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THE EFFECTS ON FRESHWATER SHRIMP SURVIVAL DURING WATERLESS SHIPMENT USING A ZEOLITE PACKAGING ENVIRONMENT

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ABSTRACT. Live shipment of aquatic animals has increased over the last ten years, sparking both more interest (providing a larger market through product diversification) and a broader geographical market. To be commercially competitive in the world market, it is becoming increasingly more important to be able to deliver a live product. Increasing the survival time during transfer without increasing shipping costs by sending the animals in a dry environment, would enlarge the geographic radius of shipment, making it possible for aquaculture producers to be more competitive in exporting their products worldwide.

Methods had already been developed to ship freshwater shrimp (*Macrobrachium rosenbergii*) live for 17 hours (pretreated for five minutes at 10° C and stored at 17° C and 50% relative humidity). It was also known that metabolic changes occur several hours before death in kurama prawns. What was not known was whether methods of removing toxic metabolic by-products from the shipping environment would increase these survival times even further. Zeolites are commonly used in animal production systems to reduce the content of ammonia and other forms of nitrogen by-productrs in the growth medium. The survival rates of shrimp with and without zeolite inside the shipping containers are reported. Recommendations of conditions for the highest survival rate are made. To better understand the efficacy of the zeolite treatment reported here complete nitrogen budgets for treated and untreated shrimps are going to be conducted.

INTRODUCTION

The world's economy grew by some $4 trillion (U.S.) dollars between 1985-1995, more than the beginning of civilization until 1950. From 1991-1995 the Chinese economy expanded 57%, raising the income per person of 1.2 billion people more than half (Brown et al 1996). There is a growing market that can afford live freshwater shrimp.

The University of Puerto Rico is now renovating a commercial freshwater shrimp farm which has recently been obtained. The venture must be self-sustaining and serve the needs of the aquaculture industry in Puerto Rico and the Caribbean. Developing a successful method of waterless shrimp shipping would certainly help this endeavor. The local market is limited and being able to send the animals in a dry environment greatly increases the economic payoffs of shrimp production.

The decline or flat cycle in per capita U.S. shrimp consumption during the 1990/91 period was the direct result of massive white collar layoffs during the start of the U.S. recession (Filose, 1995); resulting in the only Puerto Rican fresh water shrimp producer to reduce prices and delay harvesting, and ultimately going out of business (Lacroix, 1994). Being dependent on only one market is not wise.

By expanding the survival time of fresh water shrimp during shipment the geographic radius of the market will also be expanded. The quality of the product will be increased and economic loss due to spoilage eliminated. It will finally be possible to bring the market to the consumer.

To do this it must first be determined why the shrimp die and design against it. The shipping container and environment must then be optimized.

The Japanese ship their shrimp in chilled sawdust from the Japanese cedar, *Cryptomeria japonica* (Korringa, 1976). It appears that this particular sawdust is a superior shipping medium over not only other types of insulation but other types of sawdust. From this a hypothesis can be drawn that it is possible that increased survival is not purely dependent on the insulation properties. There may be a chemical removal of toxic metabolic by-products by the sawdust that also increases survival times.

If this hypothesis was true then the inclusion of something to remove toxic metabolic by-products in the shipping environment should increase survival time. Zeolites are commonly used in aquaculture methods to reduce the content of ammonia and other forms of nitrogen by-products in the growth medium (Mumpton and Fishman, 1977). They are non-toxic and have been tested in feed for pigs (Castro and Elias, 1978) and hens (Berrios et al, 1983) to increase production. It was decided to include zeolite in the package environment to see if survival time of the freshwater shrimp (*Macrobrachium rosenbergii*) could be increased.

MATERIALS AND METHODS

Macrobrachium rosenbergii have a temperature range of 14-35° C in which they can survive. It has been shown that using rapid chilling techniques on fresh water shrimp (Schmitt and Uglow, 1996) did not affect the ammonia-N and total nitrogen efflux rates. Following a quick chill pretreatment procedure (Davila, 1996) the shrimp were refrigerated for five minutes at -10°C and then stored at 17° C in a dry environment. Sponges moistened with 600 ml of pond water were placed on the bottom of expanded polystyrene (looks like Styrofoam®) containers (12" x 18" x 12") to maintain 100% relative humidity. Davila had used 1800 ml of water and had achieved 100% survival rate for 17 hours. By reducing the amount of water the survival rate also decreased. Conclusions about the effectiveness of zeolite were still able to be determined and research is on-going on increasing survival with the reduced amount of water. Four containers were used, two were used as controls and two had 70 grams of zeolite (14 x 40 potassium-sodium, alumino silicate from St. Cloud Mining Company in Truth or Consequences, NM) sprinkled on top of the moist sponges. Ten pretreated shrimp were placed in each container along with Stowaway™ temperature and humidity sensors. Survival rates were observed once an hour after the first twelve hours until 21 hours had passed. This test was repeated four times.

RESULTS AND DISCUSSION

Results can be viewed in Table 1. The percent increase of survival rate with zeolite ranged from 23-50%. Although our procedure is fairly rudimentary at this point it seems conclusive that zeolite will be included in the final packaging environment.

Table 1. Increase in Freshwater Shrimp Survival Rate in Containers with Zeolite

EXPERIMENT #	PERCENT INCREASE OF SURVIVAL RATE WITH ZEOLITE
1	23
2	44
3	50
4	50

Temperature control of tropical aquatic products is more difficult because the safety range is narrower than for cold water aquatic products. Successfully maintaining a safe temperature range with gel ice, packaging design, good insulation materials, and in some cases a computer control system is mandatory. Airline handling practices need to be researched and agreements reached with the carriers to ensure proper delivery of product. Tests with and without oxygenation and tests with ammonia probes will be done to determine what type of environment is optimum for freshwater shrimp. "Active" packaging which is permeable to a particular size of molecule will be considered. Collaboration agreements with Northrup Grummon and United Parcel Service (UPS) are signed. All this leads up to what we really plan to do next--export live freshwater shrimp!

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