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STUDIES UPON SOME CHEMICAL INDICES IN HORSES AFTER INTOXICATION WITH JIMSON WEED (DATURA STRAMONIUM)

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ABSTRACT

Investigations for monitoring of changes in some blood chemical parameters in horses intoxicated with Jimson weed were carried out. It was established that the intoxication was accompanied by hyperglycaemia, bilirubinaemia, hypoproteinaemia, increased piruvat and activities of ASAT and LDH.
No changes occurred in the albumin, globulin and globulin fractions (α_1, α_2, β_1, β_2 and γ).
The studied blood laboratory parameters returned to normal between post intoxication days 2 and 5.
The data presented could be used in the rapid and correct diagnostics and effective treatment of this intoxication.

Key words: intoxication, Jimson Weed (Datura stramonium), horses, chemical indices.

INTRODUCTION

Jimson Weed (*Datura stramonium*) is an annual plant from the *Solanaceae* family. It is widely distributed in the southern parts of Asia, Europe and North America (1 - 5). In Bulgaria, it is most commonly encountered in maize and sunflower fields as a result of ineffective use of herbicides and inadequate mechanical soil cultivation. More rarely, it could be seen in uncultivated lands, meadows, pastures, alfalfa, cereals (wheat, barley etc.) (6, 7).
The toxins in Jimson Weed are tropane belladonna alkaloids which possess strong anticholinergic properties. They include: hyoscyamine (leaves, roots, seeds), hyoscine (roots); atropine (d,l-hyoscyamine) and scopolamine (l-hyoscine), as well as sitosterol and proteins (1, 3, 5). All parts of the plant are toxic, but the greatest amount of alkaloids are contained in ripe seeds (1, 3, 4, 8). They act as competitive antagonists to acetylcholine at peripheral and central muscarinic receptors at a common binding site (1 - 3, 6 - 8). Poisoning results in widespread paralysis of parasympathetic innervated organs (1 - 8).
The wide distribution, the strong toxicity and the potential for occurrence in foodstuffs are responsible for the numerous incidents in humans (9 - 14).
The cases of Jimson weed intoxication in animals are considerably less frequent – cattle (15, 16), swine (17 - 20), dogs (21, 22), sheep and goats (23) and poultry (3, 24). In horses, poisoning has occurred after ingestion of Jimson weed seeds (25 - 29).
In the literature, the possibility of intoxication after ingestion of silage containing Jimson weed is reported (1, 2, 16), but there are no communications in horses that have consumed the poisonous plant with maize, prior to its silaging.
This motivated our study upon the blood laboratory changes occurring in horses after Jimson weed intoxication with regard to the rapid and correct diagnosis and prognosis and consequently, effective treatment of this intoxication.

MATERIALS AND METHODS

In October 1999, three stallions have been referred to the Clinical of Internal Diseases and Clinical Toxicology to the Faculty of Veterinary Medicine, Stara Zagora. The history revealed that 12–18 hours before, 34 horses owned by the Sport Horse Station of the Faculty of Agriculture to the Trakia University, were fed *ad libitum* with fresh maize, harvested and intended for silaging, with a high content (approximately 50%) of Jimson weed.

All animals that ingested the forage manifested signs of intoxication with a various degree, the animals referred to the clinic being with the most evident clinical symptoms.

The examination in situ showed that the horses were at the age of 3 to 14 years, with a live body weight of 400–600 kg, from various breeds (Trakehner, Hanoverian, Danube, East-Bulgarian, Arabian etc.) and type. The animals were from both genders: 18 mares, 12 stallions and 4 geldings.

Depending on the degree of clinical symptoms, the animals were divided into 3 groups:

Group one (n=18) – horses with typical clinical symptoms: 9 stallions, 1 gelding, 8 mares, 3 of them pregnant.

Group two (n=16) – horses with atypical symptoms: 3 stallions, 3 geldings, 2 pregnant mares, 8 lactating dams (the suckling foals were not included in the group).

Group three (n=18) – horses (owned by the Mounted police), housed in the same premise under similar conditions, but fed another forage, serving as controls.

By days 1, 2, 3, 4, 5, 6 and 7 after the incident, blood was sampled from v. jugularis for determination of: protein fractions (Dade Behring Nephelometer II, Germany), aspartate aminotransferase (AST; U/L), lactate dehydrogenase (LDH; U/L), total bilirubin (TB; μmol/L), direct bilirubin (DB; μmol/L), blood glucose (Glu; mmol/L), total protein (TP; g/L) and albumin (Alb; g/L) on an automated biochemical analyzer (Olympus AU 600, Japan). The globulin concentrations were calculated as albumin subtracted from total protein.

All results were statistically processed using the ANOVA test (Statistica software). The significance of differences was evaluated vs the control group for each time interval. The results were determined as statistically significant at the $p<0.05$ level.

RESULTS

The blood concentrations of glucose (Fig. 1) in horses from group I were elevated from post intoxication days 1 and 4. The peak values of this parameter in both groups were determined one day after Jimson weed ingestion – 9.55±1.21 mmol/L ($P<0.001$) and 7.74±0.81 mmol/L ($P<0.001$) in groups I and II respectively, compared to control values (3.61±0.61 mmol/L).

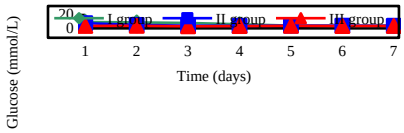

Fig. 1. *Changes in blood glucose concentrations in horses after intoxication with Jimson weed (Datura stramonium) (groups I and II) and controls (group III).* $^{a}p<0.05$; $^{b}p<0.01$; $^{c}p<0.001$.

The total bilirubin (Fig. 2) in intoxicated horses was increased vs controls. In group I the changes took place between days 1 and 5 whereas in group II – up to day 4. The highest values of this parameter in group I occurred by day 3 – 59.2±5.8 μmol/L ($P<0.001$ than controls – 22.8±2.9 μmol/L). In group II, the peak total bilirubin concentrations were observed by day 2: 50.4±6.1 μmol/L ($P<0.001$), compared to controls (24.4±3.6 μmol/L).

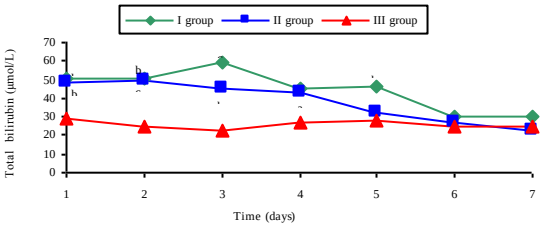

Fig. 2. *Changes in total bilirubin concentrations in horses after intoxication with Jimson weed (Datura stramonium) (groups I and II) and controls (group III).* $^{a}p<0.05$; $^{b}p<0.01$; $^{c}p<0.001$.

The changes in direct bilirubin were similar to those in total bilirubin (Fig. 3) In group I, statistically significant differences were present between days 2 and 5, with highest concentrations by day 3 – 21.2±2.6 μmol/L (P<0.01). In group II the parameter was increased between post intoxication days 2 and 4 with a peak also on the 3rd day – 19.9±2.3 μmol/L (P<0.01), compared to control determinations (9.8±1.0 μmol/L).

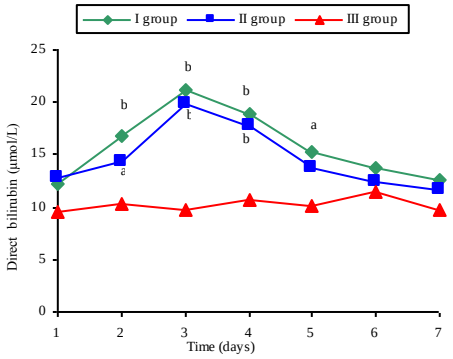

Fig. 3. *Changes in direct bilirubin concentrations in horses after intoxication with Jimson weed (Datura stramonium) (groups I and II) and controls (group III). ap<0.05; bp<0.01; cp<0.001.*

The activity of aspartate aminotransferase (AST) (Fig. 4) was higher from the 1st to the 5th day whereas in group II: only by day 1. The peak activities were measured on the 1st day in both groups – 483±54.2 U/L (P<0.001) and 315±42.8 U/L (P<0.05) in groups I and II, compared to controls (212±18.6 U/L).

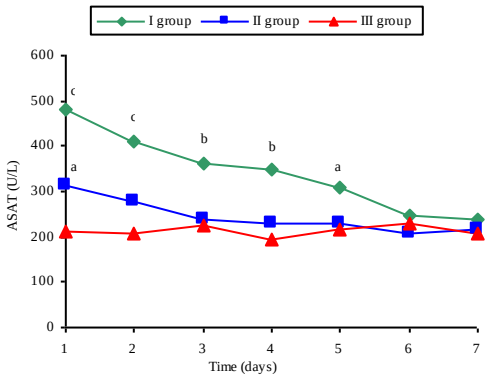

Fig. 4. *Changes blood ASAT activities in horses after intoxication with Jimson weed (Datura stramonium) (groups I and II) and controls (group III). ap<0.05; bp<0.01; cp<0.001.*

The activity of lactate dehydrogenase (Fig. 5) was elevated by days 1 and 2 only in group I. The peak level was measured on day 1 – 515±84.3 U/L (P<0.05 than controls – 288±46.9 U/L).

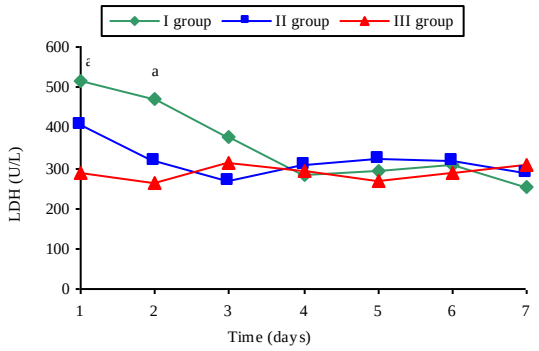

Fig. 5. *Changes blood LDH activities in horses after intoxication with Jimson weed (Datura stramonium) (groups I and II) and controls (group III). ap<0.05; bp<0.01; cp<0.001.*

The pyruvate levels (Fig. 6) in group I were increased between post intoxication days 1and 5. In group II, the changes lasted up to day 2. The peak values in both groups were observed on the first day after the poisoning – 2.02±0.16 μmol/L (p<0.001) and 0.24±0.03 μmol/L (p<0.001) in groups I and II, vs controls (0.064±0.007 μmol/L).

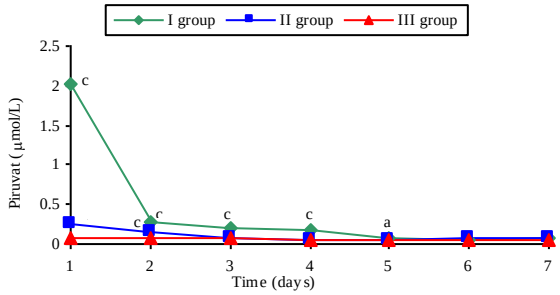

Fig. 6. *Changes in piruvat concentrations in horses after intoxication with Jimson weed (Datura stramonium) (groups I and II) and controls (group III). ap<0.05; bp<0.01; cp<0.001*

Total protein concentrations (Fig. 7) were lower only in horses from group I by days 1 and 2. The lowest levels occurred by day 1: 47.1±2.4 g/L (P<0.01 vs controls – 66.2±4.1 g/L).

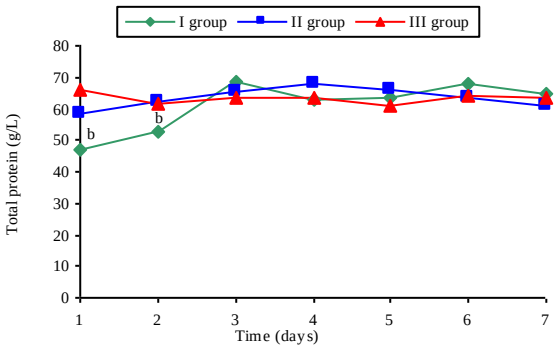

Fig. 7. *Changes in total protein concentrations in horses after intoxication with Jimson weed (Datura stramonium) (groups I and II) and controls (group III).* $^{a}p<0.05$; $^{b}p<0.01$; $^{c}p<0.001$

There were no statistically significant changes in albumin, total globulins and globulin fractions (α_1, α_2, β_1, β_2 and γ) (P>0.05).

DISCUSSION

The blood biochemical analysis revealed increased blood glucose, piruvat, total and direct bilirubin concentrations as well as increased ASAT and LDH activities and reduced total protein levels. These changes corresponded to the observed gross changes in liver parenchyma (4, 10, 11, 16, 20), following Jimson weed intoxication. The observed hyperglycaemia could be due, on one part, to glycogen released by hepatocytes that is metabolized to glucose and on the other, could result from the inhibited function of gastrointestinal glands (1, 6, 7, 10, 25 – 28), including the pancreas, decreasing the production of insulin. A third possible explanation for the observed elevation in blood glucose could be a hyperfunction of adrenal glands following the occurring nervous signs in Jimson weed intoxication in horses, observed by us and others (4, 6, 8, 12, 13, 21, 25 – 27).
These data are similar to reports of other investigators (1, 4, 7, 10, 16, 18, 23, 25 - 27) and support the hepatotoxicity of Jimson weed alkaloids.

CONCLUSIONS

1. The intoxication with Jimson weed (Datura stramonium) in horses is accompanied by Blood biochemical changes consisted in hyperglycaemia, bilirubinaemia, hypoproteinaemia, increased piruvat and activities of ASAT and LDH.
2. The duration and the extent of observed alterations are directly dependent on the consumed amount of Jimson weed and the stage of intoxication. The normalization of parameters after 4-5 days was indicative about the favourable issue of the intoxication.

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