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EFFECT OF SODIUM HYDROXYMETHANESULFONATE ON AMMONIA AND RELATED WATER QUALITY PARAMETERS

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Abstract:

A Sodium Hydroxymethanesulfonate product (ClorAm-X®, AquaScience Research Group Inc., USA) was used in water from a recirculating holding system tank after 8 days Channel Catfish holding experiment with Total ammonia nitrogen (TAN) 15.8 mg/L. Three treatments; T1-50% the recommended dose (15.95 mg/L of ClorAm-X® for 1mg/L of total ammonia), T2-recommended dose (31.9 mg/L of ClorAm-X® for 1mg/L of total ammonia) and T3-150% of recommended dose (47.85 mg/L of ClorAm-X® for 1mg/L of total ammonia) were applied in 10 liters of water, each with three replications. Three replications of control without ClorAm-X® application were also used. 30 minutes post application, TAN, Nitrite, Nitrate, unionized ammonia and pH were measured using HACH® kits, spectrophotometer and pH meter.

Results show that the product is effective in reducing TAN and unionized ammonia in concentration dependent manner. Nitrite and pH were not affected by treatments but nitrate increases slightly with increasing dose of ClorAm-X®. Increase of nitrate may be of concern only in seriously heavy doses of the product. Thus, Sodium Hydroxymethanesulfonate can be used in reducing ammonia content in recirculating holding systems where ammonia buildup is one of concern.

Keywords: TAN, ClorAm-X, Nitrate, Spectrophotometer

Introduction:

Fish can assimilate high protein diet and commercial aquaculture practice involves feeding high protein diet to ensure optimum growth within desired time frame. They excrete ammonia as nitrogenous waste of metabolism in water that can accumulate to a level that becomes threat to the proper growth and survival of the fish in an aquaculture system. Ammonia buildup; in aquarium, recirculating aquaculture systems (RAS) for holding/production and in hauling tanks and shipping bags/boxes of fish during transportation is a concern. Measures like; bio filters, water exchange, low stocking of fish, reduced feeding, keeping lower pH, high dissolved oxygen and adding ammonia neutralizer, are common ways to manage ammonia in aquaculture system. Each strategy mentioned has its own limitation of efficacy and applicability. Sodium Hydroxymethanesulfonate is a reducing agent that reacts with free/unionized ammonia producing an aminomethanesulfonate salt which is non-toxic and can be metabolized by nitrification bacteria. (Watson et al. 2010). In this experiment, investigators evaluated a Sodium Hydroxymethanesulfonate product (ClorAm-

X®, AquaScience Research Group Inc., USA) for removal of ammonia and effects on related water quality parameters in a non-fed, short term, recirculating holding system.

Objectives:

1. Determine dose dependent treatment effect of ClorAm-X® on ammonia, nitrate, nitrite and pH of the water sample.
2. Evaluate the relationship of ammonia, nitrate, nitrite and pH according to different treatments.

Materials and Methodology:

Materials used: Water from a recirculating holding system tank after 8 days Channel Catfish holding experiment, 12 plastic buckets, ClorAm-X® powder, 12 Sampling plastic bottles, Low range ammonia kit, High range nitrite kit and Low range nitrate kit from HACH®, DR 3900 Spectrophotometer from HACH®, pH meter.

Methodology: Water from holding tank number 4 was taken as it contained highest ammonia level among other tanks after a holding experiment with Channel Catfish.

Following are the initials;

TAN: 15.8 mg/L

Nitrite: 1.53 mg/L

Nitrate: 1.24 mg/L

Temperature: 15.1 °C

Dissolved Oxygen: 11.10 mg/L

Conductivity: 7.1 ms

pH: 7.69

Alkalinity: 197

Turbidity: 1.75 NTU.

The experiment involved 3 treatments and a control each with 3 replications in plastic buckets filled with 10 liters (22 lbs.) of water from tank 4 as follows;

T1: 50% of the recommended dose

T2: Recommended dose

T3: 150% of the recommended dose

Control: No ClorAm-X®

Calculation of Required dose of ClorAm-X®:

TAN: 15.8 mg/L

As, for each 1mg/L of total ammonia 31.9 mg of ClorAm-X® is suggested; so for 22 lb=10 liters water per bucket we need;

T1: 2520.1 mg

T2: $15.8 \times 31.9 \times 10 = 5040.2$ mg

T3: 7560.3 mg

ClorAm-X® was added to each 10 liters of water in bucket from tank 4 as three treatment doses each with three replications. Total 9 buckets of treatment and 3 buckets were control. These were left for 30 minutes and after 30 minutes, samples in plastic bottles with lid, were taken for analysis.

HACH® Test kits were used for Ammonia: Low range, Nitrite: High range, Nitrate: Low range. DR 3900 spectrophotometer from HACH® was used to read the concentration of each parameter in samples. After measuring pH and temperature; proportion of unionized ammonia in total ammonia was calculated using factor from the table (Emerson et al. 1975). Each data were put into excel for further analysis.

Chemical reaction between ammonia and ClorAm-X®:

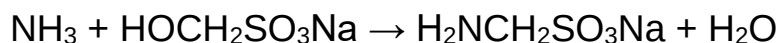


Fig 1: Treatment buckets (white) and Control buckets (blue) each with 10 liters of water

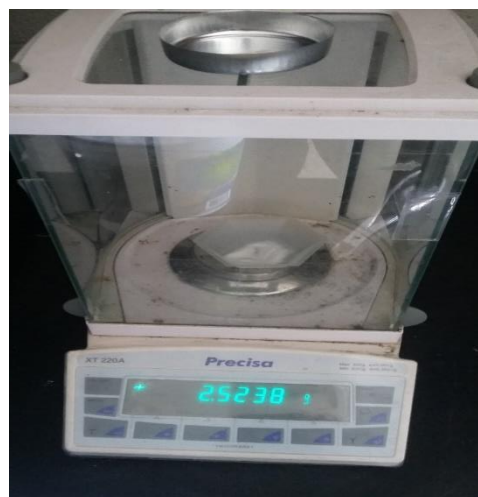


Fig 2: Measuring required amount of ClorAm-X® in Analytical balance



Fig 3: Samples and test vials for analyzing ammonia, nitrate, nitrite and pH



Fig 4: Using DR 3900 spectrophotometer by HACH® for reading concentration

Observations and Results:

The results indicate that there is dose dependent effect of ClorAm-X® on reducing ammonia. Increasing ClorAm-X® dose shows increased reduction in total ammonia nitrogen and unionized ammonia in treated water. pH and nitrite didn't change due to ClorAm-X® application while nitrate showed slight increase with increased dose of ClorAm-X®.

Treatments	Temperature (°C)	TAN (mg/L)	Unionized ammonia (mg/L)	pH	Nitrate (mg/L)	Nitrite (mg/L)
Control	19.2±0.23	16.03±0.14	0.0937±0.0014	7.19±0.014	1.097±0.04	1.52±0.022
T1	20.5±0.05	6.19±0.06	0.0327±0.0007	7.11±0.003	1.113±0.05	1.54±0.01
T2	20.2±0.05	2.52±0.08	0.013±0.0005	7.11±0.01	1.513±0.21	1.54±0.01
T3	19.2±0.12	1.29±0.005	0.006	7.11±0.01	2.383±0.13	1.6±0.07

Table 1: Water quality parameters post-treatment. Data is expressed as Mean ± Standard Error (SE)

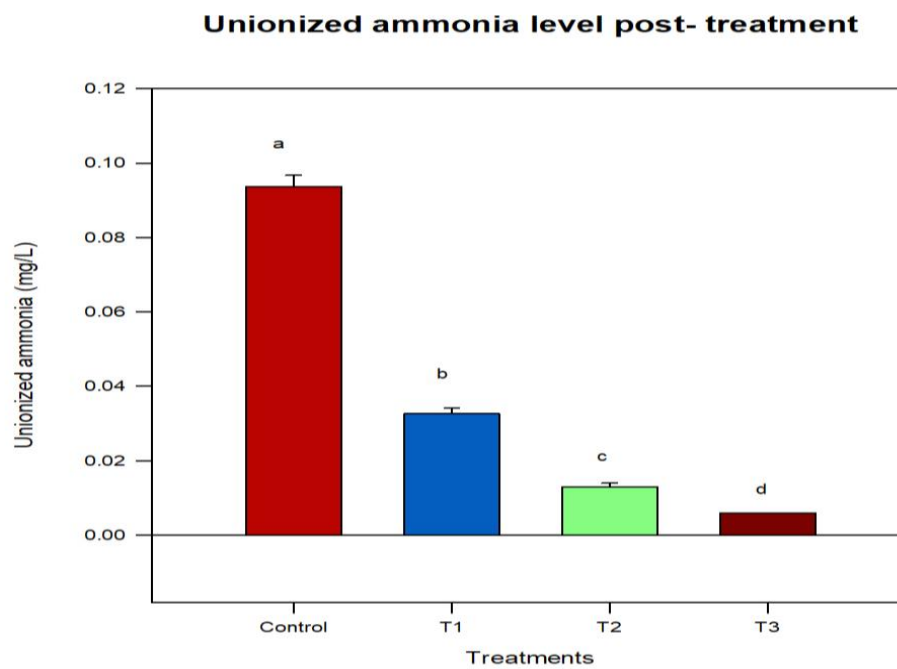


Chart 1: Means of Unionized ammonia level post-treatment. Means without a letter in common are significantly different (<0.001)

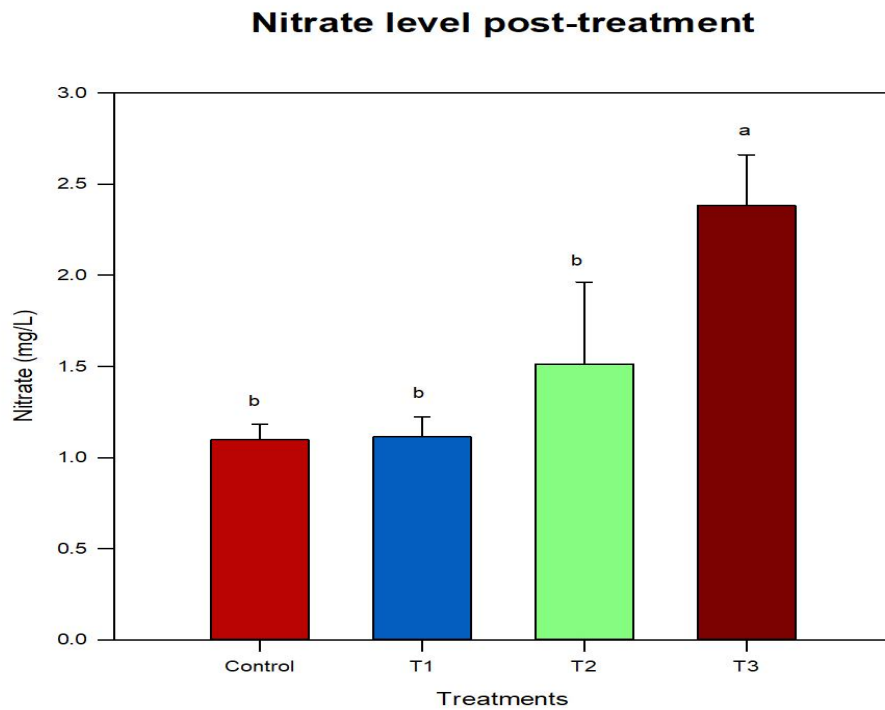


Chart 2: Means of Nitrate level post-treatment. Means without a letter in common are significantly different (<0.05)

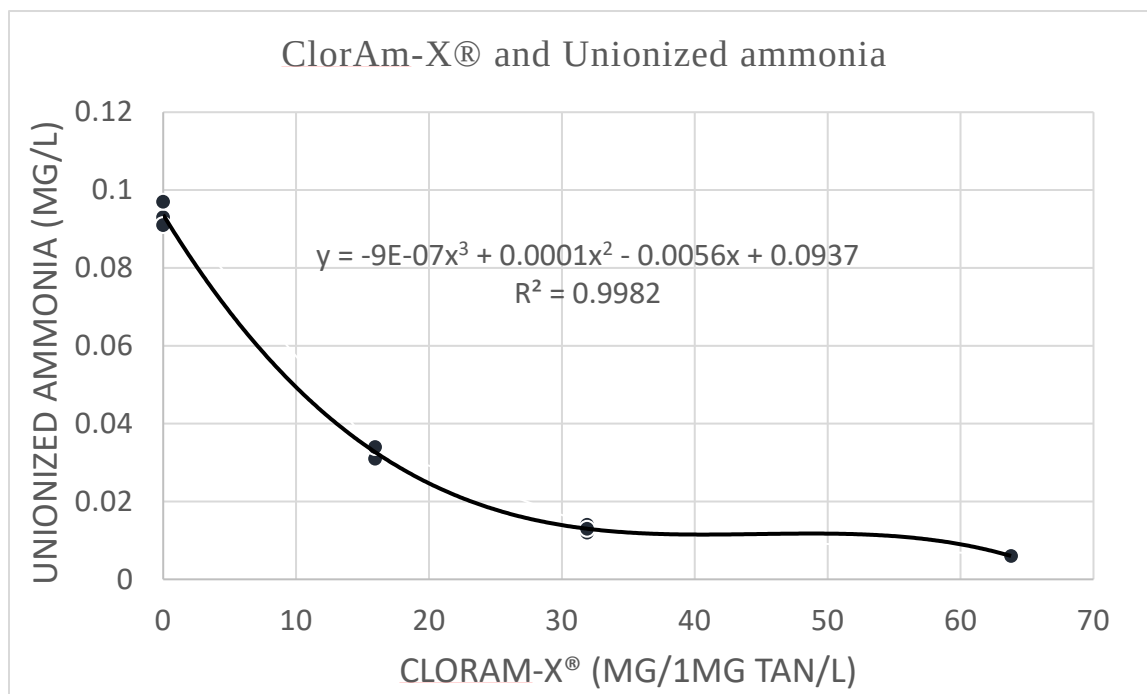


Chart 3: ClorAm-X® dose and Un-ionized ammonia relationship showing strong correlation

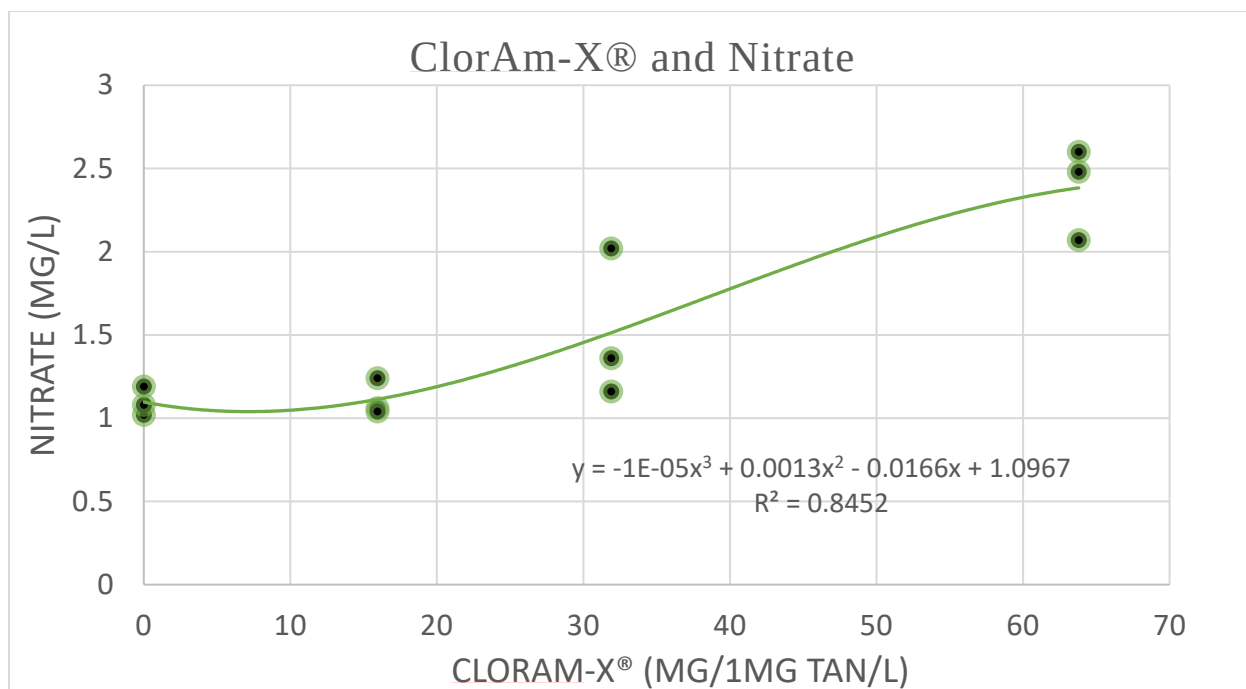


Chart 4: ClorAm-X® and Nitrate relationship showing good correlation

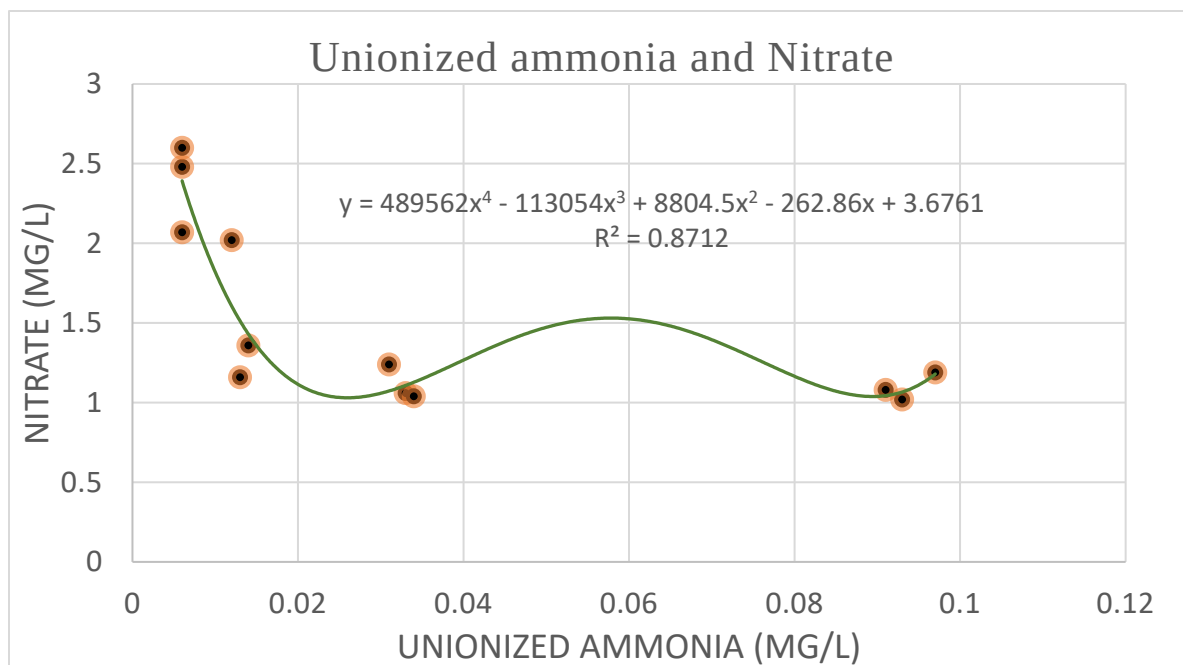


Chart 5: Unionized ammonia and Nitrate relationship

Discussions:

ClorAm-X® reduced ammonia content of sample in dose dependent manner in this study. ClorAm-X® was found effective also by Riche et al. (2006) in reducing ammonia level in small-scale rotifer batch culture system. In our study, control group had no change in TAN, pH, Nitrate and Nitrite while treatment group had varying effects. All treatments work well to reduce ammonia content. T3 had the largest reduction in ammonia content while T1 had the smallest reduction among treatments. ClorAm-X® dose and Un-ionized ammonia showed strong correlation on regression analysis. Nitrate levels increased according to increased ClorAm-X® but with very low rate. Increase in nitrate may be of concern only in case of heavy doses. The results suggest that Sodium Hydroxymethanesulfonate can be of use in reducing TAN and unionized ammonia in holding tanks that accumulate during holding of fish for research, sales. It can be used also in hauling tanks, fish shipping bags/boxes and aquariums to maintain optimum water quality and reduce unionized ammonia induced stress, diseases and loss due to mortality.

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