

Agave americana* (Ketuke) toxicity in the kidney of *Clarias batrachus

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ABSTRACT

Different parts of plant have been used since many decades by humans for catching fishes. In this investigation, 'ketuke' leaf effect was observed on behavioural change and histological alterations in the kidney of *Clarias batrachus*. Few fishes were kept as control i.e. not exposed to plant piscicide. The other fishes were exposed to 3gm per 30 liters of water for 24 and 48 hrs. In exposed fishes restlessness, vigorous movement, excessive secretion of slime and loss of appetite was seen. Histologically, glomerular contraction, clumping of melanomacrophages, degeneration of epithelial tissue along with the degeneration of renal tubules and others were seen. Increase in the Bowman's space was one of the noticeable change. Extract accumulation was seen in the tissues. Exposure to sublethal concentrations of Ketuke (*Agave americana*), caused duration dependent histopathological alterations in the kidney of *Clarias batrachus* which is discussed in the paper.

Keywords: kidney, piscicide, glomerulus, renal, clumping

INTRODUCTION

Other than toxic chemicals, varieties of plant poisons have been used traditionally for catching the fish (Karki & Rai, 1982). Different species of the plants have found to be used by hunters to stun fishes like *Trifolium*, *Nicotiana*, *Sapium*, *Agave* etc (Van-Andel, 2000; Shrestha, 2008; Agbor & Okoi, 2014). *Agave americana* is a native plant from Mexico which is popular by 'Ketuke' in Nepal. It grows in semi-arid environments from the sea level to an altitude of about 9000 feet (Karki & Rai, 1982). Local people use its fleshy leaves in the body of both confined and flowing water in order to paralyze the fish only after grinding. The juice of more virulent Agaves has been used as fish poison and arrow poison (Dimmit, 2003).

Kidney is one of the important organs of any vertebrate working for the elimination of nitrogenous wastes from the body helping in the regulation of body fluid and electrolyte balance of animals (Khanna, 1996). Any abnormality in the kidney produces overall change in the body function. The present study is focused to see the effect of *Agave americana* or 'Ketuke' on the kidney histology of *Clarias batrachus*.

MATERIALS AND METHODS

A. americana leaves were procured from Tribhuvan University, Kirtipur premises. It was made into powder after cutting and air drying. *C. batrachus* (250±5 gm and 30 cm) was bought from Kalimati, Kathmandu fish market and acclimatized for 15 days in Central Department of

Zoology, Kirtipur laboratory. Aquarium was set for control and treatment, each with ten fishes. Fishes were fed with protein diet (liver of chicken) and herbal extract each day. Lc50 was calculated to be 4.5 gm /30 l water. Therefore the dose experimented during the study was 3 gm per 30 liter of water- a sub lethal dose for 24, 48 hours. Fishes were sacrificed and the kidney were fixed in Bouin's solution for histological study. Double staining was used to study the slides.

RESULTS AND DISCUSSION

In control fishes movement and feeding was normal with normal slime secretion. While in 24 hours treatment, they showed restless and vigorous movement with secretion of more slime. The food intake was reduced as more of feed was seen left in the aquariums. In 48 hours treated fish erratic movement, loss of balance with excess secretion of slime was seen within five minutes. The feeding was slower than those of 24 hours treated fish after 30 minutes of treatment. In control fishes, glomerulus were the central rounded compact mass of numerous mesangial cells, surrounded by the tufts of glomerular capillaries. Bowman's capsule contained thin squamous epithelium with an outer peritoneal and inner visceral layer (fig. 1, 2). In 24 hours treatment, the number of melanomacrophages increased and clumping of it started. Degeneration in renal tubules and pseudostratified epithelial cells was seen. Large collecting ducts were enlarged. Vacuolar/hydropic degeneration and fibrosis appeared. Toxin accumulation on the tissues was seen (fig. 3, 4). In 48 hours, mild degenerative changes in the renal tubules was observed. Epithelial cells were detached, contraction of glomerulus was clear and Bowman's capsule space increased. Variable sized glomeruli appeared. Necrotic changes in the proximal convoluted tubule appeared (fig. 5, 6).

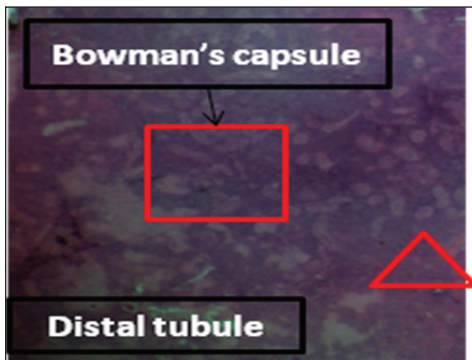


FIG. 1
Control condition (without treatment) x 400.

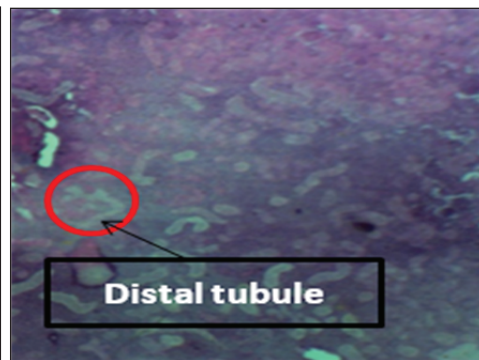


FIG.2

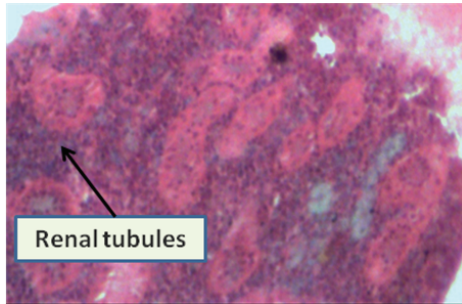


FIG. 3

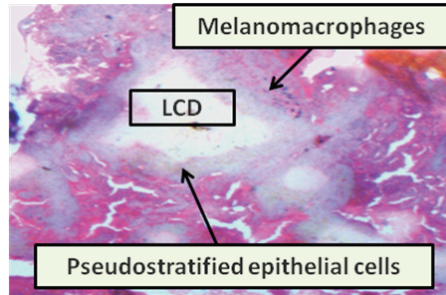


FIG. 4

After 24 hours treatment with *Agave americana* x 400.

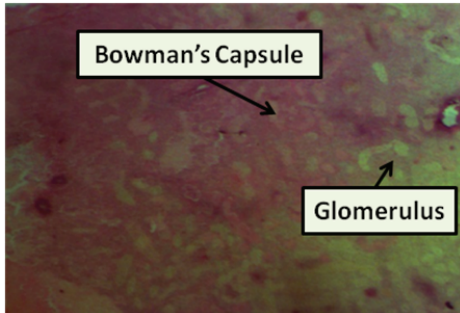


FIG. 5

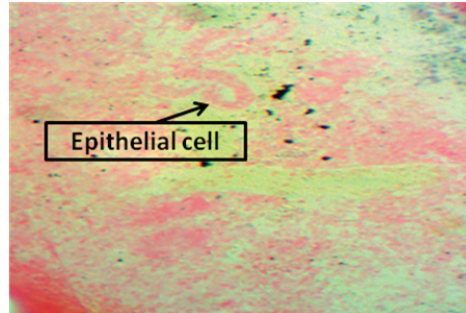


FIG. 6

After 48 hours treatment with *Agave americana* x 400.

In present study kidney with cloudy swelling in tubule cells was found. Veiga *et al.* (2002) found swollen Bowman's capsule cells and melanomacrophages in the kidney of fishes exposed to organic contaminants. The kidney is a major site for toxic effects due to a wide variety of environmental pollutants (Foulkes & Hammond, 1975; Hook, 1980, Ongo, 2002). After 48 hours exposure, the number of renal tubules were increased to overcome the toxicity. Cormier *et al.* (1995) reported the increase in the frequency of new nephrons and regenerated tubules, during the process of the recovery of the damaged kidney in fish. In present study, the glomeruli were thickening with increase in glomerular space and condensation of Bowman's capsule. Sharma & Gautam (1978) also observed necrosis in glomeruli and tubules of sheep infected with experimental toxoplasmosis. Similar results had been reported by Ahmad (2011) in *Clarias batrachus* exposed to cadmium chloride. The disorganization in this vital organ kidney might have resulted in physiologic and metabolic dysregulations, which further led to behavioral alterations, indicates that there might be some biochemical/hormonal disorders. In the long run, therefore, Ketuke exposures to even sub lethal concentrations may pose serious threat to fish health if used haphazardly. Further research is needed to define the roles of herbal pesticide in relation to human health when ingested through fish, indirectly, as it showed bioaccumulation. Further research is recommended to have the best utilization of *Agave americana* (Ketuke) which is known to have three main uses ornamental, medicinal and agricultural.

REFERENCES

- AGBOR, R B; OKOI, E P (2014) The early life toxicity of Godogbo (*Adenia cissampeloides*) stem against catfish juveniles. *Researcher* 6(9): 17–19. Doi: 10.7537/marsrsj060914.03. Available at <http://www.sciencepub.net/researcher>.
- AHMAD, B; QURESHI, T A; MANOHA, S; KAUR, P; KHALIQ, R (2011) Effect of cadmium chloride on the histoarchitecture of liver and kidney of freshwater catfish, *Clarias batrachus*. *International journal of environment science* 2: 531–536.
- CORMIER, S M; NEIHEISEL, T W; WERSING, P R; RACINE, N; REIMSCHUESSEL, R (1995) New nephron development in fish from polluted waters, a possible biomarker, *Ecotoxicology* 4: 157–168.
- DIMMIT, M A (2003) A natural history of Sonoran desert. Arizona-Sonora Desert Museum Press; Tucson, AZ, USA; 590 pp.
- FOULKES, E C; HAMMOND, P B (1975) Toxicology of the kidney, *Toxicology: the basic science of poisons*. MacMillan, New York, USA; pp 190–200.
- HOOK J. B. (1980): Toxic responses of the kidney. In DULL, J; KLAASSEN, C D; AMDUR, M O (eds) *Casarett and Dull's toxicology: the basic science of the poisons*. MacMillan; New York, USA; 232–245.
- KARKI, K B; RAI, A K (1982) Observation on the effectiveness of some local plants used as fish poison. Proceedings of first National Science and Technology Congress, Kirtipur, Kathmandu, Nepal; 2: 270–274.
- KHANNA, S S (1996) An introduction to fishes. Central Book Department. Indian University Press, Allahabad, India; pp 96–300.
- ONGO, J S (2002) Fish poison use in the Americas..Available at: <http://www.survival.com/fish.htm>.
- SHARMA, S P; GAUTAM, O P (1978) Studies on some aspect of pathogenesis of experimental toxoplasmosis in sheep. *Arch. Vet.* 13: 117–25.
- SHRESTHA, T K (2008) Ichthyology of Nepal, a study of fishes of the Himalayan waters. Himalayan Ecosphere, Kathmandu, Nepal; pp 1–6.
- VAN-ANDEL, T (2000) The diverse use of fish poison in north west Guyana. *Economic Botany* 54 (4): 500–512.
- VEIGA, M L; RODRIGUES, E L; PACHECO, F J; RANZANI-PAIVA, M J T (2002) Histopathologic changes in the kidney tissue of *Prochilodus lineatus*, 1836 (Characiformes, Prochilodontidae) induced by sub lethal concentration of Trichlorfon exposure. *Brazilian Archives of Biology and Technology* 45: 171–75.