

Role of Abiotic Factors and Plant Molluscicides against Reproduction of Snail



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Received: 📅 May 13, 2018; Published: 📅 May 17, 2018

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Abstract

The snail *Lymnaea acuminata* is the intermediate host of liver fluke *Fasciola gigantica* which causes endemic fasciolosis in cattle as well as human population of Eastern Uttar Pradesh. Snail control with plant molluscicides has been one of the effective methods used for rapid and effective control of Fasciolosis. Toxicity of active molluscicidal component present in them are more potent than their synthetic counterpart. The metabolic activity of invertebrates is influenced to a large extent by change in both biotic and abiotic factors, which mainly depends on the season. These abiotic factors and bait containing plant molluscicides can significantly alter the biochemical parameters and ultimately the reproduction rate and developmental process of snail *Lymnaea acuminata* seasonally.

Keywords: Molluscicides; CDCs; Abiotic factors; Reproduction; AChE

Introduction

The snails of lymneidae and planorbidae family are the intermediate host of *Fasciola* spp. which causes endemic fasciolosis in cattle as well as in human population [1]. The reproduction of snails is continuous throughout year and under favourable condition is very high; an estimated one viable snail may produce one million snails within two months [2]. Reduction of snail population below a threshold level reduces the infection rate of parasite *Fasciola* because the snails represent weakest link of lifecycle [3]. Molluscicides release in to the snail habitat in different seasons will have different impact on snail mortality [4]. The impact of environment on these molluscicides may be positive or negative [5]. Positive impact may increase the toxicity of molluscicides and negative impact of environment may reduce the effectiveness of molluscicides [6]. In the present review I have summarize the molluscicidal activity of certain plant molluscicides viz. papain, piperine and eugenol against snail *Lymnaea acuminata* in each month of the year Nov- 2011 to Oct-2012. The WHO has tested several thousands of synthetic compounds for the control of the snail host. Several limitations are experienced in mixing the synthetic molluscicide with water in which the snails live.

Plant derived molluscicides

Snail control with plant molluscicides has been one of the effective methods used for rapid and effective control of Fasciolosis [7]. Plant molluscicides are gaining wide attention because they are effective, cheaper, safer to non-target organism, easier to handle and environmentally acceptable [8]. Natural products especially plants contain compounds lethal to pestiferous gastropods [9]. Toxicity of active molluscicidal component present in them are more potent than their synthetic counterpart [10]. Use of these plant products against harmful snails has the additional advantage as they are easily biodegradable, ecologically sound and more acceptable to the native farmers and live-stock keepers [7].

Role of abiotic factors

The metabolic activity of invertebrates is influenced to a large extent by change in both biotic and abiotic factors, which mainly depends on the season [5]. Srivastava et al. [11] [reported that the effect of plant molluscicides and abiotic factors (temperature/ pH/ DO/ CO₂) on the reproduction of *Lymnaea acuminata* and correlate the change of metabolic activity of snails. Plant derived molluscicides

(papain, piperine and eugenol) are nerve poison and trigger the CDC cells [12]. The CDC cells in brain of the snail control egg laying [13]. Thus the endogenous levels of biochemical parameters (protein, amino acids, and nucleic acids) and acetylcholinesterase activity in snails were measured with treatment of sublethal doses of plant molluscicides. Studies clearly indicates that use of plant molluscicides has great potential in reducing the reproduction rate of snail *L. acuminata* and caused significant change in protein, amino acids, nucleic acids when compared with control. The seasonal fluctuations caused inhibition of protein Kinase A and C in neuroendocrine cells of *Aplysia californica*. It is paly a significant role in regulation of egg laying hormone [14]. Wayne et al. [15] reported that cAMP and diacylglycerol second messenger pathways are regulated on a seasonal basis. Variation in fecundity in snail fed to bait formulations of papain in present study may be due to regulated by cAMP/ diacylglycerol. The essential metabolic activity is Dissolved oxygen required by snails [4]. At higher temperature the increasing rate of snail's metabolism caused high release of CO₂, which affects the pH of water. This was evident from the elevated concentration of CO₂ and decrease in pH of water in summer season [16]. Srivastava et al. [11] reported that there was positive correlation between feeding of bait formulations containing plant derived molluscicides and different abiotic factors (temperature/ pH/ dissolved O₂/ CO₂) of water. It indicates that the effect of drugs in aquatic medium is significantly altered with seasonal variation in abiotic factors. It may be possible that there was a cumulative effect of these abiotic factors on the level of protein, amino acids and nucleic acids in ovotestis of *L. acuminata*. These effects may be direct/or indirect through caudo dorsal cells (CDC_s). Caudo dorsal cells release ovulation hormone and may affect the reproduction process of snails seasonally [13,17]. The reduction in protein and amino acids levels may be due to indirect interference of the environmental abiotic factors with protein synthesis or due to direct interference of plant molluscicides [18]. The synthesis of protein in any of a tissue can be affected by two ways; firstly, it either affects the RNA synthesis at the transcription stage, or secondly it affects the uptake of amino acids in the polypeptide chain. Both these possibilities may account for the lower protein content in the affected tissue. In the first case, the RNA synthesis would be inhibited resulting in reduced RNA as well protein content. In the second case, only the protein content would be affected. In the present study there is a significant reduction in nucleic acid/protein/amino acids in ovotestis of snails. It indicates that *Carica papaya* (papain) affects the protein synthesis at transcriptional level. pH is one of the crucial environmental factor that have significant effect on number of enzymes involved in protein synthesis [6]. Change in the level of DNA and RNA in ovotestis of *L. acuminata* were significantly influenced by the water temperature. Instead of it reduction in amino acids level in ovotestis also indicates that amino acid pool was affected as there was reduction in amino acid synthesis. If it hit protein synthesis at

translation level there must be higher amino acid in ovotestis. The synthesis of DNA and RNA are influenced by the intracellular pH physiological range. The activity increases with increasing pH from 7.0-8.0 [19]. The process of cellular growth and divisions requires the synthesis of nucleic acids and protein. Increase in pH from 7-8 caused a significant increase in DNA and protein level in ovotestis of *L. acuminata* [17]. Acetylcholinesterase plays a significant role in nerve conduction process at myoneutral junction of nerve ending of muscle tissue. Plant molluscicides caused a significant inhibition of AChE activity in the nervous tissue of *L. acuminata*. Inhibition of acetylcholinesterase results in accumulation of AChE at the nerve synapses so that the post- synaptic membrane is in a state of permanent stimulation. Resulting paralysis, ataxia and general lack of coordination in neuromuscular system and finally death [19]. Srivastava and Singh [18] reported that there was a significant positive correlation between the AChE activity and the fecundity of snail. It indicates that the reproduction rate of snails up to some extent is mediated through cholinergic stimuli in the brain of snail.

Conclusion

In conclusion, it can be stated that different abiotic factors temp/ pH/ DO/ CO₂ concentration in the aquatic environment vary with seasonal variation in each month of the year and affect the reproduction of snail. These abiotic factors and bait containing plant molluscicides can significantly alter the biochemical parameters and ultimately the reproduction rate and developmental process of snail *Lymnaea acuminata* seasonally. The picture emerges from this study conclusively stated that rainy season is most suitable period for the control of the snail at threshold level which ultimately reduce the infection rate of parasite.

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DOI: [10.32474/OAJBEB.2018.02.000140](https://doi.org/10.32474/OAJBEB.2018.02.000140)



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