STUDIES ON IN- SACCO EVALUATION OF A COMPLETE DIET TREATED WITH ZINC IN CATTLE

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ABSTRACT : A study was undertaken to determine the effects of supplementation of Zn from inorganic zinc sulphate to a basal diet on in-sacco DM, OM, CP & NDF digestibility (%) in three male rumen fistulated cattle fed on rice straw and concentrate based total diet. The animals were offered total diet supplemented with 0 ppm Zn (T0) and 33 ppm Zn (T1) as per NRC, 2001 from inorganic source like zinc sulphate. After 21 days of feeding, feed samples were incubated for different time intervals at 2, 6, 18, 24 & 48 h to study the nutrient disappreance and rate of degradation at different hours. This study inferred that supplementation of Zn through feed can improve the digestibility and there will be more utilization of nutrient like crude protein, ether extract and organic matter. Trace mineral like Zn at per NRC (2001) recommendation was found more effective for the purpose than without supplementation in a diet.

Key words: Zn, Zinc sulphate, DM, CP, OM, NDF In sacco Digradability, Fistulated cattle.

INTRODUCTION

The presence of zinc in proper concentration in the diet of animals is of immense importance not only for well being but also for optimizing the overall performance of the animals. Supplementation of minerals either separately or through concentrate mixture may correct the imbalance or deficiencies of minerals to the animals.

Among the many proposed methods, the in sacco nylon bag technique may predict the dietary value of feeds & to evaluate their digestibility & their feed value (Michalet-Dorean, 1990). Apparent digestibility of DM, OM, CP, NDF, ADF of feeds & fodders can be measured well by these laboratory methods. The digestibility of a feed is affected by the type of feed as well as energy, protein & mineral contents. In sacco study may assess the comparative effect of different feeds, fodders, minerals and enzymes added diet with respect to estimate the in sacco DM, CP, OM & NDF digestibility. The higher values of these parameters are the indication of a direct correlation with superior type of diet that fulfills the actual requirement of macro and micro nutrients. Keeping in view, the present experiment was conducted to study the effect of supplementation of Zn from inorganic source with a basal diet on nutrient utilization in cattle.

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MATERIALS AND METHODS

Three physically sound & normal cattle aged 3 year & weighing about 300 ± 50 kg were selected & fistulated at the left abdominal flank as per the standard surgical procedure (AFRC, 1992) for in sacco studies of basal diet with supplementation of inorganic mineral like Zn. A basal diet was formulated (Table-1) to meet the entire nutrient requirement according to NRC, 2001 except Zn. Chemical compositions of the diet were determined as per AOAC (1995) & Goering & Vansoest (1970). Fistulated animals were fed basal diet with inorganic mineral Zn at 0 ppm and 33 ppm in 2 treatment groups like T0, T1 respectively, twice daily each for 7 days interval with ad libitum clean drinking water (Table-2).

Nylon bags with pore size 35-40µ pore size were used in the present trial. Representative samples of 5 gm from all experimental diets were taken in nylon bags & the bags were sealed tightly with nylon thread. Then the bags were introduced in the rumen & considered five incubation time as 2 hour, 6 hour, 18 hour, 24 hour and 48 hour and were attached with 60 cm long stainless steel chain with nylon thread. Nylon bags connected chain was kept in the ventral sac of the rumen for better exposure to the rumen microbes. According to incubation hours (2, 6, 18, 24 & 48) sequentially respective bags were removed from rumen & put in a bucket of cold water to stop the microbial fermentation. Then the bags were washed with running tap water gently until the rinsing water becomes clear indicating the absence of bacterial residues & rumen fluids sticking to the feed. Later, the samples with nylon bags were dried in a hot air oven at 60ºC for overnight. In sacco degradability (%) of all the experimental diets were estimated as per the standard method (Orskov et al, 1980 & AFRC, 1992).

Statistical analysis for all the parameters under this study were one way analysis of variance technique used for studying the main effect of two diets having one supplemented with Zn from inorganic sources and significant differences were calculated by post hoc test. From the experiment, the effect of supplementation of inorganic Zn in a basal diet was measured based upon their performances on in sacco DM, OM, CP and NDF degradability.

Table-1: Computation of experimental diet on DM basis (%)

Ingradients composition of experimental diet (% on DM basis)

Ingredients	Experimental Diet (%)
Rice bran	6.5
Wheat bran	10
Gram Chuni	10
Mustard cake	5
G.N.C.	2.5
Paddy straw	35
Hybrid Napier	25
Mollasses	5
Salt	1
Total	100

Chemical composition of experimental diet on DM basis (%)

DM	70.77
TDN*	56.82
OM	86.88
CP	11.74
CF	20.76
EE	2.87
NFE	51.51
NDF	53.50
ADF	37.54
TA	13.12
Zn, ppm	33.07

*Calculated value

Table-2: Formulation of different diet-mineral combinations

Treatment	Type of diet	Type of Supplementation	Zn (ppm)
To	Basal Diet	No supplementation (Control)	0
T1	Basal Diet	Zn from inorganic source as per NRC, 2001	33

RESULTS AND DISCUSSION

Table 3 showed the effect of Zn supplementation to a basal diet on in sacco DM degradability at different hours of incubation. Statistical analysis revealed that the two levels had significant effect ($P<0.05$) through hourly interval on dry matter degradability (DMD) at 2, 6, 18, 24 & 48 hours and more effect was observed in case of T1 group having 33 ppm Zn in the basal diet due to increased microbial activity leading to improved ruminal microbial function indicating positive response of mineral. Besides, within each treatment group, ISDMD (%) of substrate was more after 48 h compared to other incubation time indicating 48h of incubation time is appropriate for complete digestion of substrate by rumen microbes. So, treatment having Zn supplementation (33 ppm) as per NRC (2001) performed better result on nutrient digestibility at 5 incubation periods. Chandanshive et al (2007) reported that Zn supplementation at 50 ppm & 100 ppm improved DM digestibility which was decreased ($P<0.05$) at higher levels of Zn supplementation (150 ppm to 300 ppm) probably due to adverse effects of higher concentration of zn on rumen microbes. But Sawhney et al (1970) & Arelovich et al (2000) reported decreased DM digestibility due to supplementation of Zn.

Table-3: Effect of Zinc supplementation on *in sacco* DM dedradation (%) of diet

Treatment	DMD 2h	DMD 6h	DMD 18h	DMD 24h	DMD 48h	ED DM
T0	21.50 ± 0.03^{b}	31.57 ± 0.02^{b}	41.39 ± 0.03^{b}	51.28 ± 0.03^{b}	60.27 ± 0.03^{b}	40.70 ± 0.06^{b}
T1	22.03 ± 0.07^{a}	31.73 ± 0.05^{a}	42.49 ± 0.04^{a}	51.75 ± 0.06^{a}	61.07 ± 0.03^{a}	42.79 ± 0.06^{a}

Means with different superscripts within a column differ significantly ($P<0.05$)

Table 4 showed the effect of Zn supplementation to a basal diet on in sacco OM digestibility at different hours of incubation. Statistical analysis revealed significant differences ($P<0.05$) between control group & treatment groups on organic matter digestibility at 2, 6, 18, 24 & 48 hours and there was more effect in supplemental group in case of T1 having 33 ppm Zn in the basal diet on OM digestibility at different time interval(except 48 h). Increased OMD in T1 probably due to presence of higher proportion of Zn in the substrate that resulted in better microbial activity resulting increased microbial fermentation leading to more production of TVFA leading to improved degradability and utilization of nutrients which may be further assessed through in vivo feeding trials in animals. So, treatment having Zn supplementation (33 ppm Zn) as per NRC (2001) performed better result on

nutrient digestibility at all incubation periods.

But the present finding did not corroborate with the findings of Engle & Spears (2000) who reported that in vitro OM disappearance % and VFA were unaffected by supplementing graded level of Cu as 0, 10 and 20 ppm with fixed 20 ppm Mn and 30 ppm Zn in basal diet for steers. Bedi and Sawhney (1979) also did not observe any difference in the digestibility of OM in calves supplemented with 20, 40 and 60 ppm of Zn (as ZnSO4) to a basal diet containing 35 ppm of Zinc to an in vivo trial. Jadhav et al (2008) found that digestibility of OM was similar (P> 0.05) in crossbred calves supplemented with 0, 35 or 70 ppm zinc in the basal diet. Similarly, there was no effect on the digestibility of OM with supplementation of Zn ranging from 26- 86 ppm (Khan, 1978) in the diet of growing calves.

The degradation kinetics and effective degradability of CP has been depicted in Table 5 at 2 levels with and without inorganic trace mineral supplemented in basal diet. Statistical analysis revealed that the 2 levels had significant effect (P<0.05) throughout hourly interval on degradability and on effective degradability of CP. Supplementation of inorganic mineral showed significantly (P<0.05) highest rate of degradability (%) and effective degradability (%) of CP. The subsequent may be due to increased microbial activity leading to improved ruminal microbial fermentation indicating response of mineral. Bedi (1976) in growing calves & Daghash and Mousa (1999) in lambs did not find any effect on the CP digestibility supplemented with Zn ranging from 4.16 ppm to 135 ppm.

Table-4: Effect of Zinc supplementation on *in sacco* Organic matter dedradation (%) of diet

Treatment	OM 2h	OMD 6h	OMD 18h	OMD 24h	OMD 48h	ED OM
T0	23.26 ± 0.05 ^{b}	31.66 ± 0.06^{b}	42.65 ± 0.06^{a}	54.74 ± 0.05^{b}	62.67 ± 0.06^{b}	42.50 ± 0.06^{b}
T1	24.11 ± 0.06 ^{a}	33.29 ± 0.06^{a}	41.36 ± 0.06 ^{b}	55.20 ± 0.02^{a}	62.76 ± 0.04^{a}	43.17 ± 0.03^{a}

Means with different superscripts within a column differ significantly (P<0.05)

Table-5: Effect of Zinc supplementation on *in sacco* CP dedradation (%) of diet

Treatment	CPD 2h	CPD 6h	CPD 18h	CPD 24h	CPD 48h	ED CP
T0	15.28 ±0.01^{b}	26.44 ±0.02^{b}	35.65 ±0.08^{b}	49.49 ±0.01^{b}	62.54 ±0.02^{b}	37.37 ±0.03^{b}
T1	17.78 ± 0.01^{a}	28.57 ±0.01^{a}	40.57 ± 0.02^{a}	50.41 ± 0.01^{b}	62.49 ± 0.01^{b}	39.85 ± 0.03^{a}

Means with different superscripts within a column differ significantly (P<0.05)

Table 6 showed the effect of Zn supplementation to a basal diet on in sacco NDF digestibility at different hours of incubation. Statistical analysis revealed significant differences (P<0.05) between control group & treatment group on neurtal detergent fibre digestibility at 2, 6, 18, 24 & 48 hours and there was more effect in case of T1 group having 33 ppm Zn in the basal diet on NDF digestibility at different time interval. The digestibility of NDFD (%) was affected by Zn supplementation which may be due to the fact that Zn requirement of the rumen microbes was not met from the basal diet. So, treatment having Zn supplementation (33 ppm Zn) as per NRC (2001) performed the best result on nutrient digestibility at all incubation periods. Mandal (2004) did not find any difference in the digestibility of NDF in calves supplemented with 0, 35 or 70 ppm zinc in the basal diet containing 32.5 ppm zinc. But these results could be correlated with the findings of Roudringerez et al (1995) as there was significant decrease in NDF digestibility at higher levels of Zn supplementation due to inhibition of urease activity by inhibiting the growth & population of ureolytic bacteria. Although Chandanshive et al (2007) reported improved NDF digestibility with Zn supplementation.

detergent fibre in the cattle. Therefore, it is necessary to supplement zn while formulating balance

total mixed ration for better nutrient utilization leading to more productivity and reproduction efficiency.

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Table-6: Effect of Zinc supplementation on *in sacco* NDF dedradation (%) of diet

Level	NDFD 2h	NDFD 6h	NDFD 18h	NDFD 24h	NDFD 48h	ED NDF
CTL	18.65 ± 0.00^{b}	24.56 ± 0.00^{b}	30.89 ± 0.00^{b}	38.65 ± 0.00^{b}	50.11 ± 0.00^{b}	32.37 ± 0.03^{b}
NRC	19.25 ± 0.01^{a}	24.99 ± 0.01^{a}	31.82 ± 0.01^{a}	40.25 ± 0.01^{a}	51.41 ± 0.01^{a}	34.96 ± 0.02^{a}

Means with different superscripts within a column differ significantly (P<0.05)

CONCLUSION

It was concluded from the present study that supplementation of 33 ppm Zn in the basal diet improved the nutrient degradability like dry matter, organic matter, crude protein and neutral

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