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A Review on the Efficacy of Yucca SP for Ammonia Control in Aquaculture

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Abstract
In modern aquaculture, the increase in stocking density has led to the accumulation of ammonia in ponds, resulting in reduced growth rates and poor health conditions for aquatic animals. As synthetic chemicals often aggravate this issue, natural remedies like Yucca have gained attention for their potential benefits. Yucca, a plant from the Asparagus family, has long been used for various medicinal purposes and is now recognized for its effectiveness in controlling ammonia in aquaculture ponds. This plant contains compounds like saponins, phenolics, and steroidal substances that exhibit anti-inflammatory, antioxidative, and growth-promoting properties.
Yucca helps mitigate ammonia levels by acting as a pH regulator and supporting nitrifying bacteria that convert toxic ammonia into less harmful nitrites. Furthermore, Yucca enhances primary productivity by promoting the growth of plankton and improving dissolved oxygen (DO) levels at the pond's bottom. Its benefits extend to soil conditioning, waste decomposition, and odor removal. Through a series of trials, including lab and field tests, Yucca's efficiency in controlling ammonia and its positive effects on aquaculture have been confirmed.
Yucca SP, in particular, has demonstrated its role in improving water quality and animal health, highlighting its potential as a cost-effective and environmentally friendly solution for aquaculture management. The results support the use of Yucca as a valuable addition to aquaculture practices, enhancing both the welfare of aquatic animals and the overall health of the aquatic environment.

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Introduction

In modern aquaculture, with an increase in stocking density, the formation, and accumulation of ammonia in the ponds have also increased, resulting in reduced growth rates and poor health conditions (1 Dawood MAO, Goodly MS, Monier MN, Younis EM, Van Doan H, Similar H. 2021) [1]. Any chemical or addition of any synthetic material is either naïve or aggravating the issue, the looks are all now on natural remedies.
Yucca, a family of plants that have been utilized as natural agents for the control of many animal health issues, is an age-old practice that has been time tested. However, of late, they have been seen as the natural herbal alternative in aquaculture and specifically have shown to be powerful, efficient, and cost-effective for Ammonia control.
Yucca acts as a growth promoter, immunostimulant, anti-oxidative agent, natural cleaner, and odor remover apart from ammonia control.

About Yucca

The yucca, of Asparagaceae, is a perennial shrub native to North America, Mexico, the Caribbean, and Brazil with tough sword-shaped leaves and a comb of whitish flowers. It can withstand arid conditions deficient in water and nutrients. As a desert

inhabitant, the leaves, stem bark, roots, and flowers have medicinal properties.

Yucca is rich in saponins, phenolic, steroidal, and antioxidant compounds that make it stand out from the other members of its family. These alleviate the effects of environmental stressors and improve physiological parameters. (2 Roberto A. Santa Cruz-Reyes, Yeah Chain. 2010) [2] The steroidal saponins and polyphenolics show anti-inflammatory activity, these inhibit nuclear transcription. The saponins are anti-inflammatory, anti-stimulator, growth promoting, hypocholesterolemic, and hypoglycemic and also act as anti-oxidants.

Yucca Vs Ammonia

Ammonia and other unpleasant gases in aquaculture ponds are a result of the normal metabolic processes of the animal, particularly those containing proteins. In this case, ammonia is the byproduct that is excreted through the gills. They are also a result of wastedown of waste accumulation on the pond bottom – sludge, uneaten feed, fecal matter, dead algae, and their breakdown releases ammonia mainly.(4 Lansing Wang 1, Di Wu 2, He Fan 2, Chongqing Li 3, Jinnah Li 2, Yuan yuan Zhang 2, You EU 4, Kuan Hua Wang 3, Wen Peng Zhu 5 2020) [4].

YUCCA acts as a limiting agent in the correction of pH values and also practically manages the ammonia level. The Nitrifying bacteria of the pond use the inorganic minerals in the product for their energy and efficiently convert the toxic ammonia to the less toxic nitrites, which, in turn, are taken up by the primary producers, enhancing primary productivity. Altogether, this product, as it is designed, adsorbs toxic and unpleasant gases and acts as a mineral supplement containing both micro and macro minerals. Helps to fulfill the mineral requirement of the animal. Improves and maintains stable photo and zooplankton, decomposes dead plankton, waste feed, improves the DO levels of the pond bottom, and helps in soil conditioning too. The results of the trials and practical application on aquatic animals like fish, prawns, and shrimp stand proof of the significant benefit of this formulation.

Yucca Sp's Benefits

YUCCA absorbs Ammonia, Nitrite and other toxic gases of the pond bottom. It reduces water toxicity by removing excess ammonia, the saponin physically bonds with ammonia by the process of nitrification, and it also maintains and balances the pH of the pond. It improves and maintains stable photo and zoo plankton growth. It can be used for soil conditioning, like loose soil and black soil. Decomposes dead plankton, waste feed, and improves the DO levels in the pond bottom. Yucca's Macro and Micro nutrients act as good nutrient supplements. 100 % Safe, with no side effects of any kind, and cost-effective.

Working of yucca

Yucca contains 2 stillborn polyphenols 3355 tetra hydroxyl methoxy silences and 3 4 5 5 tetra hydroxyl methoxy silent (resveratrol) (3 Santa Cruz-Reyes RA, Chien OH. 2012) [3].

The TRI terpenoid steroidal saponin and resveratrol bind with ammonia via glycol component fraction, this ammonia is converted to protein, thereby weight gain in animal by the enhancement of the animal's protein metabolism.

The part of ammonia that is converted to non-toxic nitrates and nitrites is taken up by the primary producers. The saponins act as absorbents and surfactants, absorbing the remaining gases and off flavors.

There is a reduction in bacterial loads, thereby the molting and other related growth issues are reduced, creating a clean healthy odorless pond bottom and happy inmates.

Yucca trial test

CRITERIA FOR YUCCA TRIAL TEST. The sample of YUCCA to study its efficacy was obtained from M/S Advance Aqua Bio Technologies India Private Limited, Vijayawada, Andhra Pradesh as YUCCA SP (Yucca special). The trial tests were performed to understand the economic viability, efficacy in ammonia control, and working of YUCCA SP in aquaculture. (5 Yang Q-h, Tan B-p, Dong X-h, Chi S-y, Liu H-y 2015) [5].

Lab Test

4 test tubes with 10 ml of the sample. Tt-1 – distilled water, tt2- trial pond 1, tt3- trial pond 2, and tt3 – trial pond 3. The following parameters were checked before starting the test. Temp., PH, DO, and Ammonia – nitrate level. Time of the test. Zero hrs. To each of the test tubes, 8 drops of Solution A and 8 drops of Solution B from the kit are added and allowed to stand for about 5 minutes. Based on the development of a green color in the solution, the quantity of Ammonia is measured against the color chart along with the Kit. To each of the test tubes, add the same calculated quantity of the YUCCA SP. Note the observations. The change in the color from Green to yellow indicates the working of yucca. The color changes indicate the conversion process. The earlier, the faster, note the time and calibrate.

Field Trial

The 3 ponds selected should have the same or similar parameter criteria – same species, similar stocking, culture period, water depth min 5 ft., and pond size. PH should be neutral.

Dawn or dusk is the time of application. The application should be concentrated at the band water interface. Close to where the pond ends. Method of application for powder - Can be mixed in water and broadcasted, Can be added to lime and strewn in water, Can be added to pond soil, mixed and strewn in water.

The liquid is applied directly at the dosage specified.

Before the start of the trial, all readings were calibrated.

Observations

Hardness played a very important role in the working of Yucca. The harder the hardness, the less efficiency. Just an increase in dosage, say doubled, can give even better results. The application of Zeolite or Lime before the Yucca application is recommended. This will balance the pH. Powder Yucca is more efficient than liquid since the total saponin is max. 10% only, and as a liquid, this gets diluted. Increasing dosage will make this saponin more available. But if liquid is preferred, no further dilution should be done. The efficiency of yucca working can also be assessed by recording the DO levels before and after application. The nitrogen, as ammonia, is converted to nitrates and nitrites by yucca, so the TAN will explain the working of yucca. The ammonia level in a living culture pond will be 0.5 to 1 ppm. This is permissible, but any claim of zero ammonia in a pond is not possible. Testing is done in a sample where no further Ammonia is released, but in a pond, it is a continuous process. (6 Claude E. Boyd, C.S. Tucker 1998) [6]

In the above trial yucca liquid worked efficiently. The first pond's culture area is large, but the level of ammonia has been kept standard, there is no increase, though there has been continuous addition of ammonia in the culture system. In pond 2, the B50 level was reached within 24 hours of application. 1 Ppm, being the base level, got standardized there. In pond 3, the efficiency of working is observed with reduction in the first 24 hours, and then after 48 hours further reduction can be clearly noticed. Even when the Ammonia level is high, the depth of the pond is more, the working was observed to be good. The best result not earlier than 72 hours

Conclusion

This study is mainly aimed at evaluating the efficacy of YUCCA SP in handling the Ammonia problem and related issues of the aquaculture pond, while embarking on the fact that it is a good mineral supplement indirectly influencing the growth and wellbeing of the animal.

There is nearly 26 % production loss due to diseases and poor water quality management. Of these, the first place goes to the DO problem, wherein a DO level of 4 ppm is considered dangerous. The turbidity management takes an important position, pH is also very crucial, and managing this is the primary task.

TAN (both Ionized Ammonia NH4+ and Unionized Ammonia NH3 exist simultaneously) Total Ammonia Nitrogen.NH3 is what we typically know as ammonia; When this dissolves in water, it forms ammonium ions, also known as NH4+. This unionized form is less able to pass through the gill membranes than the Iodized form (NH3), making it less harmful. YUCCA SP helps in nitrifying NH4+ to NH3, this is absorbed by the phytoplankton available as a nutrient there, and primary productivity is maintained. (8 Lowell Hays. Aug 27, 2020 [8]. As unionized ammonia does not thrive at lower pH, YUCCA SP acts as a limiting agent to correct and balance the pH values. As the proportion of TAN in the toxic form increased with an increase in temperature and pH,

$H^+ + NH_3 = NH_4^+$ (and vice versa).

Thus, the efficiency of YUCCA as YUCCA SP is proved to be a good ammonia controller and also a health, growth, and weight enhancer due to its phytochemicals, mainly the Saponins.. (7 Cheese, R. 1996) [7]

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