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# Effectiveness of oral Elancoban™ and Avimix-ST™ against *Nematopsis* (Apicomplexa: Porosporidae) gametocyts infecting the shrimp *Litopenaeus vannamei*

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**Abstract**

Gregarines from *Nematopsis* genus are a common intestinal parasite infection in the white shrimp, *Litopenaeus vannamei*, that is cultured on the Pacific coast of Mexico. Slow growth and mortalities of white shrimp have been associated with gregarine infections. Control of gregarine infections in Mexican shrimp farms with antibiotics by empirical methods is becoming increasingly important. However, no effective chemotherapeutic control has been demonstrated. The objective of the present study was to evaluate the effectiveness of oral administration of sodium monensin, Elancoban™ and sulfachloropyrazine, Avimix-ST™ in removing *Nematopsis* gametocysts from the intestine of naturally infested cultured white shrimp (*L. vannamei*). Four experiments were carried out where different concentrations of antibiotics were administered to naturally infested shrimp through medicated feed for 5 consecutive days. The experimental system consisted of glass aquaria containing 8–10 shrimp. Concentrations of antibiotic varied from 2 to 8 g $kg^{-1}$ for Elancoban™ and from 1.5 to 7 g $kg^{-1}$ for Avimix-ST™. After 5 days of treatment, both products significantly reduced the mean intensity of *Nematopsis* gametocysts when compared to the control. Elancoban™ treatment reduced *Nematopsis* gametocysts by 92% and 94% at 5.5 and 6 g $kg^{-1}$, respectively, and Avimix-ST™ reduced the numbers of gametocysts by 85% and 83% at 2.5 and 3.5 g $kg^{-1}$, respectively. No mortalities were recorded for these treatments. The study demonstrates the effectiveness of Elancoban™ and Avimix-ST™ used in medicated feed as a gregarinostats in the control of *Nematopsis* gametocysts in the white shrimp *L. vannamei*.


*Keywords:* Gregarines; *Nematopsis* sp; *Litopenaeus vannamei*; Elancoban™; Avimix-ST™

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## 1. Introduction

Gregarines are probably the most taxonomically diverse and ubiquitous of the apicomplexan parasites. They are reported to infect a wide range of non-vertebrate hosts (Clopton and Smith, 2002). Several species of the gregarine *Nematopsis* are known to reside in the digestive tract of cultured penaeid shrimp but their pathogenic role is unknown; only *Nematopsis penaeus* infection has been reported in association with mortality and lesions (Lightner, 1996).

*N. penaeus* has been observed to cause severe damage to the midgut mucosal epithelium, and the damage or a secondary associated disease possibly caused mortalities in juvenile blue shrimp, *Litopenaeus stylirostris*. Recently, an increase of gregarines infecting white shrimp, *Litopenaeus vannamei*, in farms located in Sinaloa, Sonora and Nayarit states has been observed (Morales-Covarrubias, personal communication), and this appears to be associated with slow growth and mortalities.

Empirical methods of control gregarine infections in Mexican shrimp farms with antibiotics are becoming increasingly important. However, records of effects or usage of the antibiotics are scarce. Drugs used for treatment of poultry coccidiosis approved for use in feed in the USA by the American Food and Drug Administration (FDA) include monensin and sodium sulfachloropyrazine (MMV, 1998). Monensin orally administered against the coccidia *Eimeria funduli*-infecting killifish exhibited a reduction in oocysts by 50–70% within 20 days (Solangi and Overstreet, 1980). Noga (1996) reported as experimentally effective the use of sodium monensin [(Coban 60 (Elanco) Rumensin 60 (Elanco)] against the coccidia *Calyptospora* parasiting fish.

Sulphamethoxine and sulphachloropyrazine are, among others, widely used in veterinary medicine, in the control of systemic infections due to their low cost and relatively high efficiency (MMV, 1998). Sulfadimethoxine displays some toxicity for species in apicomplexan group, and this drug may be useful for control of gregarine infection in arthropod rearing systems (Clopton and Smith, 2002). Thus, the objective for the present study was to evaluate the effectiveness of oral sodium monensin, Elancoban™ and sulfachloropyrazine, Avimix-ST™ against *Nematopsis* gametocysts infestation in white shrimp [*L. vannamei* (Boone, 1931)].

## 2. Materials and methods

### 2.1. Experimental shrimp

Juvenile white shrimp, *L. vannamei* (naturally infected with gregarines), with an average wet weight of 4 g, were obtained from a shrimp farm in Sinaloa, Mexico and used for the present study. Four batches of 250 juvenile shrimp were transported to the laboratory facilities in four plastic bags ($0.5\times0.7$ $m^3$) with oxygenated ambient seawater and maintained in a 800-L circular tank at $22\pm0.5$ °C and salinity 35‰ for a 12-h acclimation period prior to the experiment.

### 2.2. Medication of the experimental diets

Commercial diet (Cenzone 35% protein) was ground to powder in a mortar to particles of 250 μm. Afterwards, particles were mixed for 10 min, adding slowly and carefully the antibiotic previously weighed to ensure the effective incorporation in the mix and guarantee the desired final concentration. Finally, 350 ml of water was added per kilogram of feed, the moist mixture should have a stuff, plastic consistency when compressed (Lovell, 1988).These pastes were pelletized in a butcher's grinder (Tor-rey, Mexico) equipped with a 1.6-mm-diameter die. The pellets were dried in a forced air oven $38\pm2$ °C for 12 h and then stored at 4 °C until required. All the experimental diets required for the study were prepared in one batch. Control diet was processed in the same manner with no drug addition.

### 2.3. Experimental design

Taking into account that trophozoites and gamonts in syzygy of *Nematopsis* sp. were released from the gut during the acclimatization, the drugs were tested against gametocysts. An initial survey of 30 shrimp (initial control, IC) randomly selected from each batch was performed to determine the numbers of *Nematopsis* gametocysts in the batches to be used.

The experiments were performed in an acclimatized room in order to maintain constant temperature