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Some Physiological Responses of Sheep Fed Bagasse Treated With Different Chemical Reagents

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THE Changes in some physiological parameters of sheep fed sugar cane bagasse treated with alkali and acid to improve its nutritive value were investigated. In summer 4 Ossimi rams were fed untreated bagasse, 5% NaOH, 2.5% NaOH + 2.5% Ca (oH) $_2$ and 6% NH_3 treated bagasse in a 4x4 latin aquare arrangement. In winter this experiment was repeated with an addition of 2.4% H_2 SO_4 treatment in a 5x5 latin square arrangement. Chemical treatment of bagasse had insignificant effect on the physiological responses (rectal temperature, pulse rate and respiration rate), on blood hemoglobin and white blood cell counts, on serum total protein, albumin globulin and glucose, on plasma osmolality, sodium and potassium values. Values of packed cell volume and red blood counts decreased ($P< 0.01$) by NaOH treatment. Urine osmolality, sodium and potassium values were higher ($P < 0.01$) in both NaOH and NaOH + Ca $(OH)_2$ treatments than control. Summer season induced significant ($P < 0.01$) decreases in blood hemoglobin and packed cell volume and in urine sodium and potassium, and significant increases in rectal temperature, respiration rate ($P < 0.01$) white blood cell counts ($P < 0.05$) and in serum total protein and albumin ($P < 0.01$).

Key words : Sheep, Physiological response, bagasse feeding

Sugar cane bagasse can be used as alternative feed for ruminants to partially fill the gap in available feeds. In general, the feeding value of bagasse, as a roughage, can be improved through physical, microbiological or chemical treatments. The improvement of feeding value of roughages achieved through the chemical treatments depends on several factors e.g., the treated stuff, the chemical reagents used, reagent concentration, ... etc. (Sundstol and Coxworth, 1984). Feeding on chemically treated roughages induce marked changes in several physiological parameters in animals fed the treated ration (Salem, 1980; Klimer *et al.* 1981; Vincent *et al.*, 1987). The aim of this study was to determine the changes in the physiological response of sheep fed on sugar cane bagasse treated with different alkali or acid detergents.

Material and Methods

The present study was carried out at the Experimental Farm, Faculty of Agriculture, Minia University. The animals used were Ossimi rams at 10 - 12 months of age and 30 - 40 kg body weight. All animals were individually confined in digestion crates which were maintained in semi-open stable.

During summer 4 rams were fed on 4 different chemically treated bagasse in a 4x4 latin squar design. The treatments were as follows : untreaed sugar cane bagasse (control), sugar cane bagasse treated with 5% NaOH, sugar cane bagasse treated with 2.5% NaOH + 2.5% $Ca(OH)_2$ and sugar cane bagasse treated with 6% NH4 OH. One more treatment (Sugar cane bagasse treated with 2.4% H_2 SO_4) was added during the winter experiment, and a 5x5 latin squar design was used. The bagasse represented 75% of the diet, while the rest (25%) was a concentrate mixture. Animals were fed ad-libitum on experimental diets for a period of 17 days. After 10 days of adaptation on the new feed, physiological parameters were recorded daily for a period of 7 days. Rectal temperature, pulse rate and respiration rate of all animals were measurud twice a day at 8.30 a.m and 4.00 p.m. Three blood samples were obtained from the jugular vien of each animal. Blood collection was carried out every other day during the 7 day period. In part of blood sample EDTAwas used as anticoagulant. Plasma or serum was obtained by centrifugation of blood at 3000 r.p.m. for 20 minutes, and were stored at 20C until used for analysis. Whole blood samples were analyzed for hemoglobin (Hb) concentration (Eilers, 1967) red blood cell (RBC) and white blood cell (WBC) counts (using Bright line hemocytometer) and packed cell volum (using microhematocrit tubes and hematocrit centrifuge). Total serum protein (TP), albumin (A) and glucose were determined using commercial kits (Bio-Merieux, France). Globulin (G) concentration was obtained by substracting the values of albumin from the corresponding values of total protein. Sodium (Na) and potassium (K) concentration were measured in plasma and urine samples with flame photometer. Plasma and urine osmolality were measured using osmometer (osmett A 5002) . The average air temperature, relative humidity and vapour pressure were 22.2 °C, 64.2% and 7.4 mbar during summer and were 11.0 °C, 68.4% and 3.1 mbar during winter. Data obtained were subjected to statistical analysis according to Snedecor and Cochran (1980).

Results and Discussion

1- *Rectal temperature (RT) respiration rate (RR) and pulse rate (PR)*

Data presented in Table 1 show that chemical treatments of bagasse casued no significant effect on these parameters either in summer or in winter. The overall mean of RT, RR and PR were higher during afternoon than at morning. Also, the mean values of RT and RR were significiantly higher ($P < 0.01$) during summer than during winter, while in PR was not significantly affected by season. There is a relationship

TABLE 1. Means (±SE) of rectal temperature (RT) , respiration rate (RR) and pulse rate (PR) in Ossimi rams fed sugar cane bagasse treated with different chemicals in summer and winter seasons.

Treatment	RT (C-)			RR (res./ min.)			PR (pulse / min.)		
	a.m.	p.m.	Average	a.m.	p.m.	Average	a.m.	p.m.	Average
Summer			N.S			N.S			N.S
Untreated	38.8 ±0.25	39.1 ±0.20	38.9 a ±0.14	23.5 ±3.59	30.6 ±6.02	27.1 a ± 4.77	51.0 ± 9.31	54.8 ± 8.94	52.9 a ± 9.08
NaOH	38.9 ±0.15	39.2 ±0.13	39.1 a ±0.14	24.5 ±1.69	30.7 ±2.77	27.6 a ± 2.13	63.9 ± 8.36	70.7 ± 10.48	67.3 a ± 9.37
$NaOH+Ca(OH)_2$	39.1 ±0.14	39.4 ±0.17	39.2 a ±0.15	31.2 ±6.28	39.2 ±8.97	35.2 a ± 7.62	62.8 ± 9.53	66.5 ± 10.19	64.6 a ± 9.84
NH_4 OH	39.9 ±0.26	39.3 ±0.14	39.1 a ±0.20	30.3 ±7.56	39.9 ±8.06	35.0 a ± 7.70	57.1 ± 5.48	62.9 ± 5.87	60.0 a ± 5.64
Winter			N.S			N.S			N.S
Untreated	38.1 ±8.34	39.1 ±0.10	38.6 a ±0.20	12.4 ±1.73	14.1 ±1.93	13.3 a ± 1.83	58.0 ± 4.50	64.1 ± 5.57	61.0 a ± 4.97
NaOH	38.1 ±0.24	39.0 ±0.12	38.6 a ±0.13	13.4 ±1.39	15.4 ±1.65	14.6 a ± 1.43	62.2 ± 3.53	67.2 ± 4.16	64.7 a ± 3.83
$NaOH+Ca(OH)_2$	38.4 ±0.37	39.3 ±0.22	38.9 a ±0.28	12.6 ±0.99	15.0 ±1.70	13.8 a ± 1.34	65.2 ± 3.41	69.6 ± 5.02	67.4 a ± 4.18
NH4OH	38.1 ±0.22	39.1 ±0.14	38.6 a ±0.14	13.8 ±1.49	17.4 ±2.94	15.6 a ± 2.19	59.3 ± 2.07	64.8 ± 1.83	62.0 a ± 1.91
H_2SO_4	38.1 ±0.17	39.1 ±0.12	38.5 a ±0.12	12.0 ±0.87	14.4 ±1.38	13.2 a ± 1.12	55.2 ± 7.20	58.6 ± 7.26	59.9 a ± 7.22
Untreated			N.S			N.S			N.S
NaOH	38.4 ±0.24	39.1 ±0.10	38.7 a ±0.13	17.4 +2.60	21.4 ±3.93	19.4 a ± 3.25	45.9 ± 4.64	60.0 ± 4.69	57.4 a ± 4.76
$NaOH+Ca(OH)_2$	38.4 ±0.20	39.0 ±0.12	38.8 a ±0.12	18.3 ±2.20	22.2 ±3.04	20.4 a ± 2.57	59.6 ± 5.91	68.7 ±4.85	65.8 a ± 4.35
NH_4 OH	38.7 ±0.23	39.3 ±0.13	39.0 a ±0.17	20.9 ±4.18	25.8 ±5.68	23.3 a ± 4.93	64.1 ± 4.31	68.2 ± 4.96	66.1 a ± 4.61
H_2SO_4	38.5 ±0.21	39.2 ±0.10	38.8 a ±0.14	21.1 ±4.30	27.4 ±5.36	24.2 a ± 4.78	58.4 ± 2.52	63.9 ± 2.61	61.1 a ± 2.54
Season			**			**			N.S
Summer	38.9 ±0.09	39.2 ±0.07	39.1 a ±0.08	27.4 ±2.52	35.1 ±3.28	31.2 a ± 2.87	58.7 ± 3.95	63.7 ± 4.32	61.2 a ± 4.12
Winter	38.2 ±0.14	39.1 ±0.07	38.7 b ±0.09	13.1 ±0.66	15.5 ±1.01	14.3 b ± 0.82	61.1 ± 1.73	66.4 ± 2.07	63.8 a ± 1.87

Within columns, treatment means with different letters differ significantly
(*: P<0.05; ** : P< 0.01, N.S : not significant).

between rising air temperature during summer or during afternoon and the increase in the values of RT and RR. RT and RR have been widely used by several investigators as a satisfactory mean to detect the response of animals to environmental temperature. Khalil (1980); Taher (1985) and El-Naggar (1987) noted maximum values of RT and RR in sheep during summer, while minimum values were noted during winter. Also, higher RT and RR values were recorded in the late afternoon than those recorded in early morning (Younis, *et al.*, 1977; Taher, 1985). Diurnal variations in PR in sheep were studied by several investigators (Shalaby, 1985; Taher, 1985) and PR was higher in the afternoon than in the morning.

2- *Hemoglobin (Hb), red blood cell (RBC) counts, white blood cell (WBC) counts* and *packed cell volume (PCV)*

Data presented in Table 2 show that chemical treatments of bagasse caused no significant effect on Hb and WBC counts either in summer or in winter, while RBC counts during summer and PCV values during winter were significantly affected by treatment. During winter NaOH , NaOH + Ca $(OH)_2$ and NH_4 OH treatments caused significant decline ($P < 0.01$) in PCV values as compared to the untreated bagasse (control). Treatment with H_2SO_4 also reduced PCV, but the effect was not significant. RBC counts also decreased ($P < 0.1$) by treatment of bagasse with NaOH during summer, but treatment with NaOH+$Ca(OH)_2$ during this season resulted in an increase ($P < 0.01$) in RBC counts.

Generally, in overall means there was a tendency for a decrease in Hb, RbC, WBC and PCV values when animals were fed the treated bagasse. NaOH treatment had the greatest effect on these hematological characteristics than other treatments. These data are generally in agreement with results of Salem (1980) who found that treatments of maize stalks and rice straw with NaOH and $Ca(OH)_2$ decreased Hb, RBC and WBC values in sheep when compared with untreated roughages. Also, Klimer *et al.* (1981) reported that treatment of corn silage with0.8% $NaHCO_3$ tended to decrease blood Hb, RBC and PCV and to increase WBC counts in cows fed the treated ration.

There was significant effect of season on blood Hb, WBC counts and PCV values. The mean values of Hb and PCV were lower ($P < 0.01$) in summer than in winter, while WBC were higher ($P < 0.05$) in summer than in winter. Studies on cows also indicated that high environmental temperature during summer caused an elevation in the leucocyte counts and a decrease in Hb and PCV values (El-Nouty *et al.*, 1986). This decline in blood Hb and PCV could be attributed to the hemodilution of blood, as more tissue fluid is transfered to the blood for efficient dissipation of heat by evaporation from the body surface. Lee *et al* , (1976) reported a decline in PCV during the hot season, which was partially attributed to a decrease in the circulating RBC due to an increased rate of RBC destruction.

TABLE 2. Means (± SE) of hemoglobin (Hb) concentration, red blood cell (RBC) counts, packed cell volume (PCV) and white blood cell (WBC) counts in ossimi rams fed sugar cane bagasse treated with different chemicals in summer and winter seasons.

Treatment	Hb (gm/ 100 ml)	RBC ($X 10^6$ / ml)	WBC ($X 10^3$ / ml)	PCV (%)
Summer	N.S	**	N.S	N.S
Untreated	13.1 ± 0.21 a	7.5±0.44 a	9.6±2.16 a	30.6±0.98 a
NaOH	11.5 ±0.47 a	6.2±0.21 b	7.6±1.17 a	28.4±1.12 a
$NaOH+Ca(OH)_2$	12.6 ±0.40 a	8.3±0.44 c	10.1±0.99 a	29.4±2.26 a
H_4 OH	12.8 ±0.51 a	7.5+0.27 a	7.3±0.75 a	32.5±2.28 a
Winter	N.S	N.S	N.S	**
Untreated	14.5 ±0.57 a	7.6±0.23 a	7.9±0.56 a	39.0±1.17 a
NaOH	14.3 ±0.70 a	6.8±0.61 a	6.8±0.24 a	33.2±0.44 b
$NaOH+Ca(OH)_2$	14.3 ±0.44 a	7.4±0.31 a	7.0±0.22 a	35.3±2.05 c
NH_4OH	14.2 ±0.25 a	7.7±0.28 a	7.6±0.18 a	35.4±.0.82 c
H_2SO_4	14.7 ±0.60 a	7.8±0.43 a	6.9±0.47 a	36.7±1.42 a
Overall means	N.S	**	N.S	**
Untreated	13.9 ±0.41 a	7.7±0.26 a	8.7±0.98 a	35.3±1.64 a
NaOH	13.0 ±0.64 a	6.6±0.18 b	7.1±0.51 a	31.0±0.98 b
$NaOH+Ca (OH)_2$	13.0 ±0.31 a	8.2±0.41 c	8.4±0.69 a	32.7±1.76 a
NH4 OH	13.6 ±0.34 a	7.6±0.19 a	7.4+0.33 a	34.1±1.15 a
Season	**	N.S	*	**
Summer	12.5 ±0.24 a	7.6±0.32 a	8.7±0.70 a	30.2±089 a
Winter	14.1 ±0.26 b	7.5±0.21 a	7.3±0.19 b	35.7±0.75 b

Within columns, treatment means with different letters differ significantly (*: $P < 0.05$; ** : $P < 0.01$, N S : not significant).

3- *Serum total protein, albumin, globulin and glucose*

Chemical treatments of bagasse had no significant effect on serum total protein, albumin and globulin concentrations and albumin/globulin ratio either in summer or in winter (Table 3). However, slightly lower total protein and globulin values were recorded in animals fed on alkali-treated bagasse during winter. Acid treatment caused a slight increase in total prortein and globulin concentration during winter. Similar results were reported by Klimer *et al* (1981) who found that serum total protein, albumin and globulin concentrations in cows were not significantly affected by 0.8% NaOH CO_3 treated corn silage.

TABLE 3. Means (± SE) of serum total proteins, albumin (A) , globulin (G), A/G ratio and serum glucose in Ossimi rams fed sugar cane bagasse treated with different chemicals in summer and winter seasons.

Treatment	Total proteins (gm/100ml)	Albumin (A) (gm/100ml)	Globulin(G) (gm/100ml)	A/G ratio	Glucose (mg/100ml)
Summer	N.S	N.S	N.S	N.S	N.S
Untreated	8.0±0.33 a	4.1±0.06 a	3.9±0.27 a	1.1±0.06 a	47.1±2.18 a
NaOH	8.0±0.40 a	3.8±0.24 a	4.1±0.35 a	1.0±0.11 a	47.5±1.00 a
$NaOH+Ca(OH)_2$	7.9±0.09 a	3.9±0.11 a	4.0±0.13 a	1.0±0.05 a	50.0±1.40 a
NH_4 OH	8.1±0.16 a	4.0±0.17 a	4.1±0.08 a	1.0±0.05 a	50.4±0.70 a
Winter	N.S	N.S	N.S	N.S	N.S
Untreated	7.0±0.25 a	3.2±0.28 a	3.9±0.52 a	0.9±0.21 a	49.0±1.90 a
NaOH	6.9±0.20 a	3.3±0.19 a	3.6±0.27 a	1.0±0.12 a	48.4±1.30 a
$NaOH+Ca(OH)_2$	6.9±0.28 a	3.1±0.15 a	3.8±0.39 a	0.9±0.13 a	50.4±1.50 a
NH_4OH	6.7±0.15 a	3.1±0.15 a	3.6±0.26 a	0.9±0.12 a	50.0±1.60 a
H_2SO_4	7.2±0.20 a	3.1+0.14 a	4.0±0.21 a	0.8±0.09 a	52.0±2.40 a
Overall means	N.S	N.S	N.S	N.S	N.S
Untreated	7.5±0.25 a	3.6±0.22 a	3.9±0.29 a	1.0±0.12 a	48.2±1.38 a
NaOH	7.4±0.27 a	3.5±0.17 a	3.8±0.22 a	1.0±0.07 a	48.0±0.81 a
$NaOH±Ca(OH)_2$	7.3±0.23 a	3.5±0.17 a	3.9±0.22 a	0.9±0.07 a	50.2±0.96 a
NH_4 OH	7.3±0.27 a	3.5±0.19 a	3.8±0.17 a	0.9±0.07 a	50.2±1.10 a
Season	**	**	N.S	N.S	N.S
Summer	8.0±0.12 a	4.0±0.08 a	4.0±0.11 a	1.0±0.03 a	48.8±0.74 a
Winter	6.9±0.11 b	3.2±0.09 b	3.7±0.18 a	0.9±0.07 a	50.5±0.88 a

Within columns, treatment means with different letters differ significantly (*: $P < 0.05$; **: $P < 0.01$, NS : not significant).

The overall means of serum glucose concentration were 48.2, 48.0, 50.2 and 50.2 mg / 100 ml for control, NaOH, NaOH + Ca $(OH)_2$ and NH_4OH treatments, respectively. From these results it can be observed that blood glucose was increased insignificantly in rams fed on bagasse treated with NaOH + Ca $(OH)_2$ and NH_4 OH. Treatment with acid (H_2 SO_4) in winter had similar effect. Maglad *et al.* (1986) found that grounded of nut-hulls treated with 6% NaOH insignificantly increased blood glucose in sheep.

Serum total protein and albumin were significantly higher ($P < 0.01$) during summer than during winter, while globulin was slightly increased during summer. The differnce in mean values of glucose between summer and winter was not significant, but the summer value was slightly lower than that of winter. The increase in plasme total protein levels during hot seasons was reported by other warkers (Gurrini *et al.*, 1982; More *et al.*, 1980). They attributed the variations in total protein to the changes in albumin concentration.

4- *Osmolality, sodium and potassium values in plasma and urine*

Data presented in Table 4 showed no significant variations in plasma osmolality of rams fed on bagasse treated with different chemicals either in summer or in winter. However, plasma osmolality in animals fed untreated bagesse was lower than those fed alkali-treated. In urine, the control animals had significantly ($P < 0.01$) lower values of osmolality in both seasons than those of the NaOH and NaOH + Ca $(OH)_2$ treatments. NH_4 OH treatment during both seasons also increased urine osmolality than the control, but these increases were not significant. Season of year had no significant effect on plasma or urine osmolality.

Plasma Na and K concentreation were not significantly increased in rams fed on bagasse treated with different chemicals during summer and winter, Urinary Na and K concentration were significantly increased ($P < 0.01$) by both NaOH and NaOH + Ca $(OH)_2$ treated bagasse during both seasons. Acid treatment of bagasse in winter induced a significant ($P < 0.01$) decline in urine Na and a significant ($P < 0.01$) increase in urine K in comparison with the control diet. Season of the year had no significant effect on plasma Na and K concentration, but urine Na and K were lower ($P < 0.01$) in summer than in winter. Lamm *et al.* (1979) found that the urinary excretion of Na was significantly higher in lambs fed wastelage treated with 2, 4, 8 and 12% NaOH. Increased excretion of Na and K through urine would contribute to the observed increase in urine osmolality. Probably it is more useful to study the balance of these minerals and their interrelationships rather than measuring urine Na and K concentration alone.

Results of this study provided useful information about using these chemicaly treated feed, and pointed out to the possibility of using these feeds without any adverseeffects on several physiological parameters.

TABLE 4. Means (± SE) of plasma and urine osmolality and sodium and potassium concentrations in Ossimi rams fed sugar cane bagasse treated with different chemicals in summer and winter seasons.

Treatment	Plasma			Urine		
	Osmolality (m.osmol/L)	Sodium (m.mol/L)	potassium (m.mol/L)	Osmolality (m.osmol/L)	sodium (m.mol /L)	Potassium (m.mol /L)
Summer	N.S	N.S	N.S	**	**	**
Untreated	278.0 a ±13.46	135.7 a ±4.98	5.2 a ±0.43	169.0 a ±81.10	5.9 a ±0.34	31.6 a ±3.01
NaOH	305.0 a ±5.63	140.1 a ±1.16	5.7 a ±1.00	803.0 b ±185.85	15.6 b ±2.63	75.9 b ±6.33
$NaOH+Ca(OH)_2$	306.0 a ±5.41	140.1 a ±1.16	6.5 a ±0.73	758.0 b ±170.26	12.9 b ±1.60	73.4 b c ±8.80
NH_4OH	303.0 a ±11.90	137.1 a ±2.32	4.9 a ±0.48	356.0 a ±82.31	5.9 a ±0.44	30.1 a ±6.48
Winter	N.S	N.S	N.S	**	**	**
Untreated	318.0 a ±2.17	135.7 a ±1.96	5.4 a ±0.61	294.0 a ±49.81	8.7 a ±0.95	59.8 a ±8.27
NaOH	324.0 a ±9.54	141.9 a ±0.70	5.6 a ±0.28	714.0 b ±90.90	19.1 b ±0.99	99.1 b c ±5.60
$NaOH+Ca(OH)_2$	322.0 a ±8.18	142.4 a ±0.81	6.4 a ±0.35	678.0 b c ±111.55	17.8 b ±1.40	87.2 d ±3.52
NH_4OH	323.0 a ±9.40	141.1 a ±3.17	6.1 a ±0.46	452.0 a c ±56.26	7.6 a ±1.05	56.3 a ±4.48
H_2SO_4	308.0 a ±4.35	142.2 a ±1.59	6.2 a ±0.40	355.0 a ±97.10	3.9 c ±0.40	79.7 c d ±6.69
Overallmeans	N.S	N.S	N.S	**	**	**
untreated	300.2 a ±8.99	135.7 a ±2.22	5.3 a ±0.37	238.4 a ±47.65	7.5 a ±0.71	47.2 a ±6.71
NaOH	315.4 a ±6.48	141.1 a ±0.70	6.2 a ±0.46	753.1 b ±91.08	17.5 b ±1.35	88.8 b ±5.65
$NaOH±Ca(OH)_2$	315.0 a ±5.66	141.4 a ±0.75	6.4 a ±0.35	713.7 b ±92.11	15.6 b ±1.32	81.1 b ±4.71
NH_4OH	314.0 a ±7.76	139.3 a ±2.05	5.6 a ±0.38	409.3 a ±47.94	6.8 a ±0.65	44.7 a ±5.81
Season	N.S	N.S	N.S	N.S	**	**
Summer	297.9 a ±5.29	138.2 a ±1.38	5.6 a ±0.35	521.2 a ±92.87	10.1 a ±1.30	52.8 a ±6.36
Winter	321.8 a ±3.67	140.3 a ±1.08	6.1 a ±0.23	534.6 a ±5.12	13.3 a ±1.30	75.6 b ±4.92

Within columns, treatment means with different letters differ significantly (*: $P < 0.05$; ** : $P < 0.01$, N.S : not significant).

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بعض الأستجابات الفسيولجية للأغنام المغذاة على مصاصة القصب المعاملة بمواد كيميائية مختلفة

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تم دراسة التغيرات فى بعض المقاييس الفسيولجية للأغنام المغذاه على مصاصة قصب السكر المعاملة بواسطة القواعد والاحماض بغرض رفع قيمتها الغذائية . فى فصل الصيف. غذيت ٤ أغنام على مصاصة قصب غير معاملة أو مصاصة قصب معاملة بأيدروكسيد الصوديوم ٥٪ أو معاملة بأيدروكسيد الصوديوم ٢.٥٪ + أيدروكسيد كالسيوم ٢.٥٪ أو معاملة بأيدروكسيد أمونيوم ٦٪ وذلك باستخدام تصميم المربع اللاتيني ٤x٤ فى فصل

الشتاء تم اعادة نفس التجربة مع اضافة معاملة المصاصة بحمض الكبرتيك ٤ . ٢٪ باستخدام تصميم المربع اللاتيني ٥x٥. المعاملة بالكيماويات كان لها تأثير غير معنوى على كل من درجة حرارة المستقيم المعاملة بالكيماويات كان لها تأثير غير معنوى على كل من درجة حرارة المستقيم ومعدل التنفس وهيموجلوبين الدم وعدد كرات الدم البيضاء والبروتين الكلى والألبيومين والجلوبيولين والجلوكوز فى الدم وكذلك على الضغط الأسموزى للبلازما وقيم كل من الصوديوم والبوتاسيوم بها . أدت المعاملة بأيدروكسيد الصوديوم الى انخفاض معنوى (١٪) فى كل من المكونات الخلوية فى الدم وعدد كرات الدم الحمراء . فصل الصيف أدى الى حدوث نقص معنوى ١٪ فى هيموجلوبين الدم والمكونات الخلوية وقيم كل من الصوديوم والبوتاسيوم فى البول وأيضا الى حدوث زيادة معنوية فى درجة حرارة المستقيم ومعدل التنفس (١٪) وعدد كرات الدم البيضاء (٥٪) وكل من البروتين الكلى والألبيومين (١٪).