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Research Article

INFLUENCE OF FEEDING FORMALDEHYDE TREATED GUAR (*Cyamopsis tetragonoloba*) MEAL AND PRILL FAT SUPPLEMENTATION ON WATER INTAKE AND WATER REQUIREMENT OF GROWING SURTI BUFFALO CALVES

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Abstract: The experiment investigated the influence of feeding formaldehyde treated guar meal and prill fat supplementation on water intake and water requirement of growing Surti buffalo calves. 16 Surti breed buffalo calves were equally distributed into four dietary treatment groups. Further, each group comprised four calves. All group of calves were offered basal diet as per ICAR, (2013) nutrient requirements for buffalo calves. T_1- group served as control group, offered basal diet, T_2 group offered basal diet along with 30% replacement of protein of concentrate mixture with formaldehyde treated guar meal, T_3 group offered basal diet + 100 g of prill fat and T_4 group offered basal diet along with 30% replacement of protein of concentrate mixture with formaldehyde treated guar meal+ 100 g prill fat in combination. Overall mean water intake per day (Liter/day/head) of buffalo calves were not affected by the dietary inclusions. The water intake with respect to body weight and feed and nutrient intake was significantly influenced with the dietary treatments. Overall, 30% replacement of protein in concentrate mixture with formaldehyde treated guar meal with or without prill fat reduced the water intake per kg body weight, per kg metabolic body weight and per kg body weight gain in growing Surti buffalo calves.

Keywords: *Buffalo, Calves, Protein, Prill fat, Water*

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Introduction

Protein and energy are the key nutrients in feeding of growing dairy animals. However, quality protein and economy are likely to be contrasting factor for dairy producers due to the higher cost. Optimizing performance and profitable dairy farming needs to adopt strategic management practices [1]. As nutrition accounts 60-70% contribution in dairy farming. Different feeding systems for livestock acquire large proportion of water on daily basis and as the water crisis is critically affecting the globe [2]. So, minimizing water usage along with improving nutrient utilization and performance of dairy cattle and buffaloes is necessary. Thus, the present study was conducted to assess the influence of feeding formaldehyde treated guar meal and prill fat supplementation on water intake and water requirement of growing dairy buffalo calves.

Materials and Methods

The present experiment was conducted during the month of May, 2020 to February, 2021 including of three seasons (summer, monsoon and winter) at Reproductive Biology Research Unit, Anand Agricultural University, Anand. Total 16 Surti buffalo (*Bubalus bubalis*) calves (male and female) of 5-9 months of age were distributed in to four treatment groups (4 Calves/ treatment group) for this study. The treatments groups were T_1- Control; Basal diet, T_2 - Basal diet + 30% protein of concentrate mixture replaced with protein of formaldehyde treated guar meal (FTGM), T_3 - Basal diet + 100 g Prill fat (PF) and T_4 - Basal diet + 30% protein of concentrate mixture replaced with protein of FTGM + 100 g PF. The basal diet was formulated as per ICAR, (2013) [3] nutrient requirements. The treatment diets were offered for the duration of 280 days. Daily offered and left-over feed were measured and daily feed intake was derived. All calves were having free access to clean drinking water in separate plastic buckets throughout the experimental period and water intake (WI) (Liter/day) of individual calves was measured. A tendency for playing with water buckets and dribbling water by any of the calves was not observed. Data obtained were subjected to statistical analysis using IBM SPSS (Version 20). The means were compared and interpreted by Tukey's test of significance.

Results and Discussions

The water intake (WI) per day (Liter/head/day) of buffalo calves was not influenced significantly by the dietary treatments during the initial months of the experiment. However, during month of November, January, February, and at the end of experiment, the WI was highest ($P \leq 0.05$) in T_4 group followed by T_3, T_2 and T_1. The overall mean WI was numerically higher in T_4 group followed by T_3, T_2 and low in T_1 group [Table-1]. The period had significant effect on water intake per day, however, the interaction effect between treatment and period was non-significant [Table-1]. The overall mean WI per kg body weight (mL) and WI per kg metabolic body weight (ml/kg w0.75) were lowest ($P \leq 0.05$) in T_2 group over the T_4, T_1 and T_3 groups [Table-2] and [Table-3]. WI per kg gain in the body weight was higher ($P \leq 0.05$) in T1 group as compared to other treatment groups at the end of experiment. The overall mean WI per kg gain in the body weight was lowest ($P \leq 0.05$) in the T_2 and T_4 groups than T_3 and T_1 groups [Table-4]. The period effect was found significant on WI/ kg BW and WI/ kg W0.75, but non-significant on WI/ kg gain. Further, the interaction between treatment and period was significant for WI/ kg BW, WI/ kg W0.75 and WI/ kg gain. The trend for higher water intake per kg dry matter intake (DMI) (L/kg) was observed in T_4 and T_2 groups during most of the months [Table-5]. The overall mean water intake per kg DMI (L) was higher ($P \leq 0.05$) for T_2 and T_4 groups over the T_1 and T_2 groups.

Table-1 Influence of feeding formaldehyde treated guar meal and prill fat supplementation on water intake (Liter/head/day) of buffalo calves

Months	Treatment Groups				Period Mean
	T_1	T_2	T_3	T_4	
Initial	8.29±0.57	7.96±0.52	8.20±0.99	8.46±0.66	8.23±0.32
June	10.26±1.28	10.14±0.73	10.33±0.36	10.83±1.10	10.39±0.43
July	14.10±1.28	13.63±0.86	14.26±0.66	15.36±1.10	14.34±0.47
August	16.63±1.14	16.04±0.68	16.79±0.65	17.72±1.10	16.80±0.44
September	16.99±1.08	16.42±0.72	17.12±0.60	18.32±1.03	17.21±0.43
October	19.51±0.99	19.53±0.71	20.60±0.47	20.61±0.72	20.06±0.36
November	20.35^{b}±0.73	21.19^{ab}±0.48	21.64^{ab}±0.65	22.55^{a}±0.19	21.43±0.32
December	23.53±0.60	24.05±0.42	24.41±0.53	24.75±0.71	24.19±0.28
January	24.91±0.51	25.21±0.43	25.71±0.50	26.11±0.52	25.49±0.25
February	25.14^{b}±0.74	25.44^{ab}±0.55	26.23^{ab}±0.37	27.06^{a}±0.33	25.97±0.30
End	26.14^{b}±0.71	27.12^{ab}±0.71	27.62^{ab}±0.60	29.12^{a}±0.47	27.5±0.39
Treatment Mean	18.71±0.70	18.80±0.56	19.36±0.43	20.08±0.67	19.23±0.30
Source of variation		T	P	T×P	
Sem		0.70	1.11	2.23	
P value		0.85	0.00	0.98	
CD (0.05)		NS	3.12	NS	
CV %		21.94			

Table-2 Influence of feeding formaldehyde treated guar meal and prill fat supplementation on water intake per kg body weight (mL/kg BW) of buffalo calves

Months	Treatment Groups				Period Mean
	T_1	T_2	T_3	T_4	
June	101.98±12.72	104.67±7.09	108.49±8.03	114.53±11.66	107.42±4.70
July	129.55±13.10	123.18±9.12	133.95±7.70	142.27±12.49	131.49±5.17
August	135.23±13.15	130.19±11.59	141.45±7.13	145.06±12.14	137.98±5.24
September	129.17±13.56	119.85±9.99	130.67±5.06	134.00±10.13	127.67±4.73
October	133.02±14.01	127.88±10.78	143.20±5.73	130.81±9.67	133.73±4.91
November	125.31±13.02	123.19±9.97	138.30±8.30	122.92±7.99	127.43±4.77
December	133.31±14.36	128.00±10.59	140.42±9.45	122.46±7.41	131.05±5.10
January	131.57±14.24	123.19±8.93	136.78±8.91	118.55±7.53	127.52±4.93
February	123.94±13.50	112.93±7.08	129.46±9.65	113.08±7.52	119.85±4.74
End	120.54±13.12	110.55±7.59	123.02±9.09	112.98±7.74	116.77±4.51
Treatment Mean	126.36^{a}±11.76	120.36^{b}±8.65	132.57^{a}±6.60	125.67^{a}±9.15	126.24±4.27
Source of variation		T	P	T×P	
Sem		1.18	2.97	5.94	
P value		0.00	0.00	0.00	
CD (0.05)		5.27	8.33	16.67	
CV %		9.42			

Table-3 Influence of feeding formaldehyde treated guar meal and prill fat supplementation on water intake per kg metabolic body weight (mL/kg w0.75) of buffalo calves

Months	Treatment Groups				Period Mean
	T_1	T_2	T_3	T_4	
June	320.53±35.39	326.81±12.86	337.78±16.63	354.12±21.02	334.81±10.84
July	415.14±28.43	397.58±17.38	429.18±16.12	455.85±25.50	424.44±11.45
August	447.46±29.16	431.70±25.07	466.07±14.87	480.12±27.64	456.34±12.06
September	434.31±29.94	408.32±22.21	441.51±10.43	456.63±24.01	435.19±11.14
October	460.56±35.44	447.87±25.59	495.47±12.81	462.41±25.07	466.58±12.48
November	445.13±31.96	444.95±25.14	488.60±22.50	451.74±21.17	457.61±12.33
December	483.64±36.34	472.80±28.31	509.17±25.96	461.12±20.90	481.68±13.51
January	485.98±37.25	465.08±24.36	505.90±25.43	456.02±21.33	478.24±13.38
February	465.81±36.40	436.85±19.49	487.72±27.63	444.08±21.72	458.62±13.16
End	460.87±36.72	436.93±23.02	475.54±27.25	452.02±23.19	456.34±13.07
Treatment Mean	441.94^{ab}±26.94	426.90^{b}±20.37	463.69^{a}±16.11	447.41^{a}±22.44	444.99±10.33
Source of variation		T	P	T×P	
Sem		1.18	2.97	5.94	
P value		0.00	0.00	0.00	
CD (0.05)		5.27	8.33	16.67	
CV %		9.42			

The period had significant impact on WI/ kg DMI, however, the interactive effect of treatment and period was noted non-significant. The water requirement (mL) per g of CPI was higher (P<0.05) in T_2 and T_4 groups during each month of experiment than the T_1 and T_2 groups [Table-6]. The overall mean WI per kg of CPI was higher (P≤0.05) in T_4 and T_2 groups over the other treatments. Overall mean WI per kg of digestible crude protein intake (DCPI) (mL) was non-significantly greater in T_2 followed by T_4, T_3 and T_1 group [Table-7]. The WI per kg total digestible nutrient intake (TDNI) remained unaffected during all the months of experiment [Table-8]. However, the overall mean WI per kg TDNI (L) was greater (P≤0.05) in T_2 and T_4 than the T_1 and T_3 groups. The period had a significant influence on WI/ g CPI, WI/ g DCPI and WI/ kg TDNI, although the interaction between treatment and period was observed non-significant for WI in relation to the nutrient intake for CP and DCP. Drop in the growth efficiency of dairy animals is generally induced by feeding management and is greatly compounded by change in feed and water intake [4]. As water is the most critical nutrient to maintain the life of each animal, it is essential and involved in many biochemical processes in the body (nutrients transport, digestion, and metabolism), the elimination of waste products (respiration, urine, feces), the regulation of body temperature (perspiration) and osmotic pressure, the maintenance of an enough fluids and optimal electrolyte dilution [5-7].

Table-4 Influence of feeding formaldehyde treated guar meal and prill fat supplementation on water intake per kg gain (Liter/kg gain) of buffalo calves

Months	Treatment Groups				Period Mean
	T_1	T_2	T_3	T_4	
June	0.94±0.21	1.36±0.28	1.71±0.53	1.19±0.11	1.30±0.15
July	1.38±0.15	1.02±0.17	1.48±0.28	1.39±0.33	1.32±0.12
August	1.41±0.43	1.24±0.12	1.51±0.24	1.37±0.23	1.38±0.12
September	2.42±0.80	1.22±0.12	1.54±0.22	1.31±0.13	1.62±0.22
October	1.46±0.33	1.28±0.15	1.66±0.19	1.10±0.21	1.38±0.11
November	1.48±0.31	1.23±0.19	2.40±1.00	0.91±0.10	1.51±0.28
December	1.63±0.15	1.51±0.06	1.62±0.48	1.37±0.12	1.53±0.12
January	1.96±0.07	1.57±0.07	2.19±0.51	1.45±0.16	1.79±0.14
February	1.92±0.20	1.27±0.06	2.15±0.75	1.42±0.15	1.69±0.20
End	2.05^{a}±0.39	1.34^{b}±0.03	1.26^{b}±0.05	1.58^{ab}±0.14	1.56±0.12
Treatment Mean	1.66^{a}±0.10	1.31^{b}±0.04	1.75^{a}±0.21	1.31^{b}±0.11	1.51±0.08
Source of variation		T	P	T×P	
SEM		0.09	0.15	0.31	
P value		0.03	0.86	0.04	
CD (0.05)		0.27	NS	0.87	
CV %		41.12			

Table-5 Influence of feeding formaldehyde treated guar meal and prill fat supplementation on water intake per kg dry matter intake (Liter/kg DMI) of buffalo calves

Months	Treatment Groups				Period Mean
	T_1	T_2	T_3	T_4	
June	4.65±0.52	5.33±0.34	4.81±0.19	5.02±0.18	4.95±0.16
July	5.23^{b}±0.26	5.92^{ab}±0.17	5.38^{ab}±0.30	6.08^{a}±0.22	5.65±0.14
August	6.28^{b}±0.27	6.91^{ab}±0.31	6.40^{b}±0.19	7.32^{a}±0.28	6.73±0.16
September	5.97^{b}±0.27	6.39^{ab}±0.18	6.01^{b}±0.16	7.07^{a}±0.31	6.36±0.15
October	5.76^{b}±0.19	6.77^{a}±0.17	6.16^{b}±0.21	6.74^{a}±0.11	6.36±0.13
November	4.69^{b}±0.13	5.52^{a}±0.13	5.03^{a}±0.06	5.78^{a}±0.12	5.25±0.12
December	5.26^{c}±0.09	6.05^{a}±0.09	5.52^{b}±0.06	6.13^{a}±0.06	5.74±0.10
January	5.48^{a}±0.04	6.21^{a}±0.08	5.70^{a}±0.10	6.36^{a}±0.01	5.94±0.09
February	5.40^{d}±0.07	6.06^{b}±0.10	5.68^{c}±0.07	6.48^{a}±0.07	5.91±0.11
End	5.35^{c}±0.11	6.08^{b}±0.10	5.62^{c}±0.10	6.57^{a}±0.03	5.91±0.12
Treatment Mean	5.41^{b}±0.13	6.12^{a}±0.15	5.63^{b}±0.10	6.36^{a}±0.08	5.88±0.11
Source of variation		T	P	T×P	
Sem		0.09	0.15	0.30	
P value		0.03	0.04	0.78	
CD (0.05)		0.26	0.42	NS	
CV %		10.27			

Table-6 Influence of feeding formaldehyde treated guar meal and prill fat supplementation on water intake per g crude protein intake (mL/g CPI) of buffalo calves

Months	Treatment Groups				Overall
	T_1	T_2	T_3	T_4	
June	27.32±2.80	31.75±1.58	28.12±1.17	29.49±0.80	29.17±0.90
July	31.52^{b}±1.52	36.38^{a}±1.08	31.91^{ab}±2.00	36.62^{b}±1.12	34.10±0.91
August	36.20^{b}±1.56	40.58^{ab}±2.16	36.81^{ab}±1.15	41.88^{a}±1.50	38.86±0.96
September	33.11^{b}±1.47	36.32^{ab}±0.85	33.56^{b}±0.85	39.46^{a}±1.53	35.61±0.85
October	31.39^{c}±1.17	36.99^{a}±1.14	33.27^{bc}±1.33	36.56^{ab}±0.60	34.55±0.77
November	26.42^{b}±0.77	31.23^{a}±0.80	28.26^{b}±0.42	32.91^{a}±0.93	29.70±0.73
December	29.74^{b}±0.68	34.39^{a}±0.65	31.16^{b}±0.49	35.00^{a}±0.31	32.57±0.62
January	30.98^{b}±0.40	35.32^{a}±0.63	32.24^{b}±0.72	35.94^{a}±0.12	33.62±0.58
February	30.42^{c}±0.49	34.27^{b}±0.59	31.95^{c}±0.53	36.68^{a}±0.51	33.33±0.66
End	30.46^{c}±0.74	34.58^{b}±0.51	31.83^{c}±0.62	37.29^{a}±0.16	33.54±0.72
Treatment Mean	30.75^{b}±0.74	35.18^{a}±0.83	31.91^{b}±0.72	36.18^{a}±0.34	33.51±0.65
Source of variation		T	P	T×P	
SEM		0.51	0.81	1.62	
P value		0.00	0.04	0.98	
CD (0.05)		1.44	2.28	NS	
CV %		9.72			

Calves fulfill their water need by the three sources: water consumed voluntarily, water contained in the feed, and the metabolic water formed in their body [8]. As the water intake is directly relates to the feed intake in ruminants [9], so the more feed the calf consumes, the more water it will consume. Due to the close association between feed intake and water consumption, any lessening in water accessibility would be accompanied by a decline in feeding activity. Different researchers suggested that calves received ad lib water consumed more feed and gained more weight [10, 6]. The dairy calves require four times more water than DMI [7]. However, in present study the dry matter and nutrient intake, *i.e.*, CP, DCP and TDN intake were decreased in T_2 and T_4 groups, although the water intake on the basis of DMI, CPI, DCPI and TDNI was greater in both of these groups. The probable reason for this is that oxidation of nutrient particularly of CHO, protein and fat generate heat as a heat increment when it gets metabolized in the animal body. As per Reddy (2016) [11], heat production from protein and carbohydrates and fat metabolism were 398.8 and 1452 Kcal, respectively. The production of heat is not only due to the organic nutrients oxidized, but also during the tissue synthesis [12]. Hence, in present study, though the feed and nutrient consumption was lower, there was an improvement in growth performance as well as increased daily gain and body weight of calves, however, with the less consumption of nutrient there might be a greater generation of metabolic heat during the hot and humid period of experiment.

Table-7 Influence of feeding formaldehyde treated guar meal and prill fat supplementation on water intake per g digestible crude protein intake (mL/g DCPI) of buffalo calves

Months	Treatment Groups DCPI				Period Mean
	T_1	T_2	T_3	T_4	
June	40.23±3.77	42.55±1.96	41.21±2.25	38.37±0.89	40.59±1.16
July	46.48±1.83	48.76±1.20	46.82±3.60	47.70±1.66	47.44±1.04
August	53.44±2.23	54.41±2.92	53.94±2.61	54.54±1.91	54.08±1.10
September	48.83±1.68	48.68±0.79	49.17±2.10	51.40±2.08	49.52±0.83
October	46.42±2.25	49.60±1.56	48.77±2.70	47.63±1.21	48.10±0.95
November	39.04±1.41	41.88±1.15	41.36±1.23	42.86±1.30	41.28±.68
December	43.98±1.60	46.12±1.04	45.61±1.49	45.60±0.82	45.33±0.61
January	45.81±1.42	47.36±1.00	47.22±1.78	46.82±0.64	46.80±0.60
February	44.99±1.47	45.95±0.80	46.77±1.46	47.79±1.01	46.37±0.61
End	45.06±1.89	46.36±0.38	46.58±1.49	48.57±0.51	46.64±0.64
Treatment Mean	45.43±1.19	47.17±1.06	46.74±1.89	47.12±0.72	46.61±0.60
Source of variation		T	P	T×P	
Sem		0.71	1.13	2.27	
CD (0.05)		NS	3.18	NS	
P value		0.94	0.00	0.86	
CV %		9.74			

Table-8 Influence of feeding formaldehyde treated guar meal and prill fat supplementation on water intake per kg total digestible nutrient intake (Liter/kg TDNI) of buffalo calves

Months	Treatment Groups				Period Mean
	T_1	T_2	T_3	T_4	
June	7.38±0.89	7.85±0.79	7.29±0.46	7.26±0.42	7.45±0.31
July	8.23±0.47	8.68±0.56	8.12±0.50	8.75±0.51	8.44±0.24
August	9.96±0.55	10.19±0.86	9.71±0.57	10.54±0.64	10.10±0.31
September	9.47±0.51	9.41±0.58	9.14±0.50	10.19±0.68	9.55±0.27
October	9.21±0.45	9.97±0.67	9.39±0.44	9.71±0.18	9.57±0.22
November	7.52±0.33	8.17±0.52	7.69±0.27	8.38±0.14	7.94±0.18
December	8.43±0.29	8.95±0.49	8.44±0.28	8.90±0.28	8.68±0.17
January	8.78±0.19	9.19±0.50	8.71±0.27	9.23±0.21	8.98±0.15
February	8.63±0.11	8.96±0.51	8.67±0.24	9.40±0.24	8.91±0.16
End	8.57±0.14	8.99±0.42	8.60±0.31	9.53±0.24	8.92±0.17
Treatment Mean	8.62^{b}±0.32	9.03^{a}±0.58	8.57^{b}±0.35	9.19^{a}±0.32	8.85±0.19
Source of variation		T	P	T×P	
Sem		0.15	0.24	0.47	
CD (0.05)		0.42	0.67	1.34	
P value		0.03	0.05	0.00	
CV %		10.83			

In addition, concomitantly there is tissue synthesis with better utilization of available protein as well as energy for the muscular development in calves. Thus, there was an increased water intake with relates to dry matter and nutrient intake, while reduced the requirement of water for the body weight gain and the growth. Some of the studies corroborated the present effect of nutrition on water intake. Kumar *et al.,* (2007) [4] reported feeding 100 and 120 percent ICAR recommended level of nutrition had significant influence on average daily water intake in Murrah buffalo calves. They noted the higher average daily voluntary feed and water intake in 120 % nutrition level, while the feeding level had no significant influence on voluntary water intake per kg DMI and per kg W0.75. Further, contradictory findings were reported by El Nomeary *et al.,* (2021) [13], who compared the effect of different protein sources (soybean meal, black cumin seed meal, cottonseed meal and sesame seed meal) in lamb rations on water balance. They noted no significance impact on water balance of different protein sources might be due to the positive relationship between water intake and DMI [14] in lambs.

Conclusion

The 30% replacement of protein with formaldehyde treated guar meal and the combination of 30% replacement of protein with formaldehyde treated guar meal in concentrate mixture and prill fat had greater influence on water intake of growing dairy buffalo calves. Replacement of 30 % protein with formaldehyde treated guar meal in concentrate mixture decreased the water intake per kg body weight, per kg metabolic body weight and per kg body weight gain. However, it increased the water intake for dry matter and nutrients intake. Thus, formaldehyde treated guar meal alone or in combination with prill fat supplementation can improve the growth performance along with minimizing the water usage for drinking purpose in dairy buffalo calves.

Application of research: Effect of feeding and feed supplement on water requirement for growth in growing dairy buffaloes.

Research Category: Dairy Animal Production

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University: Kamdhenu University, Anand, 388 001, Gujarat, India
Research project name or number: PhD Thesis

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Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Kamdhenu University, Anand, 388 001, Gujarat, India

Breed name: Surti buffalo (*Bubalus bubalis*) calves

Conflict of Interest: None declared

Ethical approval: All procedure involving animal care, welfare management, experimentation and sampling were approved by the Institutional Animal Ethics Committee (IAEC), College of Veterinary Science and Animal Husbandry, Kamdhenu University, Kamdhenu University, Anand, 388 001, Gujarat, India.
Ethical Committee Approval Number: IAEC/320/RBRU/2020

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