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UREA-AMMONIA TOXICITY: 2-SOME HAEMATOLOGICAL AND BIOCHEMICAL INVESTIGATIONS ON LACTULOSE CONCENTRATE TREATMENT

BY

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INTRODUCTION

The toxic effects of urea-ammonia are due to the sudden production of large quantities of ammonia with subsequent development of portal-systemic encephalopathic signs (Elkington et al., 1969 and Bartley et al. 1976). Different metabolic and blood changes were observed in urea-intoxicated animals (Davidovich et al., 1977 and Amin et al., 1980).

Our previous investigation on the treatment of urea-ammonia toxicity indicated that both rumen evacuation and lactulose treatment, unlike acetic acid had a potential effects on the correction of rumen fermentation and lowering the pathologically elevated blood ammonia N (El-Hamamsy et al., 1990). Reported herein are additional haematological and biochemical data.

MATERIALS AND METHODS

Urea-ammonia toxicity and different methods of treatment were investigated on sixteen rumen fistulated adult sheep weighting from 38-42 kg L.B.W. The animals were randomly allocated to three experimental groups (Te, Ta and TI) in addition to a control group (C), four animals each. Each group was subjected to urea-ammonia toxicity and one treatment method.

Toxicity was induced according to the methods described by Bartley et al., (1976). When symptoms of toxicity were defenitive, the first group (Te) was treated by evacuation of the ruminal fluid (Bartly et al., 1976). The second group (Ta) was treated by intraruminal administeration of acetic acid (5% v/v) at the dose rate of 2 mole/mole urea administered (Word et al., 1969). The third group (T1) was treated by intra-ruminal administeration of lactulose concentrate® (65 gm/100 ml) at the dose rate of 2 mole/mole (El-Hamamsy et al., 1990). Survival of animals was the response criterion.

Whole blood and serum samples were collected at the toxic (0-30 min), recovery (6 hours) and convalescent (24-48) phases. The blood samples were subjected to the following determinations: Blood ammonia-N (Conway, 1962 as modified by Davidovich et al., 1977), P.C.V. percent (Wintrob et al., 1976), haemoglobin contents (haemoglobincyanid-method, Van Kampen and Zijlstra, 1961), serum glucose (Werner et al., 1970), serum total protein (Weichselbaum, 1946), serum AST and ALT (Reitman and Frankel, 1957). The appropriate statistical analysis were employed whenever being convenient according to Snedcor & Cochran (1980). The obtained results are shown in Table (1) and figures(1-3).

RESULTS AND DISCUSSION

Before induction of toxicity, the obtained mean values for P.C.V. percent and haemoglobin contents, blood ammonia-N, total protein and glucose, S-AST and S-ALT for the control and test groups are shown in Table (1) and figs, (1-3). Nearly similar results were obtained by Degheidy (1981), Bartley et al., (1976), Kubesy (1986) and Boss et al., (1979) respectively for healthy sheep.

Lactulose concentrate®, supplied from Hek/Stroshein - W. Germany.

After induction of urea-ammonia toxicity, various signs of portal-systemic encephalopathy appeared on animals within 30 minutes (toxic phase). Blood ammonia-N concentrations were significantly ($P > 0.05$) elevated to high levels (Table 1 and figure 1). The increaments were going parallel with the severity of toxic signs. The chance of toxicity was extreemly high when blood ammonia-N concentration exceeded 0.8 mg/100 ml (Bartley et al., 1976). The obtained results were in general agreement with those reported by Word et al., (1969), Webb et al., (1972) and Davidovich et al., (1977).

The toxic signs were accompanied with haemoconcentration as the P.C.V. percent and haemoglobin contents were significantly ($P > 0.01$) increased. Because of the haemoconcentration observed were not accompanied with increased total protein (Table 1 and figure 3) the increased P.C.V. percent and haemoglobin contents may be due to stresses of toxicity and releasing of the stored erythrocytes into the peripheral circulation. Lloyd (1970) reported increased P.C.V. % in sheep and cattle from the time they ingested urea to death.

There was a significant ($P > 0.01$) increase of blood glucose at the time of toxicity (Table 1 and Fig.2). Lloyd (1970) reported severe hyperglycaemia in cattle dying from urea toxicity. Singer (1969) attributed the hyperglycaemia to reduced glucose utilization, due to imbalance in tricarboxylic acid-cycle metabolism, brought about primarily by over loading of the urea cycle and to lesser extent to hepatic glycogenolysis caused by adrenaline release. However, Prior et al., (1971) reported that ammonia will cause refractiveness to insuline resulting in decreased peripheral glucose uptake.

The intoxicated animals showed increased transferase activities as both S-AST and S-ALT enzymes were

Table (1): Urea-ammonia toxicity. Effect of different treatments on PCV, haemaglobin contents, glucose, total protein, S-AST and S-ALT activities.

	Group	Toxic phase		Recovery phase (6h)	Convalescent phase	
		0.m	30.m		24 h	48 h
Ammonia-N mg/100 ml	C	.13±.06	.13±.02*	.14±.01	.13±.06	.14±.03
	Te	.13±.04	1.20±.60	.18±.03*	.14±.05	.13±.02
	Ta	.14±.03	1.04±.08*	1.12±.08	.40±.08	.16±.05
	Tl	.13±.02	1.18±.06*	.16±.06*	.15±.06	.16±.02
P.C.V. %	C	30.0±1.0	29.6±1.7	29.8±0.8	30.1±1.4	30.3±1.2
	Te	29.2±1.6	45.6±1.4*	23.8±1.4*	33.2±1.1	31.8±1.2
	Ta	30.1±1.0	40.2±0.8*	41.1±1.2	40.4±1.0	31.8±0.9
	Tl	30.3±1.4	44.3±1.1*	36.9±1.3*	33.3±0.8	30.7±1.1
Haemoglobin gm/100 ml	C	11.3±.40	11.3±120	11.2±.20	11.0±.10	11.3±.30
	Te	11.2±.25	16.2±.45*	12.5±.27	11.5±.35	11.2±.40
	Ta	11.1±.25	14.8±.30*	14.5±.27	14.5±.58	11.1±.50
	Tl	11.3±.20	16.0±.10*	12.2±.42*	11.8±.40	11.4±.35
T.protein gm/100 ml	C	7.3±.86	7.2±.90	7.3±.50	6.9±.85	7.1±.32
	Te	7.4±.46	7.2±.20	7.3±.68	6.9±.43	7.1±.23
	Ta	7.2±.84	7.2±.70	8.0±.46	7.8±.32	7.2±.38
	Tl	6.9±.82	7.0±.60	7.4±.54	7.3±.65	7.1±.32
Glucose mg/100 ml	C	61.2±1.2	61.5±2.1	62.1±3.2	58.8±1.7	60.1±1.2
	Te	60.8±3.3	97.6±4.2*	75.4±5.8*	68.4±3.3	62.8±4.6
	Ta	58.5±4.2	92.2±5.3*	102.3±8.0	98.3±6.5	63.5±7.2
	Tl	62.6±3.8	104.5±7.1*	80.6±6.2*	65.4±4.2	65.2±4.0
S-AST I.U/L	C	53.1±2.8	53.3±1.2	55.2±3.2	56.1±2.4	55.3±4.2
	Te	51.3±10.5	128.5±8.1*	77.7±5.6*	60.9±6.2	58.6±5.8
	Ta	55.8±5.3	139.2±6.0*	139.6±7.5	108.3±9.6	69.3±6.7
	Tl	58.5±2.5	117.1±8.2*	99.8±7.0*	64.5±5.8	62.8±6.2
S-ALT I.U/L	C	2.8±1.0	2.8±0.8	3.1±0.5	3.0±0.8	3.1±0.2
	Te	2.8±1.1	33.0±1.2*	26.3±1.0	33.0±0.9	3.8±1.1
	Ta	3.0±1.2	28.0±1.0*	33.0±0.8	26.0±0.8	3.5±0.7
	Tl	3.2±0.8	36.0±0.7*	24.3±0.9*	6.2±0.5	3.3±0.3

* Significant differences at ($P > 0.01$).

significantly ($P > 0.01$) increased. Amin et al., (1980) and Rakha (1985) found a significant increase of S-AST in sheep fed rations supplemented with excess urea. The increased activities may be due to a progressive impairment of liver functions because of the overwhelming ammonia intoxication (Lloyd, 1970 and Davidovich et al., 1977).

When the symptoms of urea-ammonia toxicity were definitive, the first group (Te) was treated by evacuation of the ruminal fluids. The second (Ta) and third (T1) groups were treated by intraruminal administeration of acetic acid and lactulose concentrate respectively. The previous investigation on urea - ammonia toxicity (El-Hamamsy et al., 1990) indicated that both rumen evacuation and lactulose concentrate treatment resulted in a decline of the pathologically elevated blood ammonia-N levels. Subsequent rapid improvement associated with more or less normal blood ammonia-N levels were reached during the convalescent phase, (Table 1 and fig. 1) . On the other hand acetic acid treatment was initially accompanid with a decrease of blood ammonia-N in the early recovery phase; yet it was re-elevated to reach a toxic level later. Further administeration of acetic acid did not alleviate the toxicity, and the blood ammonia-N was still significantly ($P > 0.01$) high until rumen evacuation was induced.

As shown in Table (1) and figure (2), the P.C.V. percent, haemoglobin contents and glucose levels were gradually and significantly ($P > 0.01$) decreased after rumen evacuation (Te) and intra-ruminal lactulose administeration (T1). Both treatment methods resulted in abolished toxic stresses with subsequent diminished haemoconcentration and hyperglycaemia. Meanwhile the acetic acid treatment group (Ta) exhibited non significant changes as the P.C.V. percent, haemoglobin contents and blood levels were remaind elevated until rumen fluids were evacuated. The obtained results were in consistent with those reported by

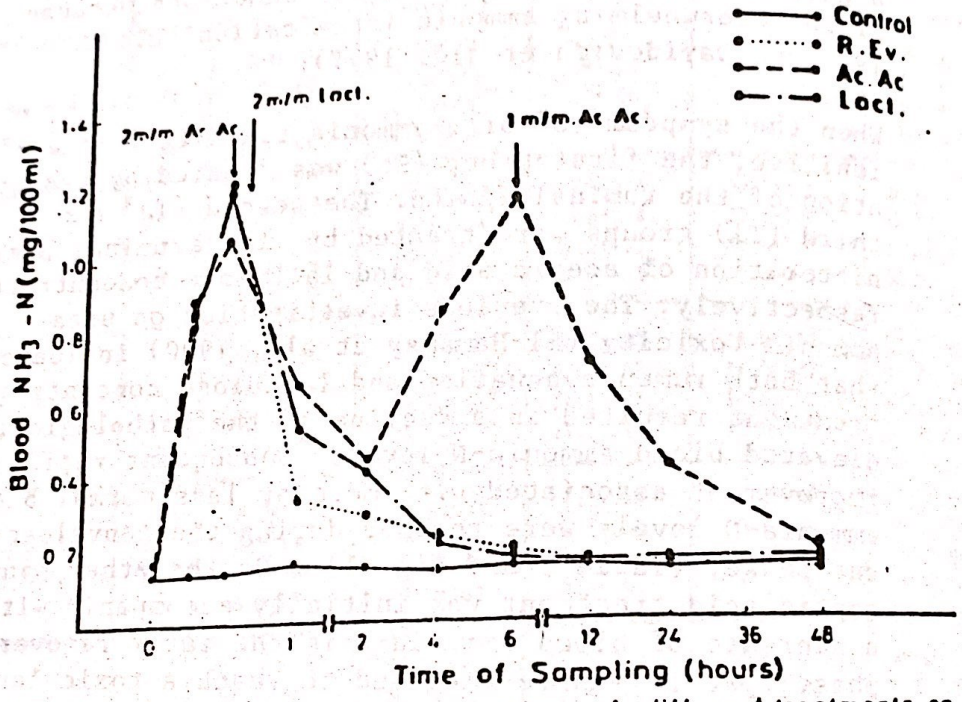

Fig (1) Urea Toxicity in Sheep : effect of different treatments on blood NH_3 -N.

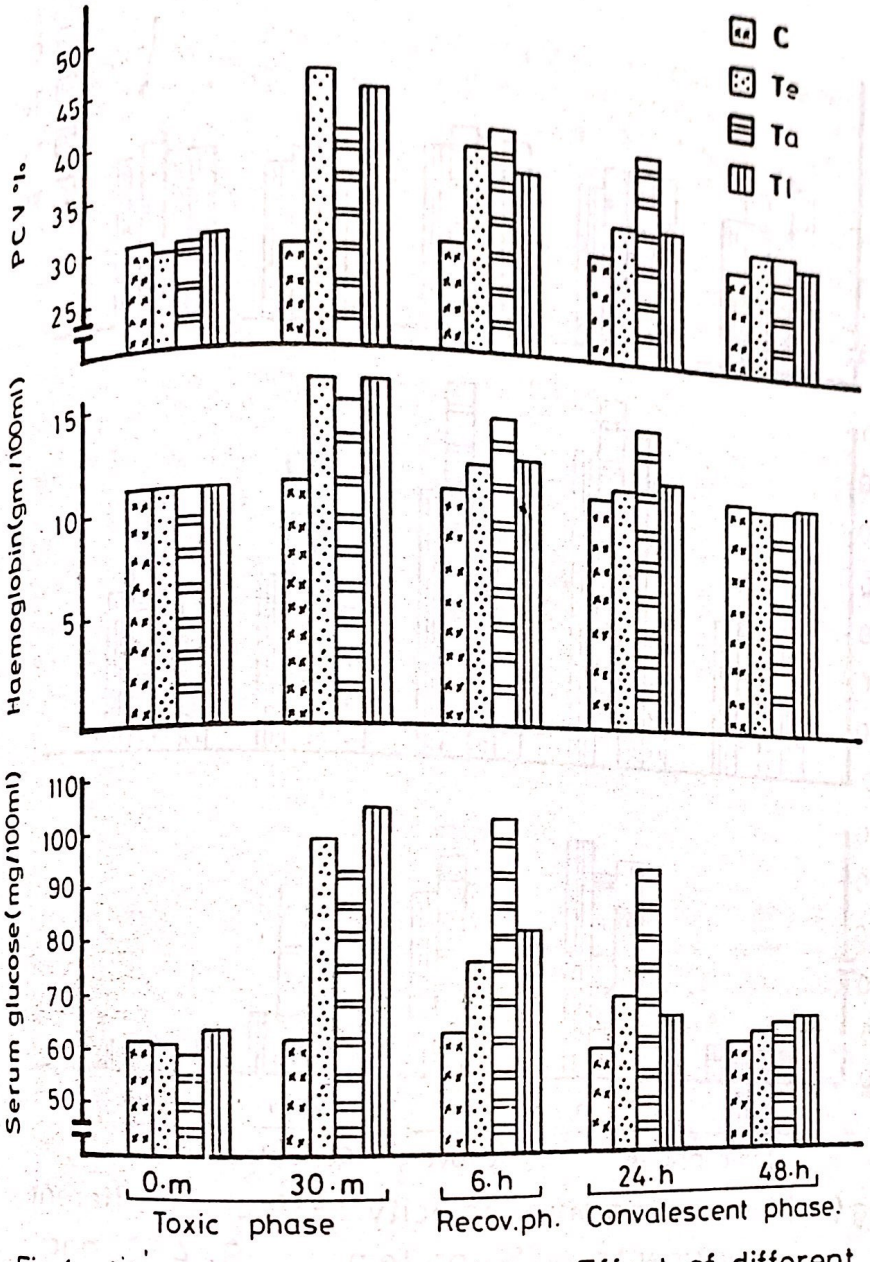

Fig.(2) Urea ammonia toxicity : Effect of different treatments on blood PCV %, haemoglobin contents and serum glucose level .

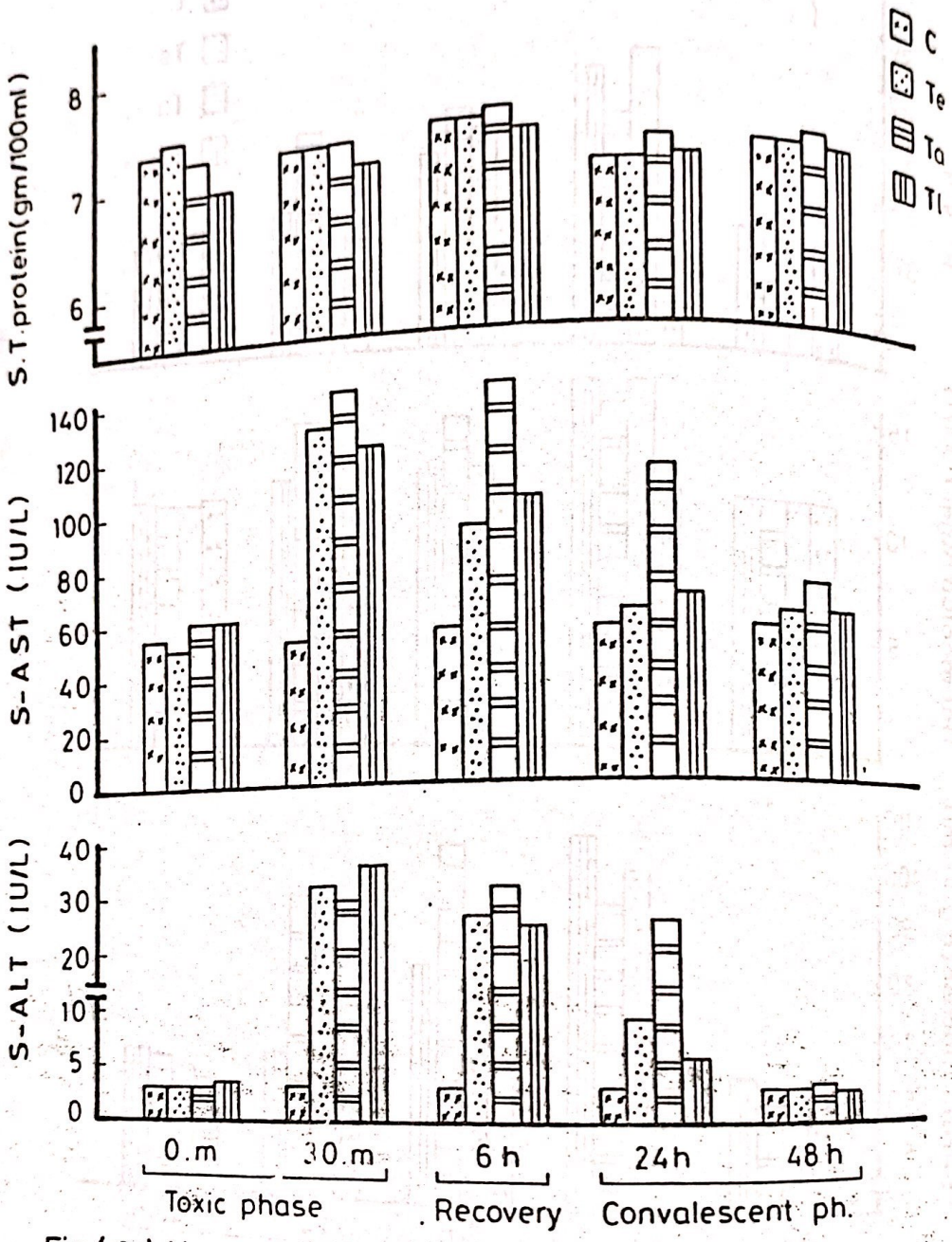

Fig.(3) Urea-ammonia toxicity : Effect of different treatments on S.T.protein , S-AST and S-ALT activities .

Singer (1969), Lloyd (1970) and Davidovich et al., (1977).

As shown in Table (1) and figure (3) the transferas activities S-AST and S-ALT were significantly ($P > 0.01$) decreased in the first and third groups while it decreased only in the second group after rumen evacuation was carried out. Deprssion of the pathological elevated ammonia-N due to either lactulose treatment (Conn and Liberthal, 1977 and El-Hamamsy et al., 1990) or rumen evacuation (Bartley et al., 1976 and Davidovich et al., 1977) may be associated with improvement of hepatic functions.

Our data establish that acute urea-ammonia intoxication provokes definite changes in some blood components and transferase activities. If the intoxicated animals are treated at the onset of symptoms by either rumen evacuation or intera-ruminal administeration of lactulose concentrate, but not acetic acid, these changes can be reversed and the animals can be expected to be clinically recovered.

SUMMARY

Urea-ammonia toxicities were induced in 3 groups of rumen fistulated sheep. The toxic signs were associated with the pathologically elevated blood ammonia-N. The stress of toxicity provokes a significant ($P > 0.01$) increase of P.C.V. percent, haemoglobin contents and blood glucose level. Also there was a significant ($P > 0.01$) increase of the S-AST and S-ALT activities.

Both rumen evacuation and lactulose concentrate administration, but not acetic acid treatment, resulted in a decline of the pathologically elevated blood ammonia-N with subsequent improvement of the intoxicated animals. The changed blood constituents returned to more or less normal values and the animals expected to be clinically recovered.

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