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NUTRITIONAL STUDIES ON USING SUGAR BEET TOPS IN ANIMAL FEEDING

III-MINERALS CONTENT OF DIFFERENT VARIETIES OF SUGAR BEET TOPS AND SOME MINERALS BALANCES.

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INTRODUCTION

It is hardly coneivable that, the animals feed which differs in their mineral contents to such extent are all providing equal opportunity for the utilization of both minerals and plant nutrients in the process of transformation. On the other hand, the very high mineral contentents that presents danger to the optimum feed conversion of the animal, fulfil the economic efficiency or profitability , (**Bokori and Tolgyesi, 1981**).

Several studies have been conducted to determine the chemical compsition of sugar beet tops and its silages (**Choneim, 1964, Lennon and Tagle, 1974, Salo and Sormumen, 1974, Eweedah, 1986 and Bendary et al., 1992**), also mineral content of sugar beet tops are very high which may lead some farm animals to health and production problems.

The aim of the presented work was to determine some mineral balances for mature Friesian calves after being fed on different varities of sugar beet tops. Also, mineral contents of some varieties of sugar beet tops were investigated.

MATERIAL AND METHODS

This work was carried out at Karada Animal Experimental Station. Ministry of Agriculture. Five metabolism trials were conducted with 15 mature Friesian calves weight 322 to 388 kg (3 in each treatment) to determine some mineral balances.

Animal were fed the following different dietary treatments:

- T1: Sun dried sugar beet tops.
- T2: Shade-dried sugar beet tops.
- T3: Sugar beet Tops silage with out additives.
- T4: Sugar beet Tops silage with urea (0.5%) and El-Mufeed* (5.0%) on fresh basis.
- T5: Sugar beet tops silage with poultry litter (5.0%) and El-Mufeed (5.0%) on fresh ba sis.

Al kinds of silages were treated by adding 0.5 kg/ton limestone on fresh basis. Sugar beet tops (dried

* El-Mufeed is composed of 91% molasses 2.5% urea, 1.5% inorganic phosphorus, trace minerals and vitamin A which are dissolved in 5% water (**Etman, et al. 1989**).

or silage) fed two weeks gradually before starting the metabolism trials, to enable the rumenal microbes to be adjusted.

The metabolism trial consists of 15 and 7 days for preliminary and collection periods, respectively. Animals were fed ad lib from 8 a.m to 5 p.m and the residuals were weighed to calculate the daily feed intake. Water was offered to the animals twice daily. Fecal sample were collected twice daily in collection pages. Urine was collected daily using rubber funnels during metabolism trials. At the end of the collection period a composed feeds, feces and urine samples were prepared and preserved to determine minerals content.

The minerals content of different varieties of sugar beet tops were investigated also by planted eleven varieties of sugar beet tops in three replicates under similar condition.

Chemical analysis for representative samples of fresh and dried tops, silages, feces and urine performed as follws: Calcium. Zinc and iron were determined by Atomic Absorption 238-Parken-Elmer. While sodium and potassium were determined by Flame Photometer PFP7. However, total phosphorus was determined colorimitry using Molybden-blue reaction. Total ash and oxalate were performed using AOAC (1980).

Data obtained were analysed statistically according to **Snedecor and Cochran (1982).**

RESULTS AND DISCUSSION

The ash and mineral content of the studied varieties of sugar beet tops are shown in table (1), which indicates that ash content on DM basis were relatively high, since they ranged between 20.44 to 31.44%. The lowest value was found in variety No. 9 (Kws-695), while the highest value was found in the variety No. 4 (Maribo Moroc Poly). The ash content in the present study were within the range of values reported by **Ghoneim, 1964, Eweedah, 1986 and Bendary, 1992**. In this connection, **Ghoneim 1964**, pointed out that the high ash content of the beet tops may be due to contamination with mud. **Frank (1978)** observed that the high ash content in the sugar beet tops silage (24% ash on DM basis) had no effect on feed utilization. Total oxalate ranged between 3.30 to 4.89% on DM basis. Simialr results were reported by **Lennon and Tagle (1974)** estimated total oxalate in leaves of sugar beet by 4.9%.

Values which were obtained in the present study for the macro and micro minerals contents of sugar beet tops especially Ca, P, Fe and Zn were within the range of values reported by **Kalashnikova and Kleimenoba 1985**. But Na and K contents obtained herein were higher than those recorded by

Table (1): Minerals of different varieties of fresh sugar beet tops.

Variety	composition of DM									
	DM	Ash	Oxalate	Macro elements g/kg				Micro elements mg kg		
	%	%	%	Ca	P	Na	K	Fe	Zn	Mn
1- Kawemira	10.48	26,17	4.33	7.28	2.41	3.92	37.8	189	117	24
2- Ras poly	10.10	30.14	4.89	7.30	1.92	5.15	40.1	151	61	24
3- pleno	10.76	22.90	4.07	6.72	1.14	4.24	38.1	79	47	23
4- Maribo Moroc	9.80	31.44	3.89	8.00	1.71	4.20	40.9	147	94	23
5- Supra poly	11.99	24.32	4.51	6.12	1.63	3.59	42.0	193	78	22
6- Tribel	11.16	25.57	4.64	6.20	1.72	4.62	35.1	110	68	25
7- Cares poly -3	10.01	30.28	4.49	7.80	1.93	4.65	34.4	70	29	25
8- Maghribel	10,33	27.05	4.11	6.48	1.91	3.48	33.1	104	33	56
9- Kws -695	11.47	20.44	3.30	6.41	2.00	3.84	30.0	68	30	18
10- Kawetrema	10.70	26.69	4.37	5.92	2.50	4.90	38.1	81	28	19
11- Despres poly	8.75	22.77	4.35	5.84	2.21	4.68	32.4	95	35	37

table (2): Minerals of dried sugar beet tops and their silages fed to friesian calves

Treatments	composition of DM								
	DM	Ash	Oxalate	Macro - elements g/kg				Micro - elements mg/kg	
	%	%	%	Ca	P	Na	K	Fe	Zn
Sun dried sugar beet tops (T1)	79.21	23.99	4.81	4.59	3.06	3.22	32.8	164.6	82.9
Shade - dired sugar beet tops (T2)	73.18	23.34	4.75	4.47	2.74	2.87	35.4	168.0	83.9
Sugar beet tops silage without additives (T3)	25.21	29.12	4.20	7.44	3.73	3.35	33.9	169.5	91.4
Sugar beet tops silage plus urea and El-Mufeed (T4)	31.64	28.45	5.18	6.45	2.95	3.10	34.8	169.6	88.5
Sugar beet tops silage plus poultry litter and El-Mufeed (T5)	30.70	31.07	4.18	8.25	3.86	3.39	32.2	141.4	78.1

Ghonein, 1964), Kalashnikova Kleimenoba 1982 and Kleimenov et al., 1987 due to the different varieties, agriculture system, soil and environmental conditions.

Since all of the eleven varieties of sugar beet tops were planted under similar conditions, so the differences in the chemical composition was related to the different varieties and must be taken in consideration when sugar beet tops were used in feeding and ration formulation.

The mineral content of the different varities of the sugar beet tops which used in feeding trials illustrated in (Table 2). It was observed that expect for Na, K, Fe and Zn were voluntarily with held from the sugar beet tops. The rest of the tested elements Ca. and P. had much higher concentraiton in silages especially the 5th treatment owing to adding poultry litter along with limertone and El-Mufeed.

The low Ca content of dried beet tops and expected Ca percentage in silages compared with Ca content in fresh tops of studied varieties may be due the losses of D.M. during drying and preparing silage especially in green leaves which rich in Ca Salo, 1978 and Eweedah, 1986 found that the losses in DM of sugar beet tops silage withou additives or with addition of urea and molasses was 14-20%.

CALCIUM:

Results in Table 3 indicated that Ca intake was higher in animals fed on silages (T3, T4 and T5) than those fed dried beet tops (T1 and T2) owing to the addition of limestone during ensiled fresh sugar beet tops. On the other hand adding poultry litter along with limestone (T5) increased significantly Ca intake compared with animals fed other different dietary. May be due to the high Ca content in poultry litter.

The differences in Ca concentration in feces were highly significant, but the differences between urinary Ca contents were not significant as affected by the different levels of dietary Ca. A large amount of Ca was secreted into the intestinal lumen and mostly lost in feces; small amounts of Ca were also excreted in sweat. For any one individual urine Ca remains relatively constant while fecal Ca varies widely in response to diet, sggesting that Ca levels are well controlled at the level of absorption (Martin et al., 1981).

Apparent Ca absorption was 6.55 g/day (32.53%); 4.96 g/day (27.45%); 8.88 g/day (31.57%); 6.30 g/day (2.56%) and 16.63 g/day (36.48%) were fed to experimental animals T1; T2; T3; T4 and T5, respectively.

The analysis of variance in Table (3) showed that Ca absorption and retention in calves fed on silages with poultry litter were higher than those fed on other dietary treatment. May be due to that poultry litter contained some nutrients had positive effect of Ca metabolism and resulted higher Ca retention.

PHOSPHORUS

Statistical analysis (Table 3) showed significant differences between concentrations of P in feces as affected by the different dietary. Animals given silages with limestone along with poultry litter showed the highest P fed intake

Table (3): Mean daily intake,fecal and urinary excretion and body retention of macro elements by Frisian calves fed different forms of sugar beet tops.

	DM Intake	Mineral Intake	Excretion g/day			Apparent absorption		Net retention	
	Kg daily	g./day	Feces	Urine	Total	g./day	% of intake	g./day	% of intake
Calcium									
T1	bBC 4.39	aA 20.13	aA 13.58	aA 0.16	aA 13.74	abA 6.55	b 32.53	abA 6.39	ab 31.74
T2	aAB 4.05	aA 18.13	aA 13.17	aA 0.14	aA 13.31	aA 4.96	aB 27.45	aA 4.82	ab 26.70
T3	aA 5.78	bB 28.13	bB 19.25	aA 0.16	bB 19.41	bA 8.88	ab 31.57	bA 8.72	ab 30.98
T4	cC 4.75	cB 30.66	cC 24.36	aA 0.10	cC 24.45	abA 6.30	a 20.56	abA 6.21	ab 20.24
T5	dD 5.52	dC 45.50	dC 28.87	aB 0.52	dD 29.39	cB 16.63	b 36.48	cB 16.11	b 35.34
S.E	0.0435	0.3412	0.4740	0.0229	0.4888	0.4750	1.5526	0.4836	1.5913
Phosphorus									
T1	bBC 4.39	bB 13.41	abA 7.89	aAB 0.57	abA 8.46	aA 5.53	41.20	aA 4.95	36.93
T2	aAB 4.05	aA 11.09	aA 6.98	aAB 0.55	aA 7.55	aA 4.11	37.28	aA 3.56	32.33
T3	aA 5.78	bB 14.10	bA 9.03	aA 0.47	bA 9.50	aA 5.07	35.98	aA 4.60	32.65
T4	cC 4.75	bB 14.02	bA 9.35	aAB 0.57	bA 9.91	aA 4.68	33.35	aA 4.11	29.30
T5	dD 5.52	cC 21.30	cB 12.34	bB 0.70	cB 13.04	bB 8.95	1.76	bB 8.26	38.50
S.E	0.0435	0.1620	0.2376	0.0152	0.2321	0.2990	1.8469	0.2894	1.8024
Potassium									
T1	bBC 4.39	bB 144.0	8.10	a 31.7	a 39.8	bBC 135.9	94.38	bAB 104.2	cAB 72.37
T2	aAB 4.05	bB 143.3	15.2	b 42.2	b 57.4	bAB 128.1	89.43	aA 85.9	aA 60.06
T3	aA 5.78	aA 128.2	13.9	a 33.7	ab 47.6	aA 114.2	89.14	aA 80.5	abAB 62.82
T4	cC 4.75	cC 165.1	15.2	a 35.2	ab 50.3	cCD 149.9	90.80	bBC 114.8	bcAB 69.51
T5	dD 5.52	dC 177.9	12.1	a 33.6	ab 45.6	dD 165.8	93.11	cC 132.3	cB 74.12
S.E	0.0435	1.4230	1.1340	0.9780	1.7650	1.9540	0.7975	2.4290	1.1871
Sodium									
T1	bBC 4.39	cB 14.15	aA 0.46	11.44	aA 11.90	bB 13.70	b 96.77	bBC 2.26	cB 15.79
T2	aAB 4.05	aA 11.62	aAB 0.74	12.47	abAB 13.21	aA 10.89	ab 93.71	aA -1.58	aA -13.66
T3	aA 5.78	bA 12.65	abA 1.02	11.90	abAB 12.92	aAB 11.63	ab 91.94	aAB -0.27	bA 2.15
T4	cC 4.75	cB 14.72	aAB 0.87	11.73	aAB 12.59	bB 13.86	ab 94.11	bBC 2.13	cB 14.47
T5	dD 5.52	dC 18.71	bB 1.87	12.58	bB 14.44	cC 16.85	a 89.81	cC 4.27	cB 22.62
S.E	0.0435	0.1446	0.1262	0.2314	0.2100	0.2455	0.8673	0.2509	1.4683

a,b,A & B values followed by different litters in the same column are significantly different ($P < 0.05$ & 0.01 respectively.

Table (4): Mean daily intake, fecal and urinary excretion and body retention of micro-elements by Frisian calves fed different forms of sugar beet tops.

	DM Intake	Mineral Intake	Excretion g/day			Apparent absorption		Net retention	
	Kg daily	mg./day	Feces	Urine	Total	mg./day	% of intake	mg./day	% of intake
Zink									
T1	bBC 4.39	aA 364.0	aA 254.7	bB 47.10	aA 301.9	bB 109.3	bB 30.0	bB 62.1	bB 17.1
T2	aAB 4.05	aA 340.2	aA 209.1	aAB 30.70	aA 239.8	bB 131.1	bB 38.5	bB 100.4	bB 29.4
T3	dA 5.78	aA 345.3	aA 206.2	aA 24.40	aA 230.7	bB 139.1	bB 40.3	bB 114.6	bB 33.2
T4	cC 4.75	bB 420.5	bB 481.6	aAB 32.70	bB 514.3	aA -61.1	aA -14.5	aA -93.8	aA -22.3
T5	dD 5.52	bB 430.8	bB 480.9	abAB 35.5	bB 516.4	aA -50.1	aA -11.5	aA -85.6	aA -19.7
S.E	0.0435	3.4120	12.2242	1.6685	11.9262	11.4113	3.0917	11.0750	2.9790
Iron									
T1	bBC 4.39	bBC 722.5	bcAB 329.3	32.6	bcABC 362.0	393.2	54.4	360.5	49.9
T2	aAB 4.05	abAB 680.8	abAB 283.6	35.91	abAB 319.5	397.2	58.4	361.3	53.2
T3	aA 5.78	aB 640.6	aA 252.8	32.40	aA 285.2	387.9	60.5	355.5	55.5
T4	cC 4.75	cD 805.5	dC 400.6	34.59	dC 435.2	404.8	50.3	370.3	46.0
T5	dD 5.52	cCD 780.2	cdBC 375.1	38.72	cdBC 413.8	405.1	51.6	366.4	46.7
S.E	0.0435	6.3260	9.0740	1.0614	9.2655	11.6139	1.3521	11.2880	1.3541

a,b,A & B values followed by different litters in the same column are significantly different (P< 0.05 & 0.01 respectively.

apparent availability was attributed to a relatively constant K loss in the feces regardless of K intake. At low K intakes, the endogenous Fecal K would represent a much larger percentage of the K consumed than a much a high intakes. (Poe et al., 1985).

Potassium retention increased from 80.5 to 132.3 g/day by increasing K intake (from 128.2 to 177.9 g/day) when calves were fed different forms of sugar beet tops. Other researches (Newton et al., 1972; Green et al., 1983 a,b,c and poe et al. 1984) indicated that K retention increased when animals were supplemented with additional K. Potassium retained expressed as a percentage of intake was not affected by treatments.

SODIUM:

Sodium balance of Friesian calves fed different forms of sugar beet tops (dried and silages) represented in Table (2). The means daily intake of Na were similar for diets 1st and 4th (14.15 and 14.42 g/animal) also nearly similar for diet 2 nd 3 rd (11.62 and 12.65 g/animal), but increased significantly with the 5th treatment (18.71 g/animal) may be due to that poultry litter contanined high percentage of Na.

The experimental calves were in a positive balance for Na in T1, T4 and T5 but the 2nd and 3rd treatments recorded a negative Na balance. The negative values obtained However, the concentration of P in urine was not statistically significant. Feces is the main path for P excretion, though it is also excreted urine in small quantities in the herbivores (Ranjhan, 1980).

It was observed that P absorption and retention had the same trend of Ca due to the close metabolic interrelationship among them (Georgievskii et al., 1982). Also the highest values of P retention with calves in the 5th. treatment cleared the benefit effect of adding poultry litter during ensiled fresh sugar beet tops.

POTASSIUM

Potassium absorption and balance showed presented in Table (3). Potassium intake was increased from 128.2 to 177.9 g/d with different dietary treatments, however, fecal K execretion did not alter significantly ($p > 0.05$). Apparent K absorption increased from 114.2 to 165.8 g/day with increasing K consumed. Greene et al. (1983a), reported a small increase in fecal K excretion and a linear increase in K absorption by feeding increased amounts of K. Newton et al. (1972) found that feeding lambs 4.9 vs 6% K resulted in no change in fecal K, but a higher quantity of K absorbed and retaind and larger amounts of K excreted in urine. Greene et al. (1983 b,c) also reported increased in apparent K availability for lambs and steers when increasing levels of $KHCO_3$ were fed. This increase is for retention of Na are difficult to explain but, may be that these calves consumed quantities of Na considered not adequate for maintenance but adequate for the clves in the 1st, 4th and 5th groups. Ruminants require supplementation with Na because plants are usually low in this element (**Ammerman and Goodrich, 1983**).

ZINC

The data for dietary intake, fecal and urinary excretion of Zn and calculated values for apparent absorption and net retention of the element are summarized in Table (4). In this study, calves in all Treatments feed rations contained from 78.1 to 91.4 ppm (Table 3) received daily 340.2 to 430.8 mg/ animal (Table, 4). Since this dietary Zn intake is greatly excess of requirement. zinc requirements have been listed as 40 ppm for all classes of dairy cattle (NRC, 1978), and 20 to 30 ppm for growing and finishing cattle (NRC, 1976). The maximum tolerable level of dietary Zn has been set 500 ppm for cattle and 300 ppm for sheep (NRC, 1980).

The average daily intake of Zn were nearly similar for T1, T2 and T3. However, absorption and retention in the 2nd treatment had the same trend and in a positive side. On the contrary the calves in the 4th and 5th treatments showed a negative Zn balance although they consumed daily more Zn than other calves in the different treatments. May be due to the adverse effect of high Ca intake on Zn availability, the correlation between Ca intake and Zn absorption was negatively Cr= -.7). **Suttle and Field (1970)** reported increased fecal excretion of Zn in sheep fed a high Ca diet. Also, **Georgievskii et al., 1982** reported antagonistic effect between high dietary Fe and Zn absorption. **Rose et al., 1982**, found that high that high dietary Fe decreased kidney Zn concentration.

IRON

Iron balance data in Table (4) indicated that Fe intake was in great excess of requirement for all treatments (640.6 to 805.5 mg/day for each calve. due to the high Fe content in sugar beet tops (141.4 to 169.0 ppm) as shown in Table (2). Dietary requirements are listed as 50 ppm for most classes of dairy cattle (NRC 1978) Iron toxicity is seldom a problem in domestic aniamls and maximum tolerable dietary levels for the element are given as 1000 ppm for cattle and 500 ppm for sheep (NRC 1980).

The results indicated that increasing Fe intake by feeding experimental dietary rations leads to significant increase in Fe excretion in feces, on the contrary Fe excretion in urine was not significant as affected by different levels of dietary iron. Ingested Fe excreted in feces varied with chemical form, but ranged from 84 to 98% for sheep (**Ammerman et al., 1967**) with and average of 76% for cattle

(Hansard et al., 1966). 0.04% and 0.09%, being excreted in urine. Fecal Fe therefore represents that unabsorbed from feeds, desquamated mucosal cells and that from the bile (Hansard, 1983). However, no differences between treatments if Fe absorption and retention. Underwood, 1971, Stated that into mucosal cells is converted into ferritin and when the cells become physiologically saturated with ferritin, further absorption is impeded until the iron is released from ferritin and transfered to plasma.

The study of the relationship between the mineral intake from the different forms of sugar beet tops and of the fecal samples had shown that in the case of four elements (Ca, P, Fe and Zn) there was a significant correlation. The closest correlations between intake and excretion were highly significant with the following minerals: Ca (r=0.94), P (r=0.89), Fe (r=0.83) and Zn (r=0.94). There was no correlation between the intake and excretion of alkaline metal (Na and K). This explained by the fact that Na and K are excreted through the kidneys and major route of excretion of other elements under investigation occurs through feces.

From this study it could be concluded that sugar beet tops had high ash and minerals content, also the differences in the chemical composition is related to the variety differences, and must be taken in consideration when sugar beet tops were used in feeding and ration formulation.

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SUMMARY

Five metabolism trials were conducted with 15 mature friesian calves (3 in each treatment) to determine some mineral balances after being fed on different forms of sugar beet tops. The animals were fed: sun dried sugar beet tops (T1), shade-dried sugar beet tops (T2), sugar beet tops silage without additives (T3), sugar beet tops silage with urea plus El-mufeed (T4) and sugar beet tops silage with poultry litter plus El-mufeed (T5). The mineral contents of 11 varieties of fresh sugar beet tops were investigated also. The results could be summarized as follows:

The ash and some macro and micro elements contents of the studied varieties of sugar beet tops on DM basis were relatively high. The ash content ranged between 20.44 and 31.44% and oxalate ranged between 3.30 and 4.89%, Ca, P;1 Na, K contents ranged between 5.84 and 8.0; 1.14 and 2.50; 3.48 and 5.15; 30.0 and 42.0 g/kg, also, Fe, Zn and Mn concentration ranged between 68 and 193; 28 and 117 and 19 and 56 ppm, respectively.

Calcium and P absorption and retention in the 5th treatment was higher than those fed the other dietary treatments.

Potassium retention increased from 0.05 to 132.3 g/day by increasing K intake (from 128.2 to 177.9 g/day) when calves

were fed different forms of sugar beet tops. Sodium was a positive balance for T1, T4 and T5 but 1st, 2nd 3rd treatments recorded a negative Na balance.

The average daily intake of Zn were similar in T1, T2 and T3. Zinc absorption and retention in those treatments, had the same trend and in a positive side. On the other hand the calves in the 4th and 5th treatments showed a negative Zn balance although they consumed daily more Zn than other calves.

Iron intake was in great excess of requirement for all calves. The difference between treatments was significant (540.6 to 805.5 mg/day/animal) but the differences between Fe absorption and retention were not significant as affected by its different levels in diet.

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