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Alteration of gross anatomy of testicles in black Bengal goat reared at the arsenic polluted area in Mymensingh district of Bangladesh

Jahagir Alam[1]*, Mirza Mienur Meher[2], Nure Jannat[3], Shonkor Kumar Das[4], Md. Abdul Awal[4]

[1]Department of Anatomy and Histology, Patuakhali Science and Technology University, Patuakhali, Bangladesh
[2]Department of Microbiology and Public Health, Patuakhali Science and Technology University, Patuakhali, Bangladesh
[3]Department of Anatomy and Histology, Bangabanghu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh
[4]Department of Anatomy and Histology, Bangladesh Agricultural University, Mymensingh, Bangladesh

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***Corresponding Author**

Jahagir Alam
jahangirbau27@gmail.com

ABSTRACT

Arsenic is a major water pollutant that may cause serious health hazards in human and animals. Drinking water is the principal source of arsenic exposure to living individuals. This study was aimed to observe the effects of arsenic on the gross anatomy of testicles in the Black Bengal goat reared at the arsenic prone area in Mymensingh district. Adult male goats were collected from the arsenic prone area of the Ishwarganj Upzilla and arsenic free area of the Nirlakha Char area of Guripur Upzilla of Mymensingh district. Testes were collected for the observation of the effects of arsenic on the gross anatomy of the collected testes of Black Bengal goats. The mean length, width, diameter and weight of the right testes of control group of goats were 5.940 ± 0.044 cm, 3.810 ± 0.041 cm, 9.920 ± 0.015 cm and 36.610 ± 0.068 gm. respectively. The mean length, width, diameter and weight of the right testes of arsenic affected group of goats were 5.880 ± 0.039 cm, 3.770 ± 0.057 cm, 9.920 ± 0.057 cm and 36.540 ± 0.676 gm. respectively. Variations were statistically insignificant ($P<0.05$). These findings indicate that chronic arsenic exposure does not alter the gross anatomy of testes of Black Bengal goat reared at the arsenic polluted area of the Mymesingh district.

INTRODUCTION

Arsenic is a potent environmental persistent toxicant persists in the nature as organic and inorganic form**.** It is a non essential trace element, a potent toxin and mutagen has recently appeared as a major pollutant of drinking water in about most of the district of Bangladesh. Arsenic and its compounds are best known as a deadly poison (ATSDR, 2005). It is ranked first in a list of 20 hazardous substances by the Agency for Toxic Substances and Disease Registry (ATSDR) and United States environmental Protection Agency (US EPA) (Goering et al., 1999). It can participate in oxidation–reduction reactions with species of oxygen like O_2, O_2– and H_2O_2 (Thomas et al., 2001). Arsenobetaine is considered to be the most predominant organo-arsenical in marine animals. Other 2 organo-arsenicals including, arsenocholine $(CH_3)_3$ As+CH_2CH_2(OH), dimethyloxyarsyl-ethanol, trimethylarsonium lactate, arsenic containing sugars and phospholipids have also been found in fish (Lau et al., 1987). It has been used as drugs, and their main use is as pesticides, veterinary drugs, herbicide and rodenticide, desiccant, feed additives and as growth prompter in animals and poultry. Industrial uses of arsenic include doping of solid state devices, laser material; bronzing and smaller amounts are used in the glass and ceramics industries (Friberg et al., 1996; WHO, 1981). A cumulative accumulation of arsenic in surface soils is expected and some recent data suggest arsenic concentration as high as 83 mg/kg in top soil, against a back ground concentration of about 3-9 mg/kg. In general, higher arsenic concentrations have been reported in the top layer of soil (Huq et al., 2003). Arsenates uncouple the formation of adenosine-5-triphosphate, again replacing phosphate and consequently disrupt oxidative phosphorylation in various cell types by substituting for phosphate in the formation of adenosine triphosphate (ATP) (Bhuvaneswaran, 1979; Dixon, 1997). In a recent report (Chakraborti et al., 2010) showed that hand

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tube wells of the tableland and hill tract regions of Bangladesh are primarily free from arsenic contamination while the flood plain and deltaic region including the coastal region are highly contaminated with arsenic. The extent of this environmental disaster is greater than any other recorded in human history. Although the exact time of onset of arsenic exposure in Bangladesh is mysterious, but suspected that it was started during the 1960s and 1970s when government of Bangladesh in collaboration with UNICEF started to install hand-pumped tube wells to provide pathogen-free drinking water to the people (Smith et al., 2000). Arsenic can enter into food chain causing wide spread distribution throughout the plant and animal kingdoms (Kile et al., 2007). Contamination of animal feed by arsenic is a newly uncovered disaster on a massive scale (Sapkota et al., 2007). Food may contribute up to 30-50% of the total dietary intake of arsenic when feed is generated from arsenic contaminated sources (Naidu et al., 2006). Although several research groups have begun to elucidate the effects of arsenic use in animal feed on its environmental concentrations in areas where animal waste has been land applied (Jackson et al., 2006; Stolz et al., 2007). Researchers from the National Institutes of Health and the USDA's Food Safety Inspection Service reported alarmingly high levels of arsenic contamination in the broiler flesh (Lasky et al., 2004). It is assumed that arsenic ingested through chicken pose potential risks to human health. The high arsenic concentrations may have the potential for adverse health effects on the cattle and an increase of arsenic exposure in humans via the plant-animal-human pathway (Abedin et al., 2003). Arsenic accumulation in rice straw at very high levels indicates that feeding cattle with such contaminated straw could be a direct threat for their health and also, indirectly, to human health via presumably contaminated bovine meat and milk. Phosphate application neither showed any significant difference in plant growth and development, nor in as concentrations in plant parts (Abedin et al., 2002). Therefore the goat rearing in this arsenic contaminated area is at risk of arsenic intoxication. This situation may hamper their reproduction capacity as like as previous study revealed decreased sperm motility, low number of sperm in semen and more critically fertilization rate may decrees (Lin et al., 2002). The effects of natural arsenic intoxication on reproductive organs of Black Bengal goat is yet to be studied. Therefore, we investigated into how extent the gonads of Black Bengal goats rearing in the arsenic contaminated areas are affected at gross morphology levels.

MATERIAL AND METHDOS

Ishwarganj Upazilla is considered as most of the arsenic affected areas of Mymensingh district and Nirlakha Char area of the Guripur Upazilla under Mymensingh district was considered as less arsenic contaminated area for the control group of Goats. The goats had no developmental anomalies and detectable diseases that would cause any problem in the morphology and physiology of the testicles. A total of 12 adult male Black Bengal goats were used in this investigation. Among these, 6 goats were collected from Ishwarganj upazilla of the Mymensingh district as a targeted affected group and the rest 6 were from the Nirlakha Char area as a control group. Right testes were removed from the goats immediately after killing the animals using conventional animal killing methods followed in the laboratory of the Department of Anatomy and Histology, Bangladesh Agricultural University, Mymensigh. Gross morphology of testis was observed carefully. The length, width and diameter of testis were taken using measuring scale and weight of the testes was taken using electric balance. The results were recorded and analyzed for drawing the effects of arsenic on the gross anatomy of the testes in the Black Bengal goat reared at the arsenic prone area of Mymensing District. The data were collected and result was expressed as mean±SD.

RESULTS AND DISSCUSSION

Testes are principal reproductive organs in the male species within which spermatogenesis takes place. The number of spermatogenic cell, nursing cell, normal size and shape of the spermatogenic cell, life span of different developmental stage of spermatogenic cell are the experimental interest. In the present study, the effects of natural arsenic intoxication on reproductive organs have been studied. We observed insignificant variations ($P<0.05$) in length, width, diameter and weight of testes of goats from arsenic affected areas as compared to control goats. The difference in the weight including color and shape of testes between arsenic affected goats and control goats was also insignificant (P<0.05).

Effect on length, width, diameter and weight of testes

The mean length of left testes of the control group of goat was 5.940 ± 0.044 cm whereas the mean length of left testes of arsenic affected goat was 5.880 ± 0.039 cm. The mean width of the left testes of the control group of goat was 3.810 ± 0.041 cm but the mean width of the left testes of arsenic affected goat was 3.770 ± 0.057 cm. The diameter of the left testes of control group of goat was 9.750 ± 0.015 cm whereas the diameter of the left testes of arsenic affected group of goat was 9.920 ± 0.027 cm. The mean weight of the left testes of the control group of goat was 36.610 ± 0.068 gm and the mean weight of the left testes of arsenic affected group of goat was 35.540 ± 0.676 gm. The differences between mean length, width, diameter and weight of testis of control and arsenic affected group of goats were statistically insignificant (Table 1).

Table1
Comparison of mean length, width, diameter and weight of testis of control and arsenic affected group of goats.

Testes Parameters	Control	Arsenic affected	Interpre-tation
Length (cm)	5.940 ± 0.044	5.880 ± 0.039	NS
Width (cm)	3.810 ± 0.041	3.770 ± 0.057	NS
Diameter (cm)	9.750 ± 0.015	9.920 ± 0.027	NS
Weight (gm)	36.610 ± 0.068	35.540 ± 0.676	NS

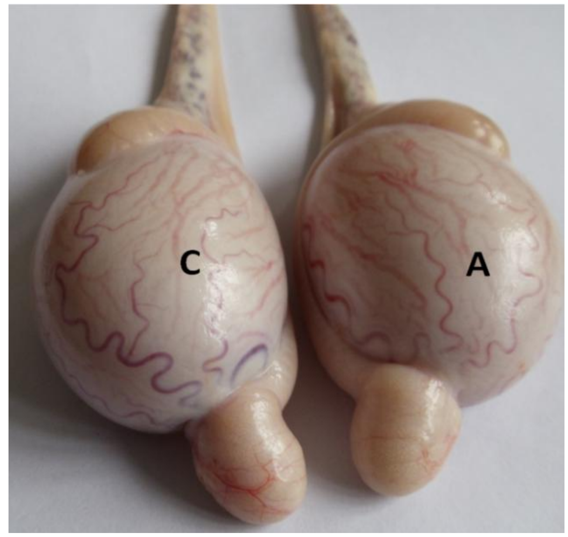

Figure 1
Testes of control group (C) and arsenic affected group (A) of Black Bengal goat.

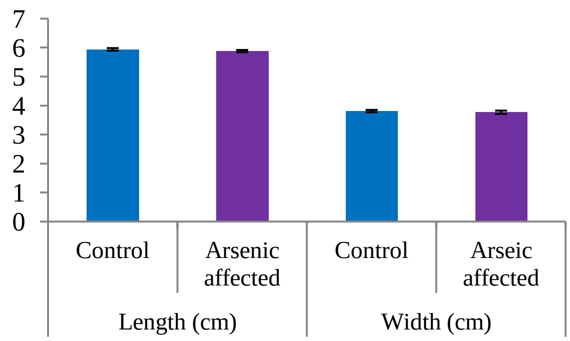

Figure 2
Graphical representation of the effects of arsenic on the length and width of testicles compared to control group (Error bar represent standard deviation of mean).

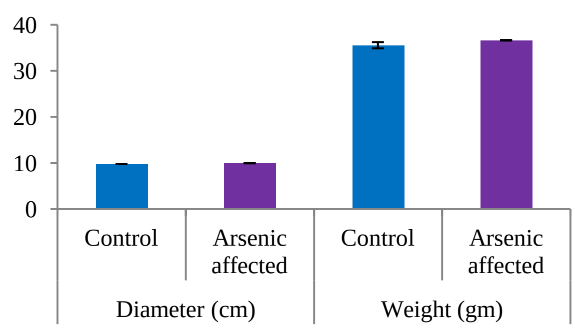

Figure 3
Graphical representation of the effects of arsenic on the diameter and weight of testicles compared

to control group (Error bar represent standard deviation of mean).

CONCLUSION

Environmental pollutants can adversely affect animal health and reproductive function, through either direct or indirect effects on numerous organs and systems. However, empirical evidence of the relationships between exposure and physiological effects is scarce, particularly for goats reflecting the fact that levels of exposure to arsenic are generally very low and they do not act individually. At this time, effects of environmentally relevant levels of exposure to arsenic are not yet reflected in visibly reduced animal performance. Nevertheless, concerns remain that there may be subtle perturbations of reproductive function and since some of the observed changes in physiological function may be expressed in subsequent generations, even without further exposure to pollutants, there may be even greater cause for concern. It is postulated that comparable deleterious effects on ruminants may also be present but until appropriate end points are recognized and measured, such potential threats may remain hide. Chronic arsenic exposure has detrimental effects on histoarchitecture of the testes in the Black Bengal goats, suggesting that arsenic may have negative impact on fertility which ultimately may exert threat on the livelihood of marginal farmers. Analyses of the large numbers of samples and wide ranges of contamination along with role of green grasses in reducing effects of arsenicosis are suggested.

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