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CEMENT KILN DUST IN ANIMAL NUTRITION:

1. CEMENT KILN DUST AS BUFFER IN SHEEP FEEDING

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ABSTRACT: Twelve local baladi rams divided into three similar groups (four animals each) with nearly one year old and equal average body weight (32.5 ± 2.72 kg). The tested animals fed *ad libittum* berseem for 3 weeks before the time of abrupt change to high concentrate feeds. The main objective of this work was to evaluate the effect of inclusion cement kiln dust (CKD) or sodium bicarbonate (SB) during 4 weeks feeding period on alleviation the depression of ruminal pH in sheep. The experimental rations were: T_1 (basal ration –BR- 75% concentrate feed mixture + 25% wheat straw), T_2 (BR+ 2%SB) and T_3 (BR+ 3%CKD).

The obtained results showed that daily water consumption significantly ($P<0.05$) increased as a result of SB (T_2) or CKD (T_3) addition than that of BR (T_1). Also, water consumption increased ($P<0.05$) with advancing time of feeding up to the 4th week. Ruminal parameters significantly increased (pH, VFA, protozoa count and microbial protein) as a result of SB or CKD inclusion than basal ration (T_1). Similar trend was observed by advancing time of feeding for the most rumen parameters.

The addition of SB or CKD significantly ($P<0.05$) improved the digestibility of all nutrients which reflected positively on the nutritive values as SE and TDN (except DCP was improved by SB addition only) when compared with the basal ration (T_1). Feeding period showed significantly ($P<0.05$) effect on crude fiber digestibility only from the 2nd week up to the 4th week.

The interaction effect between SB or CKD addition and feeding period showed no significant effect on all measured parameters.

In conclusion, addition of SB or CKD to high concentrate ration or during the time of abrupt change of feeds to high concentrate rations could avoid the depression of ruminal pH, thereby can improve the digestion in the rumen.

Key words: Cement kiln dust, sodium bicarbonate, ruminal parameters, digestibility, Sheep.

INTRODUCTION

Acidosis in ruminants is a diet-related disease caused by an abrupt increase in consumption of readily fermentable carbohydrates. Changes in ruminal microbial population and fermentation products result in absorption of large amounts of volatile fatty acids and lactic acid into the blood stream which causes systemic acidosis (Rogers and Davis, 1982; Snyder *et al.*, 1983; Church, 1988; and Lana *et al.*, 1998). Hence, dietary buffers or neutralizer (bicarbonates, hydroxides and silicates) have beneficial effects during the initial phases of adaptation to prevent depression in rumen pH associated with high concentrate diet (West *et al.*, 1992; Koul *et al.*, 1998; Santra *et al.*, 2003; Tripathi *et al.*, 2004; and Kawas *et al.*, 2007).

Cement kiln dust (CKD) is ash-like materials which remain at the end of cement manufacture process (about two million ton annually in Egypt) were used as dietary buffer, but do not show consistent ruminal effects during the first weeks of feeding high concentrate diets (Wheeler, 1980; Bush and Nicolson, 1985; Galina *et al.* 2000; and Ortiz *et al.* 2002).

The aim of this work was to verify the effects of dietary inclusion of CKD or sodium bicarbonate (SB) to prevent the digestion disturbance associated with high concentrate diet.

MATERIALS AND METHODS

The experimental work was carried out at a private farm located at Belbies, Sharkia Governorate and the laboratoral measurements were conducted at Department of Animal Production, Faculty of Agriculture, Zagazig University, Zagazig, Egypt during the years 2007-2008. Twelve local baladi rams (obtained from

commercial market) were divided into three groups (four animals each) with nearly one year old and similar in average body weight (32.5±2.72 Kg). Animals in each groups were housed in pens, and fed *ad libitum* berseem (4^{th} cut) for 3 weeks before feeding the experimental rations. Animals were fed 120% of their maintenance requirements of starch equivalent (SE) and digested crude protein (DCP) for sheep as reported by Ghoneim (1967). Rations were offered two times daily at 8 a.m. and 4 p.m during the experimental period (4 weeks). Water was offered two times daily after feeding and estimated for each animal through the last three days of every week.

Experimental Rations

The experimental rations were:

(T_1) Basel ration: 75% concentrate feed mixture and 25% wheat straw.
(T_2) Basel ration + 2% sodium bicarbonate (Farghaly *et al.*, 1998).
(T_3) Basel ration + 3% cement kiln dust (Bush *et al.*, 1985).

The chemical compositions of ingredients and the experimental rations are shown in Table 1. Cement kiln dust (Torah Cement) contained: 45.37% CaO, 17.71% SiO_2, 3.11% Al_2O_3, 2.65% Fe_2O_3, 1.45% MgO, 5.25% SO_3, 6.35% K_2O, 8.36% Cl, 11.69% Moisture and 1.06% others as analyzed by Torah Cement Company laboratories, Giza, Egypt. Sodium bicarbonate from El-Gomhouria Co. for druges, Egypt.

Rumen Fluid Parameters and Digestibility Trails

All tested animals were used to evaluate the effect of tested ration on some ruminal parameters. Samples were undertaken individually from each ram before feeding and at 3 hours after feeding through the 4^{th} day in the first week, 11^{th} day in the 2^{nd} wk, 18^{th} day in the 3^{rd} wk and 29^{th} day in the 4^{th} wk of the digestibility trials.

Ruminal fluid samples were obtained by using stomach tube. Samples were strained through four layers of cheese cloth. Each sample was divided into four portions. The first one was used immediately for the estimation of rumen pH by the Consort pH meter model P 107 (made in Belgium). Total number of protozoa was determined at zero time and 3 hours post feeding using Fuchs-Rosenthal Chamber. Total volatile fatty acids was measured at zero time and 3 hours post feeding by steam distillation as described by Warner (1964). Ruminal microbial protein was measured at 3 hours after feeding according to Shultz and Shultz (1970).

Table 1. Chemical analysis of ingredients and the composition of experimental rations

Items	%DM	%OM	%CP	%EE	%CF	%NFE	%Ash
Ingredients							
Yellow corn	85.01	98.76	8.61	3.00	2.01	85.14	1.24
Cottonseed meal	89.57	94.49	28.59	5.27	26.00	34.63	5.51
Wheat bran	86.03	96.93	14.91	2.25	5.52	74.25	3.07
Barley	86.61	94.89	10.85	1.99	7.75	74.30	5.11
Concentrate feed mixture*	86.02	93.78	14.71	2.86	10.44	65.77	6.22
Wheat straw	88.83	89.75	3.93	2.03	35.83	47.96	10.25
Experimental rations							
T_1	86.72	92.77	12.02	2.65	16.79	61.31	7.23
T_2	86.82	90.84	11.93	2.58	16.35	60.21	9.16
T_3	86.78	91.66	12.15	2.61	16.49	60.41	8.34

*Concentrate feed mixture (mash) contained : 20% yellow corn, 22.3% cottonseed meal, 45% barley, 10% wheat bran, 2% dicalcium phosphate, 0.5% common salt and 0.2% minerals and vitamins mixture (each 1g of premix contains: Vitamin A 4000 IU, Vitamin $D_3$7000 IU, Vitamin E 10 mg, Copper 100 mg, Iodine 1 mg, Selenium 0.10 mg, Iron 30 mg, Manganese 60 mg, Zinc 50 mg, Cobalt 0.10 mg and Calcium Carbonate as carrier up to 1g, from Arab International Manufacturing Co. S.A.E, Cairo, Egypt). Ration ingredients were obtained from the local market.

Twelve mature rams were assigned randomly to three experimental groups to evaluate the effect of treatments on nutrient digestibilities. Each animal had been fitted with fecal collection bag to collect the feces through the 5, 6 and 7th days of the 1st wk, the 12, 13 and 14th days of the 2nd wk, the 19, 20 and 21st days of the 3rd wk and collecting feces during 7 days of the last week(4th wk). Representative samples of feces and feeds were kept for later chemical analysis. Chemical analysis of ingredients, feeds and feces was determined according to A.O.A.C. (1990).

Statistical Analysis

The data of the experiment was statistically analyzed by factorial experiment (Snedecor and Cochran, 1982) according to the following Model:

$$Y_{ijk} = \mu + S_i + W_j + SW_{ij} + e_{ijk}$$

Where Y_{ijkl} = an observation, μ = the overall mean, S_i = the fixed effect of ith supplementations, W_j = the fixed effect of jth feeding period, SW_{ij} = the interaction between the ith supplementations and jth feeding period and e_{ijk} = random error.

Significant differences were estimated by Duncan's Multiple Range test (Duncan, 1955).

RESULTS AND DISCUSSION

Effect of CKD or SB and Feeding Period on

Feed and water consumption

The values of daily dry matter consumption as g/kg $W^{0.75}$ or % of body weight (Table 2) showed insignificantly increase as a result of CKD or SB addition compared to the basal ration without any additives. Similar result were obtained by Flachowsky *et al.* (1982), Galvano *et al.* (1982), Kim *et al.* (1985), Tripathi *et al.* (2004) and Kawas *et al.* (2007) who observed significantly ($P<0.05$) higher DM intake when ration supplemented with SB. However, Galyean and Chabot (1981) and Hogue *et al.* (1981) showed that feed intake was not affected by CKD addition.

The result of daily water consumption as ml/h/d, ml/kg $W^{0.82}$ and ml/kg DMI (Table 3) showed significantly ($P<0.05$) increase in water intake as a result of CKD or SB addition than that of basal diet. The results showed also that animals which received SB consumed significantly higher water than those which received CKD. Also, the obtained results showed that the animal consumed more water ($P<0.05$) as a result of increasing the feeding period from 1st week up to the 4th week.

Table 2. Effect of CKD or SB dietary addition on dry matter intake by sheep (x ± SE)

Items	Treatments		
	T_1	T_2	T_3
Animals Weight	33.25 ± 2.02	31.50 ± 0.65	32.75 ± 2.17
Daily dry mater intake of ration			
g /head /day	659.22 ± 23.06	659.80 ± 17.51	656.73 ± 20.74
g /kg $W^{0.75}$	47.74 ± 1.00	49.60 ± 0.57	48.17 ± 1.01
% of body weight	1.99 ± 0.06	2.09 ± 0.01	2.02 ± 0.07

Table 3. Effect of CKD or SB dietary addition, feeding period and its interaction on water consumption by sheep (x ± SE)

Items		Daily water consumption		
		ml /head /day	ml /kg $W^{0.82}$*	ml/ g DMI
Effect of CKD or SB addition				
T_1		1254.38 ^{c} ± 85.48	70.02 ^{c} ± 3.64	1.91 ^{c} ± 0.11
T_2		1933.54 ^{a} ± 76.77	113.97 ^{a} ± 4.84	3.02 ^{a} ± 0.13
T_3		1675.10 ^{b} ± 79.79	95.51 ^{b} ± 3.55	2.64 ^{b} ± 0.11
Effect of feeding period				
1st Week		1396.67 ^{b} ± 115.52	80.42 ^{c} ± 6.46	2.18 ^{c} ± 0.18
2nd Week		1569.44 ^{ab} ± 125.18	90.68 ^{bc} ± 7.70	2.45 ^{bc} ± 0.20
3rd Week		1691.95 ^{a} ± 114.30	96.88 ^{ab} ± 6.07	2.63 ^{ab} ± 0.17
4th Week		1825.97 ^{a} ± 113.54	104.68 ^{a} ± 6.39	2.84 ^{a} ± 0.18
Interaction between CKD or SB addition and feeding period				
1st Week	T_1	1129.17 ± 228.58	62.69 ± 9.44	1.71 ± 0.30
	T_2	1579.17 ± 180.55	93.58 ± 11.35	2.48 ± 0.31
	T_3	1481.67 ± 156.78	84.99 ± 8.49	2.34 ± 0.24
2nd Week	T_1	1089.17 ± 166.68	60.59 ± 6.03	1.65 ± 0.20
	T_2	1978.34 ± 69.46	116.74 ± 5.86	3.09 ± 0.17
	T_3	1640.83 ± 73.79	94.70 ± 6.97	2.61 ± 0.16
3rd Week	T_1	1353.34 ± 144.83	75.66 ± 4.37	2.06 ± 0.16
	T_2	2001.67 ± 115.84	117.71 ± 7.39	3.12 ± 0.20
	T_3	1720.83 ± 197.09	97.28 ± 6.05	2.70 ± 0.24
4th Week	T_1	1445.83 ± 123.82	81.15 ± 4.51	2.21 ± 0.16
	T_2	2175.00 ± 59.42	128.83 ± 6.34	3.40 ± 0.18
	T_3	1857.09 ± 184.01	105.07 ± 5.05	2.92 ± 0.21

a, b and c: Means in the same column with different litters differ significantly ($P<0.05$).
* $W^{0.82}$: Metabolic body mass (McFarlane and Howards, 1972).

However, the interaction effect between CKD or SB addition and feeding period showed insignificant effect on water consumption (Table 3). Similar trend were observed by Thomson *et al.* (1975 and 1978), Rogers *et al.* (1979) and Cottee *et al.* (2004).

Ruminal parameters

The results of ruminal parameters indicated that inclusion of CKD or SB in the sheep rations significantly ($P<0.05$) increased pH values from 6.71 (T_1) to 6.89 (T_2) and 6.94 (T_3) at time of feeding (zero time) and from 6.09 (T_1) to 6.51 (T_2) and 6.59 (T_3) 3 hour after feeding, respectively (Table 4). The ruminal pH values showed that CKD may be acting as a buffer material similar to limestone which conductive to more efficient of nutrients utilization (Wheeler, 1980; Galyean and Chabot 1981; Galina *et al.*, 2000 and Tripathi *et al.*, 2004).

The obtained results showed significant increase in measured values of total volatile fatty acids (VFA) and protozoa count which significantly reflected on the improvement of microbial protein (MP) synthesis compared with unsupplemented rations Table 4. Similar result were obtained by Galina *et al.* 2000; Otiz *et al.* 2002 and Santra *et al.*, 2003 who reported that CKD or SB addition increase VFA concentrations, kept rumen pH above 6.6 all the time and played a key role of maintaining cellulotic bacteria.

On the other hand, Zinn *et al.* (1979) and Bush and Nicholson (1985) found that CKD addition produced higher fecal pH, thus demonstrating buffering effect in lower digestive tract. However, Bush *et al.*, 1981; Galvano *et al.*, 1982 and Kawas *et al.*, 2007 found no significant effect on ruminal TVFA and pH values as a result of CKD or SB addition.

The results of the feeding period effect (Table 4) showed also increase in values of ruminal pH, VFA, protozoa count and microbial protein synthesis as a result of increasing feeding period from the 2nd week up to 4th week. However, the interaction effect between CKD or SB addition and feeding period showed no significant effect (Table 5).

Table 4. Effect of CKD or SB dietary addition and feeding period on some ruminal parameters by sheep (x ± SE)

Items	pH		VFA Meq/100ml		Protozoa count $\times 10^3$ /ml		MP mg/100ml
	Before feeding	3 hours	Before feeding	3 hours	Before feeding	3 hours	3 hours
Effect of CKD or SB addition							
T_1	6.71^{b} ± 0..04	6.09^{b} ± 0.07	5.63^{b} ± 0..14	9.36^{b} ± 0.20	367.69 ± 8.15	434.75^{b} ± 13.08	0.56^{b} ± 0.02
T_2	6.89^{a} ± 0.03	6.51^{a} ± 0.04	6.13^{a} ± 0.15	9.98^{a} ± 0.11	381.56 ± 11.12	521.38^{a} ± 19.53	0.63^{a} ± 0.02
T_3	6.94^{a} ±0.03	6.59 ± 0.04^{a}	5.87^{ab} ± 0.12	9.91^{a} ± 0.11	395.13 ± 10.96	538.13^{a} ± 21.98	0.63^{a} ± 0.02
Effect of feeding period							
1st Week	6.73^{b} ± 0..05	6.29^{b} ± 0.08	5.33^{b} ± 0.10	9.54 ± 0.16	355.42^{b} ± 11.79	427.67^{b} ± 15.92	0.52^{b} ± 0.01
2nd Week	6.82^{ab} ± 0.05	6.33^{ab} ± 0.11	6.25^{a} ± 0.17	9.53 ± 0.23	373.17^{ab} ± 8.55	473.17 ± 15.80 b	0.61^{a} ± 0.02
3rd Week	6.93^{a} ± 0.03	6.48^{a} ± 0.08	5.91^{a} ± 0.13	9.99 ± 0.15	400.08^{a} ± 10.57	533.58^{a} ± 21.67	0.64^{a} ± 0.02
4th Week	6.90^{a} ± 0.05	6.49^{a} ± 0.05	5.98^{a} ± 0.15	9.96 ± 0.16	397.17^{a} ± 12.79	557.92^{a} ± 26.63	0.66^{a} ± 0.02

a, b and c: Means in the same column with different litters differ significantly ($P<0.05$).

Table 5. The interaction effect between CKD & SB dietary addition and feeding period on some ruminal parameters by sheep (x ± SE)

Items		pH		VFA Meq/100ml		Protozoa count, $\times 10^3$ /ml		MP, mg/100ml
		Before feeding	3 hours	Before feeding	3 hours	Before feeding	3 hours	3 hours
1st Week	T_1	6.58 ± 0.08	5.99 ± 0.11	5.13 ± 0.15	8.95 ± 0.11	349.00 ± 18.37	388.25 ± 19.60	0.49 ± 0.02
	T_2	6.76 ± 0.07	6.44 ± 0.07	5.55 ± 0.21	9.93 ± 0.15	352.25 ± 25.36	442.25 ± 29.29	0.53 ± 0.01
	T_3	6.84 ± 0.04	6.45 ± 0.10	5.33 ± 0.14	9.75 ± 0.24	365.00 ± 22.39	452.50 ± 27.42	0.54 ± 0.04
2nd Week	T_1	6.67 ± 0.11	5.88 ± 0.13	5.93 ± 0.38	8.83 ± 0.49	364.75 ±13.28	426.25 ± 26.50	0.55 ± 0.04
	T_2	6.94 ± 0.08	6.55 ± 0.10	6.65 ± 0.22	9.93 ± 0.22	372.75 ± 20.57	495.50 ± 25.90	0.65 ± 0.04
	T_3	6.86 ± 0.03	6.58 ± 0.04	6.18 ± 0.20	9.85 ± 0.16	382.00 ± 12.45	497.75 ± 16.44	0.62 ± 0.05
3rd Week	T_1	6.81 ± 0.03	6.22 ± 0.17	5.63 ± 0.20	9.83 ± 0.30	378.25 ± 14.88	457.25 ± 21.41	0.59 ± 0.05
	T_2	6.96 ± 0.05	6.51 ± 0.07	6.15 ± 0.30	10.10 ± 0.33	404.25 ± 20.22	562.25 ± 29.67	0.68 ± 0.04
	T_3	7.01 ± 0.06	6.69 ± 0.07	5.95 ± 0.13	10.05 ± 0.20	417.75 ± 18.19	581.25 ± 29.21	0.67 ± 0.04
4th Week	T_1	6.76 ± 0.07	6.29 ± 0.06	5.85 ± 0.27	9.85 ± 0.36	378.75 ± 19.88	467.25 ± 24.72	0.60 ± 0.04
	T_2	6.90 ± 0.04	6.53 ± 0.05	6.18 ± 0.26	10.00 ± 0.19	397.00 ± 20.81	585.50 ± 31.34	0.69 ± 0.03
	T_3	7.05 ± 0.06	6.65 ± 0.07	5.90 ± 0.28	10.03 ± 0.34	415.75 ± 27.29	621.00 ± 43.47	0.69 ± 0.02

Digestibility and nutritive values

The obtained results Table 6 showed that CKD or SB addition significantly improved all nutrient digestibility coefficients (DM, OM, CP, EE, CF and NFE) as a result of improving ruminal parameter (Table 4). The improvement of digestion of most nutrients reflected positively on significant improved nutritive values (SE and TDN) for CKD and SB, while DCP value significantly improved only with SB addition (T_2) compared to basal ration (T_1) and CKD addition (T_3). Similar results were obtained by Zinn *et al.* (1979) who obtained consistent increases in digestibility of most nutrients when fed steer high energy ration plus 3.5% CKD. Several researchers reported that SB addition at different levels improved the digestibility of some nutrients, especially fiber, due to maintenance of ruminal pH above critical level and enhances the activity of rumen cellulolytic microorganisms (Mould and Ørskov, 1983; Matras *et al.*, 1991;Koul *et al.* 1998, Santra *et al.* 2003 and Kawas *et al.*, 2007).

The effect of feeding period (Table 6) showed that only crude fiber digestibility significantly ($P<0.05$) improved with increasing the feeding period from the 2nd week up to the 4th week. No significant differences were detected among the interaction effect of feed additives and feeding period (Table 7).

In conclusion, addition of CKD or SB in high concentrate grain rations or during the time of abrupt change of feeds to high concentrate rations could avoid the depression of ruminal pH, thereby improved the nutrients efficiency utilization.

Table 6. Effect of cement kiln dust (CKD) and sodium bicarbonate (SB) dietary addition and feeding period on digestability and nutritive values of the experimental ration by sheep (x ± SE)

Items	%DM	%OM	%CP	%EE	%CF	%NFE	%SE	%TDN	%DCP
Effect of CKD or SB addition									
T_1	66.40^{b} ±0.25	69.04^{c} ±0.28	66.56^{c} ±0.37	79.91^{b} ±0.24	48.67^{b} ±0.49	74.64^{b} ±0.50	56.12^{b} ±0.24	66.70^{b} ±0.26	8.00^{b} ±0.05
T_2	68.86^{a} ±0.23	71.23^{b} ±0.22	70.29^{a} ±0.28	82.36 ±0.28^{a}	51.47^{a} ±0.44	76.08^{a} ±0.31	57.10^{a} ±0.20	68.04^{a} ±0.22	8.30^{a} ±0.03
T_3	68.62^{a} ±0.26	72.03^{a} ±0.28	69.18^{b} ±0.30	82.24^{a} ±0.32	52.21^{a} ±0.36	76.93^{a} ±0.43	57.67^{a} ±0.26	67.81^{a} ±0.26	8.10^{b} ±0.04
Effect of feeding period									
1st Week	67.72 ±0.34	70.43 ±0.38	69.06 ±0.65	81.75 ±0.48	49.03 ±0.53^{b}	75.81 ±0.36	56.66 ±0.27	66.95 ±0.20	8.17 ±0.06
2nd Week	67.69 ±0.46	70.57 ±0.52	68.29 ±0.64	81.17 ±0.46	51.08^{a} ±0.64	75.56 ±0.66	56.77 ±0.36	67.06 ±0.33	8.08 ±0.06
3rd Week	68.24 ±0.47	70.95 ±0.50	68.80 ±0.50	81.87 ±0.46	51.02^{a} ±0.65	76.10 ±0.63	57.14 ±0.33	67.42 ±0.29	8.15 ±0.05
4th Week	68.19 ±0.45	71.12 ±0.51	68.57 ±0.57	81.22 ±0.45	51.99^{a} ±0.57	76.07 ±0.55	57.28 ±0.34	67.56 ±0.31	8.12 ±0.06

a,b and c: Means in the same column with different litters differ significantly ($P<0.05$).

Table 7. Effect of interaction between CKD & SB dietary addition and feeding period on digestibility and nutritive values of the experimental rations by sheep (x ± SE)

Items		%DM	%OM	%CP	%EE	%CF	%NFE	%SE	%TDN	%DCP
1st Week	T_1	66.42 ±0.32	69.06 ±0.37	66.43 ±0.54	80.04 ±0.37	46.96 ±0.41	75.15 ±0.61	56.13 ±0.31	66.73 ±0.35	7.98 ±0.07
	T_2	68.40 ±0.40	70.68 ±0.26	70.63 ±0.62	82.29 ±0.46	49.65 ±0.32	75.68 ±0.37	56.59 ±0.23	66.94 ±0.23	8.34 ±0.07
	T_3	68.34 ±0.38	71.57 ±0.59	70.11 ±0.72	82.92 ±0.81	50.51 ±0.75	76.61 ±0.77	57.26 ±0.67	67.18 ±0.51	8.20 ±0.09
2nd Week	T_1	65.98 ±0.69	68.79 ±0.85	65.77 ±0.70	79.46 ±0.41	48.88 ±0.92	74.37 ±1.45	55.87 ±0.75	66.46 ±0.79	7.91 ±0.09
	T_2	68.39 ±0.36	70.94 ±0.44	70.32 ±0.60	81.93 ±0.72	51.51 ±0.86	75.64 ±0.56	56.82 ±0.42	67.16 ±0.42	8.30 ±0.07
	T_3	68.71 ±0.54	72.00 ±0.54	68.78 ±0.46	82.11 ±0.40	52.85 ±0.38	76.65 ±1.22	57.63 ±0.37	67.55 ±0.48	8.05 ±0.06
3rd Week	T_1	66.60 ±0.47	69.14 ±0.57	67.16 ±1.00	80.56 ±0.60	48.96 ±1.18	74.56 ±1.14	56.23 ±0.47	66.82 ±0.51	8.07 ±0.12
	T_2	69.24 ±0.60	71.41 ±0.44	69.83 ±0.46	82.98 ±0.78	51.71 ±0.89	77.37 ±0.85	57.30 ±0.40	67.64 ±0.40	8.25 ±0.05
	T_3	68.88 ±0.67	72.28 ±0.68	69.41 ±0.45	82.06 ±0.65	52.41 ±0.54	77.36 ±1.03	57.89 ±0.70	67.81 ±0.60	8.12 ±0.05
4th Week	T_1	66.61 ±0.57	69.18 ±0.60	66.88 ±0.80	79.57 ±0.45	49.91 ±0.94	74.45 ±1.04	56.23 ±0.47	66.82 ±0.56	8.04 ±0.10
	T_2	69.40 ±0.35	71.88 ±0.49	70.39 ±0.72	82.23 ±0.25	53.00 ±0.59	76.65 ±0.67	57.70 ±0.44	68.04 ±0.45	8.31 ±0.09
	T_3	68.56 ±0.62	72.29 ±0.57	68.46 ±0.56	81.86 ±0.74	53.06 ±0.45	77.12 ±0.71	57.90 ±0.58	67.81 ±0.52	8.01 ±0.07

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غبار الأسمنت المحروق فى تغذية الحيوان

1- غبار الأسمنت المحروق كمنظم فى تغذية الأغنام

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أثنى عشر كبش بلدي عمر سنة تقريبا ومتوسط وزن 32.5 ± 2.72 كجم تم تقـسيمهم الى ثلاث مجاميع تجريبية متشابهة. غذيت الأغنام على البرسيم حتى الـشبع لمـدة ثلاثـة أسابيع قبل التغيير الغذائي الفجائي لعليقة عالية المحتوى من المركزات. يهدف البحث إلـى تقييم أثر إضافة غبار الأسمنت المحروق أو بيكربونات الصوديوم لعلائق الأغنام على الحد من أثر الإرتباكات الهضمية الناتجة عن التغير الفجائي للغذاء لمدة أربعة أسـابيع. غـذيت الأغنام على العلائق التجريبية المستخدمة وهى: العليقة الأولى: – عليقة المقارنة- (75%

مركزات + 25% تبن قمح)، العليقة الثانية : عليقة المقارنة + 2% بيكربونات ، العليقة الثالثة : عليقة المقارنة + 3% غبار الأسمنت المحروق.

وكانت أهم النتائج المتحصل عليها:

- زاد معنويا استهلاك الماء كنتيجة لإضافة البيكربونات أو غبار الأسمنت المحروق للعلائق المختبرة، كما زادت كمية الماء المستهلك معنويا بزيادة مدة التجربة من الأسبوع الثاني وحتى الأسبوع الرابع (نهاية التجربة).
- زادت معنويا قيم الأس الهيدروجيني، الأحماض الدهنية الطيارة، أعداد البروتوزوا، وتركيز البروتين الميكروبي لسائل الكرش كنتيجة لإضافة البيكربونات و غبار الأسمنت المحروق مقارنة بالعليقة بدون إضافة، كما أظهرت طول مدة التجربة تأثير مماثل على أغلب الصفات تحت الدراسة.
- لم يظهر التأثير المتداخل للبيكربونات أو غبار الأسمنت المحروق مع طول فترة التجربة أية تأثيرات معنوية.
- زادت معنويا معاملات هضم أغلب العناصر الغذائية للعلائق التجريبية نتيجة لإضافة كلا من بيكربونات الصوديوم غبار الأسمنت المحروق، والتي انعكست تأثيراتها على تحسن القيم الغذائية فى صورة معادل النشا أو مجموع مركبات كلية مهضومة، باستثناء البروتين الخام المهضوم الذي تحسن مع إضافة بيكربونات الصوديوم فقط مقارنة بالعليقة الأساسية بدون إضافة.
- أظهرت طول فترة التغذية تأثير ايجابي معنوي فقط على معامل هضم الألياف، اعتبارا من الأسبوع الثاني وحتى نهاية التجربة (الأسبوع الرابع).

الخلاصة أن إضافة بيكربونات أو غبار الأسمنت المحروق إلى العلائق عالية التركيز أو خلال وقت التغير المفاجئ لعلائق ذات محتوى عالي من الأعلاف المركزة قد تستطيع الحد من الأثر الضار لارتفاع الأس الايدروجينى بالكرش، وبالتالي تحسن كفاءة استخدام الغذاء.