38 $\pm$ 0.00
8	Balaji readymade concentrate mixture (n = 1)	0.61 $\pm$ 0.00	0.41 $\pm$ 0.00
9	Khedutchhap readymade concentrate mixture (n = 1)	0.78 $\pm$ 0.00	0.50 $\pm$ 0.00
10	Rajmoti readymade concentrate mixture (n = 2)	0.82 $\pm$ 0.04	0.44 $\pm$ 0.01
11	Agrofin readymade concentrate mixture (n = 1)	1.04 $\pm$ 0.00	0.52 $\pm$ 0.00
12	Amul readymade concentrate mixture (n = 2)	1.36 $\pm$ 0.04	0.58 $\pm$ 0.01
13	Rajavadi readymade concentrate mixture (n = 2)	1.21 $\pm$ 0.02	0.55 $\pm$ 0.03
14	Buddhalal readymade concentrate mixture (n = 1)	1.18 $\pm$ 0.00	0.45 $\pm$ 0.00
15	Dairy fresh readymade concentrate mixture (n = 1)	0.71 $\pm$ 0.00	0.44 $\pm$ 0.00
16	Ramkrushna readymade concentrate mixture (n = 1)	0.54 $\pm$ 0.00	0.43 $\pm$ 0.00
17	Girkamdheni readymade concentrate mixture (n = 1)	1.20 $\pm$ 0.00	0.51 $\pm$ 0.00
18	Wheat bran (n = 3)	0.36 $\pm$ 0.03	0.49 $\pm$ 0.03
19	Maize bhardo (n = 1)	0.54 $\pm$ 0.00	0.25 $\pm$ 0.00
Green fodder			
1	Lucerne (n = 7)	1.67 $\pm$ 0.06	0.37 $\pm$ 0.03
2	Napier (n = 9)	0.56 $\pm$ 0.04	0.32 $\pm$ 0.02
3	Green jowar (n = 3)	0.58 $\pm$ 0.08	0.31 $\pm$ 0.01
4	Green maize (n = 8)	0.52 $\pm$ 0.04	0.32 $\pm$ 0.01
5	Green bajra (n = 2)	0.53 $\pm$ 0.05	0.30 $\pm$ 0.03
6	Carrot plant (n = 3)	1.88 $\pm$ 0.12	0.30 $\pm$ 0.03
7	Marvel grass (n = 2)	0.93 $\pm$ 0.04	0.27 $\pm$ 0.03
Dry fodder			
1	Groundnut gotar (n = 12)	1.72 $\pm$ 0.08	0.29 $\pm$ 0.01
2	Jowar hay (n = 10)	0.57 $\pm$ 0.03	0.29 $\pm$ 0.01
3	Toor gotar (n = 2)	0.69 $\pm$ 0.16	0.28 $\pm$ 0.04
4	Wheat straw (n = 2)	0.45 $\pm$ 0.04	0.26 $\pm$ 0.01
5	Gram gotar (n = 3)	0.94 $\pm$ 0.13	0.24 $\pm$ 0.01

Figures in parentheses indicate the number of composite samples analyzed

Conclusions

The concentrate feeds commonly used by dairy buffalo owners in Amreli district comprised cottonseed cake, groundnut cake, cottonseed, coconut cake, wheat bran, maize bhardo and compound cattle feed. The green fodders offered to buffaloes during the survey period included lucerne, napier, carrot plant, marvel grass, maize, jowar and bajra. Dry fodders offered were mainly groundnut gotar, jowar hay, wheat straw, toor gotar and gram gotar. The proximate composition of feeds and fodder used in the districts was within the normal range, and calcium and phosphorus contents were adequate in most of them. However, only gram gotar contained phosphorus below the critical limit. Overall, it can be concluded that most of the feeds and fodders in the district had a normal chemical composition, indicating an adequate availability of nutrients to dairy buffaloes through locally available feed resources.

Conflict of Interest

The authors declare no conflict of interest.

Acknowledgement

The authors are thankful to the dairy buffalo farmers of Amreli district for their kind cooperation and to the Principal, College of Veterinary Science and Animal Husbandry, Kamdhenu University, Junagadh, for providing the necessary facilities to carry out the study.

References

- Anonymous. Basic Animal Husbandry Statistics 2025. New Delhi: Department of Animal Husbandry and Dairying, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India; 2025.
- AOAC International. Official Methods of Analysis. 22nd ed. Washington (DC): Association of Official Analytical Collaboration International; 2023.
- Bhanderi BM, Goswami A, Garg MR. Macro and micro-minerals status of dairy cattle in Sabarkantha district of Gujarat. *Livest Res Int*. 2016;4(1):47-51.
- Dey A, Barari SK, Bhatt BP. Chemical composition of feed resources in Bihar. *Indian J Anim Sci*. 2014;84(9):995-997.
- Dhabi LT, Bhagwat SR, Kumar S. Assessment of feeding practices for milch buffaloes in Kutch district of North Gujarat. *Indian J Anim Nutr*. 2011;28(4):407-417.
- Ganai AM, Matto FA, Singh PK, Parray BA. A survey of feeds and feeding practices in Kashmir Valley. *Indian J Anim Nutr*. 2004;21(1):69-72.
- Garg MR, Bhanderi BM, Sherasia PL. Trace minerals status of feeds and fodders in Junagadh district of Gujarat. *Indian J Dairy Sci*. 2002;55(3):154-158.
- Garg MR, Bhanderi BM, Sherasia PL. Macro-mineral status of feeds and fodders in Kutch district of Gujarat. *Anim Nutr Feed Technol*. 2003;3(2):179-188.
- Garg MR, Bhanderi BM, Sherasia PL. Animal nutrition and macro and micro mineral status of dairy animals in coastal zone of Kerala. *Indian J Dairy Sci*. 2010;63(4):292-297.
- Goswami A, Garg MR, Bhanderi BM. Macro and micro mineral status of feeds and fodders of Chhattisgarh state. *Indian J Anim Nutr*. 2017;34(3):270-276.
- Goswami C. Nutritional status of milch buffaloes of Anand district-knowledge and adoption levels [M.V.Sc. thesis]. Anand (Gujarat): Anand Agricultural University; 2005.
- Gupta L, Meena SC, Kumar A, Panchal M. Study the micro and macro-nutrient status of soil and fodder of Banswara district of Rajasthan. *Int J Chem Stud*. 2019;7(3):283-287.
- Gupta VP, Kumar V, Roy D, Kumar M. Macro and micro-mineral profile of feeds, fodders and blood of livestock under farm condition in Mathura district of India. *Indian J Anim Res*. 2016;50(2):203-206.
- ICAR. Nutrient Composition of Indian Feeds and Fodder. 2nd ed. New Delhi: Indian Council of Agricultural Research; 2013.
- McDowell LR. Nutrition of Grazing Ruminants in Warm Climates. New York: Academic Press; 1985. p. 443.
- Naliyapara HB, Savsani HH, Chavda JA, Odedra MD, Ribadiya NK. Evaluation of feeding practices of lactating Jaffrabadi buffaloes in their home tract. *Indian J Anim Nutr*. 2021;38(4):374-382.
- Patil N, Jain RK, Tewari D. Nutritional status and hemato-biochemical profile of anoestrus buffaloes of Malwa region of Madhya Pradesh. *Buffalo Bull*. 2016;35(3):417-426.
- Ramesh S, Nagalakshmi D, Reddy YR, Reddy AR. Mineral status of soils, water, feeds and fodders of dairy animals in Mahaboobnagar district of Andhra Pradesh. *Glob J Bio-Sci Biotechnol*. 2014;3(3):273-277.
- Sherasia PL, Pandya PR, Parnerkar S, Devalia BR, Bhanderi BM. Evaluation of feeding practices and certain minerals status of lactating buffaloes in coastal zone of western India. *Buffalo Bull*. 2016;35(3):467-477.
- Talapatra SK, Ray SC, Sen KC. The analysis of mineral constituents in biological materials. I. Estimation of phosphorus, chlorine, calcium, magnesium, sodium and potassium in food-stuffs. *Indian J Vet Sci*. 1940;10:243-258.
- Verma D, Shinde KP, Gupta S. Nutritional status of feeds and fodders fed to dairy animals in Haryana. *Int J Vet Sci Anim Husb*. 2024;9(2):18-21.