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Effect of arsenic on the total blood cell count of Swiss albino mice

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Abstract : *Mitigating roles of garlic and ascorbic acid on low dose arsenic- induced changes in total blood cell count were investigated in Swiss albino mice. It was found that complete picture of blood was not significantly disturbed by low dose of arsenic. However damage in the soft tissues of digestive tract and uterus were seen. Therefore, it is suggested that water containing even low dose of arsenic should not be consumed. Garlic and ascorbic acid may prove to be protective but only in higher concentration.*

Key words : *Arsenic trioxide, ascorbic acid, garlic extract, blood cell count.*

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Introduction :

Arsenic is a notoriously poisonous element. According to World Health Organization, the permissible limit of arsenic in drinking water is 0.01 mg/l. Recently however it has been reported that arsenic is toxic even at this low and permissible dose (Walker and Fosbury 2009). Arsenic is a carcinogen associated with malignancies of the lung, bladder, skin (Zhao et al 1997), liver, and prostate (Leonard 1990). Arsenic trioxide is used for curing variety of ailments including acute promyelocytic leukemia (APL). Adequate levels of ascorbic acid, in the diet may prevent or reduce occurrence of arsenic induced anaphylaxis (Mayer 1931). Efficacy of garlic extract in reducing clastogenic effects of sodium arsenite has also been reported in the past (Roy Choudhary et al 1996). We selected this topic since data on subchronic toxicity on various parameters of blood are lacking. We also investigated possible amelioration in the arsenic induced toxicity with garlic extract and L- ascorbic acid.

Materials and Methods :

Twenty healthy inbred female Swiss albino mice of same age and same body weight were selected and divided into 4 groups each containing 5 mice. Mice of group A were given normal food

and water and were treated as controls. Mice of group B were administered arsenic trioxide (3mg/Kg bwt/day). This dose is within human lethal dose (1-4 mg/kg body wt) as reported for arsenic (North et al 1997). Mice of group C were administered arsenic trioxide (3mg/Kg bwt/day) and L-ascorbic acid (10mg /Kg body weight). This dose of L-ascorbic acid is quantitatively equivalent to the human therapeutic dose (500 mg/day; Sahu and Das 1994). Mice of group D were administered arsenic trioxide (3mg/Kg bwt/day) and low dose of garlic extract (100 mg/Kg bwt). All the doses were given each day for 15 days through gavages. The aqueous extract of garlic and L-ascorbic acid were administered 30 minutes prior to the As₂O₃ dose administration.

Results and Discussion :

No change in general and feeding behaviour of mice was found.

No significant change in initial (F_{3,19}=2.09, NS) and final weight (F_{3,19}=1.13, NS) and ratio of weight of organs to body weight i.e. liver (F_{3,19}=0.23, NS), kidney (F_{3,19}=1.28, NS) and uterus (F_{3,19}=0.09, NS) were found (Tables 1 and 2).

Table 1. Comparison of initial and final weights (in g) of control and treated mice. Values are Mean±S.E.

	Control	Arsenic treated	Arsenic +Vit. C	Arsenic +garlic
Initial weight (g)	27.7±1.23	28.31±0.94	29.5±0.82	25.38±1.65
Final weight (g)	28.42±1.75	27.38±0.57	28.32±1.07	25.38±1.45

Table 2. Comparison of organ/body weight (in g) ratio of control and experimental mice. Values are Mean±S.E.

GROUP	Liver	Kidney	Uterus
Control	1.5 ± 0.2	0.2 ± 0.01	0.9 ± 0.03
Arsenic treated	1.3 ± 0.1	0.2 ± 0.01	1.0 ± 0.05
Arsenic + Ascorbic acid	1.4 ± 0.2	0.2 ± 0.02	1.1 ± 0.1
Arsenic+ garlic extract	1.3 ± 0.1	0.17 ± 0.01	1.1 ± 0.1

Table 3. Comparison of total and differential WBC count of control and experimental mice. Values are Mean±S.E.

	Control	Arsenic treated	Arsenic +vit.C	Arsenic +garlic extract
Total WBC (/cmm)	5240±75.036	5280±204.02	6060±1038.96	5000±109.84
Lymphocyte count (%)	42.8±1.24	43±1.49	36±3.97	42±2.43
Neutrophil count (%)	54.4±1.29	54±1.38	60±3.96	54.2±1.91
Monocyte count (%)	1.0±0.0	1.4±0.25	1.4±0.25	1.4±0.25
Eosinophil count (%)	1.8±0.38	1.6±0.25	2.6±0.40	2.4±0.40

Table 4. Comparison of Total RBC , platelet and Hb content of control and experimental mice. Values are Mean±S.E.

	Control	Arsenic treated	Arsenic +vit.C	Arsenic +garlic extract
Total RBC (per cu mm)	3.94±0.06	4±0.03	3.68±0.10	3.54±0.34
Platelet (lacs per cu mm)	1.84±0.02	1.86±0.04	1.76±0.05	1.58±0.11
Hb content (gm/L)	12.58±0.15	12.404±0.06	12.188±0.16	10.97±1.15

Complete picture of blood, i.e. total WBC count (F_{3,19}=0.75, NS), lymphocyte count, (F_{3,19}=1.75, NS), neutrophil count (F_{3,19}=1.48, NS), monocyte count (F_{3,19}= 0.88, NS), total RBC count (F_{3,19}=1.48, NS), hemoglobin content (F_{3,19}=1.55, NS) (Table 3 and 4) were not significantly disturbed by low dose of arsenic trioxide probably because it is removed from the blood, metabolized in the liver and excreted with urine (Roy and Saha 2002). However, a significant reduction in the platelet count (F_{3,19}= 4.02, P<0.05) was found in mice concurrently treated with garlic as compared to the arsenic treated mice. Possibly, garlic inhibits adenosine diphosphate (ADP), collagen, arachidonate, epinephrine, and calcium ionophore as well as inhibits the formation of thromboxane, phospholipase and lipooxygenase formed in the platelets (Apitz Castro and Ledezma 1986).

Ameliorative property of L-ascorbic acid leading to the reduction in the platelet count was also evident. However, tumor in the uterine wall was found in 2 mice treated with As_2O_3 . Similarly, the apparent thinning of the intestinal wall was noticed (no further histological studies were made) in three of the arsenic-treated mice. These morphological aberrations might be due to arsenic toxicity, because arsenic distributes to other tissues including the fetus as well (Wang et al 2006).

Conclusion :

The study concluded that low concentration of arsenic trioxide may have no significant side effects on the blood cell count. But it can cause damage to the soft tissues of liver, kidney and possibly haemopoetic tissues. Therefore water containing even low dose of arsenic should not be consumed.

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