Chemical use in intensive white-leg shrimp aquaculture in Ben Tre province, Vietnam

Tran Minh Phu[1], Pham Quang Vinh[2], Nguyen Le Anh Dao[1], Le Quoc Viet[1], Nguyen Quoc Thinh[1]

[1] College of Aquaculture and Fisheries, Can Tho University, Can Tho City, Viet Nam
[2] National Agro - Forestry -Fisheries Quality Assurance Department – Can Tho City, Can Tho City, Viet Nam

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Abstract- The study was done through interview of 60 white-leg shrimp farmers in Binh Dai and Thanh Phu District, Ben Tre province in order to investigate the chemical use, disease occurrence and farming practice. Results showed that the most common shrimp disease are AHPND (56.7% and 63.3%) and white feces disease (50 and 63.3%), reported by farmers. The commonly used antimicrobials were amoxicillin (20-30%), cotrim (16.7-26.7%) and oxytetracycline (10-26.7%). The used antimicrobials were belonged to the allowed listed issued by Ministry of Agriculture and Rural Development, Vietnam. Most of farmers in both models using product containing chlorin as disinfectant in water input ponds while iodine and BKC were used during grow-out. Nearly all farmers used probiotic for digestive enhancement and water quality improvement, common species were *Bacillus subtilis, B. licheniformis, B. megaterium*. However, the effectiveness was unknown. Thus, there is an urgent need to provide training to shrimp farmers to enhance knowledge on effectiveness use of chemicals, guarantee the food safety for the final product.

Index Terms- antimicrobial, chemical, intensive, white-leg shrimp

I. INTRODUCTION

Vietnam has a long coast line which is favorable for the development of coastal aquaculture. Aquaculture shrimp production increased following years, accounted for 683 thousand tons in 2017. Ben Tre is a coastal province in the Mekong Delta, Vietnam. Shrimp aquaculture area is above 4000 ha with two culture species of back tiger shrimp and white-leg shrimp. In recent years, white-leg shrimp aquaculture increased in area, shifting from black tiger shrimp.

Because of increased in stocking density, weather and environmental problems, disease has occurred. Acute hepatopancreatic necrosis disease (AHPND), white spot syndrome virus (WSSV) and white feces syndrome have been important disease in shrimp aquaculture (Oanh *et al*., 2008; Tran *et al*., 2013; Flegel and Sritunyaluucksana, 2018). Farmers used antibiotic and chemicals to prevent and control disease (Chi *et al*., 2017).

Rico *et al*. (2013) reported that shrimp aquaculture used less chemical and antibiotic compared to fish aquaculture. Shrimp farmer in the North of Vietnam used oxytetracycline to control and prevent AHPND and white feces syndrome (Chi *et al*., 2017), 20% farmers reported. Limit or no information on chemicals use in shrimp aquaculture in the South of Vietnam. Thus, the aims of this study are to investigate the chemical use, disease occurrence and farming practice of white-leg shrimp aquaculture in Ben Tre province, Mekong Delta, Viet Nam in order to provide information for better management of chemical use.

II. METHODS

The study was conducted from May to December 2018 by interviewing shrimp farmers in Binh Dai and Thanh Phu District, Ben Tre province. A total of 60 shrimp farmers was face to face interviewed. The interviewed farms divided as earthen ponds (30 farmers; MHNAD) and supper intensive system with pond liner (30 farmers; MHNLB) were randomly selected from the list provided by provincial agriculture and rural development.

The semi-structured questionnaire was piloted in two households in each group including technical information e.g. grow-out pond, input pond and waste pond area, stocking density, year of farming, production, FCR, training. Disease occurrence included types of disease, and chemical use. Information on chemical use were focused on types of chemical, disinfectant, probiotic and antibiotic. Information about handling of chemical was also obtained.

Results are expressed in descriptive statistics e.g. frequency of occurrence, mean value, and standard deviation. Statistical independent sample T-test was applied to compare the differences in technical indicators with a significance level of 95%.

III. RESULTS AND DISCUSSION

3.1 General information of shrimp farms characteristics

Farmers in rearing shrimp in earthen ponds (MHNAD) had more experience on shrimp farming compared to farmers

rearing shrimp in supper intensive system with pond liner (MHNLB) (Table 1). This is because the model named supper intensive system with pond liner (MHNLB) is newly applied in recent years and farmer in this model converted from models rearing shrimp in earthen ponds (MHNAD). Average area of grow-out ponds in model MHNLB was smaller than the model MHNAD. In the MHNLB, during culture, it required more water exchange compared to MHNAD, thus number of input water pond in MHNLB was higher than MNHAD which less exchange water during cultivation.

Table 1. General information of shrimp farms

	MHNAD* (n=30)	MHNLB (n =30)
Year of farming	7 ± 5 (1-18)	3 ± 2 (1-10)
Training	73.3%	46.7%
Total farm area (m^2)	6637 ± 4951 (1000-4000)	4033 ± 2475 (900-4500)
Area of grow-out pond (m^2)	2096 ± 698 (1000-4000)	1640 ± 732 (900-4500)
No of grow-out ponds	3 ± 2 (1-9)	3 ± 2 (1-10)
Area of water input pond (m^2)	1986 ± 2025 (200-10000)	3218 ± 3616 (400-20000)
Area of waste storage ($m^{2)}$	1285 ± 1466 (200-5000)	1220 ± 1156 (200-5000)
No of water input pond	1 ± 1 (1-3)	2 ± 1 (1-5)
Stocking density (shrimp/m^2)	90 ± 21 (40-125)	219 ± 96 (150-500)
Productivity (tons/1000m^2)	1.6 ± 0.7 (0.7-3.1)	2.6 ± 1.8 (0.8-6.3)
FCR	1.15 ± 0.09 (1-1.4)	1.19 ± 0.14 (1-1.6)
Sell to middle man	96.7%	100%
Checking antibiotic before selling	60%	70%

** rearing shrimp in earthen ponds (MHNAD) and in supper intensive system with pond liner (MHNLB)*

Between two rearing models, stocking density in MHNAD was two times higher than in MHNAD leading to higher productivity. However, the feed conversion ratio was similar. Most of farmers sold their products to middle men and few farmers sold directly to processing plants. In term of food safety, 60 and 70% of farmers checked antibiotic residue before harvest, done by buyer. Farmers received training mainly by feed and chemical producers which less getting information from authorities though getting approval for farms operation done by local authorities.

3.2 Shrimp disease reported by farmers

Results showed that Acute Hepatopancreatic Necrosis Disease (AHPND) and White Feces Disease (WFD) have been still common diseases reported by farmers in both models whereas White Spot Syndrome Virus (WSSV) was dominated in model MHNAD. AHPND occurred 20 to 40 days after stocking post-larvae, and 30-60 days for WFD and WSSV. AHPND has been firstly reported in Vietnam since 2010, caused by *Vibrio parahaemolyticus* with massive mortality (Tran *et al*., 2013; Nghia *et al*., 2015). Chi *et al*. (2017) reported that AHPND was also main serious disease in shrimp aquaculture in the North of Vietnam. Flegel and Sritunyaluucksana (2018) confirmed that AHPND causing by *Vibrio parahaemolyticus* carried gene in pVA plasmid containing two genes PirAVP and PirBVP.

Table 2. Diseases reported by shrimp farmer (%)

	MHNAD (n=30)	MHNLB (n=30)
Acute hepatopancreatic necrosis disease (AHPND)	63.3	57.6
White feces disease (WFD)	50	66.7
White spot syndrome virus (WSSV)	40	10

** rearing shrimp in earthen ponds (MHNAD) and in supper intensive system with pond liner (MHNLB)*

WFD was identified as multi-factors diseases e.g. parasite, bacteria or virus infection. The other cause was reported as microsporidian parasite *Enterocytozoom hepatopenaei* (Ha *et al*., 2011; Flegel and Sritunyaluucksana, 2018).

3.3 Antibiotic use in white-leg shrimp farming

Farmers used five types of antibiotic during cultivation of shrimp in order to prevent and control AHPNS and WFD (Table 3). Farmers in model MHNAD used more common on cotrim (containing sulfamethoxazole and trimethoprim), amoxicillin and oxytetracycline whereas in model MHNLB, the percentage of farmers used antibiotic was higher with similar common antibiotic as MHNAD.

Table 3. Used antibiotic reported by farmers (%)

	MHNAD (n=30)	MHNLB (n =30)
Florfenicol	3.3	3.3
Tetracycline	3.3	13.3
Oxytetracycline	10	26.7
Cotrim	16.7	26.7
Amoxicillin	20	30

** rearing shrimp in earthen ponds (MHNAD) and in supper intensive system with pond liner (MHNLB)*

According to regulation from the Ministry of Agriculture and Rural Development in Vietnam, these types of antibiotic has been allowed to use in aquaculture. However, the prophylactic use should not be encouraged.

3.4 Chemical, probiotic and nutritional products

Farmers in both models reported to use CaO and $CaCO_3$ for first step of pond preparation after removal of sludge from input water pond or grow-out ponds (Table 4). In model MHNAD, there were 8 farms did not possess the input water ponds, thus directly taking water from the river and doing the disinfection treatment in the grow-out ponds. After taking water to input ponds (or grow-out pond, in case farmer do not possess the input water ponds), farmer disinfect water mainly by chlorin based products (86 and 100% farmers used). Other farmers used $KMnO_4$ or Iodine to disinfect water, before pumping to grow-out ponds. Benzalkonium chloride (BKC) sometimes used for water disinfection.

During the shrimp cultivation, many farmers used iodine or BKC every 10 or 15 days to disinfect bacteria in culture water (Table 4). Few farmers reported to used chlorin based products which may be harmful to shrimp health. Virkon (containing peroxygen) was also used to disinfect the pond water, however, it was reported to be expensive to farmer, effectiveness was also confirmed by farmers. The way of using chemical for water disinfection was found similar to report by Chi *et al*. (2017).

Nearly all of shrimp farmers used probiotic products as feed inclusion for improving shrimp digestibility and used as water quality improving agents. Common bacteria listed in products including *Bacillus subtilis, B. licheniformis, B. megaterium, Lactobacilus acidophilus and Saccharomyces cerevisiae*. Other bacteria also included as *Bacillus amyloliquefaciens, Bacillus pumilus, Bacillus firmus*. The finding was similar as report of Rico *et al*. (2013) and Chi *et al*. (2017) that most of shrimp farmers used probiotic during farming. However, quality of product has not been guaranteed, reported by farmer. Noor Udin *et al*. (2015) did analysis of probiotic products. Results revealed that most of products did not contain the claimed bacteria while other bacteria contained in the products. Other studies reported that using *Bacillus* bacteria in shrimp culture can improve feed digestibility as in feed inclusion (Wang *et al*., 2005; Balcázar *et al*., 2006; Wang 2007 and 2008; Newaj-Fyzu *et al*., 2014).

Table 4. Chemical, probiotic and nutritional supplied products using in shrimp farming

	MHNAD (n=30)	MHNLB (n =30)
Chemical use during pond preparation and water treatment in input water ponds		
CaO	53.3	40
$CaCO_3$	66.7	30
Chlorin	86.7	100
$KMnO_4$	3.3	26.7
Iodine	23.3	6.7
BKC	16.7	13.3
Formalin	6.7	-
Chemical use for water treatment during grow-out stage		
$KMnO_4$	3.3	-
Chlorin	16.7	6.7
Iodine	66.7	56.7
BKC	50	50
Virkon (peroxygen)	10	16.7
Probiotic		
Probiotic for feed inclusion	93.3	83.3
Probiotic for water treatment	96.7	100
Nutritional supplied products (mineral and vitamin)	96.7	90

3.5 Handling of chemical, guidance and safety

Most of farmers used chemicals following their own experience, 86.7 and 93.3% farmers reported (Table 5). Also, they got guidance from technician in chemical shop and feed company. Missing the support from authorities e.g. extension service, local aquaculture department because of the few officers in the region. Nearly all farmers bought the chemical and stored them in the storage next to ponds, away from living area. However, this place is used for farmers and workers to take a rest during working, thus, it may affect worker health due to the chemical placing there. It is interesting that farmer used gloves, mask during handling of chemicals that less being used in other aquaculture species. One third of farmers recorded the chemical, feed and pond water quality parameters.

Table 5. Handling of chemical, guidance and safety

	MHNAD	MHNLB

	(n=30)	(n =30)
Making decision on chemical use		
Following label instruction	26.7	40
Support from technician from chemical company	40	20
By their own experience	86.7	93.3
Local authority support	3.3	-
Record chemicals and others	33.3	23.3
Safety on handling chemicals		
Available chemical storage cabinet	-	3.3
Purchase and store the chemicals in storage	100	90
Using gloves, masks during handling	76.7	80

** rearing shrimp in earthen ponds (MHNAD) and in supper intensive system with pond liner (MHNLB)*

IV. CONCLUSION

The MHNLB model, supper intensive system with pond liner, had two times higher stoking density and production compared to MHNAD, rearing shrimp in earthen ponds. AHPND and WFD were two common disease reported by farmers in both models. Farmer used cotrim (containing sulfamethoxazole and trimethoprim), amoxicillin and oxytetracycline to prevent and control disease during farming. Most of farmers used probiotic products to improve water quality and feed digestibility. In general, there is an urgent need to train farmer on chemical use and knowledge on disease diagnostic in both models.

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AUTHORS

First Author – Tran Minh Phu, College of Aquaculture and Fisheries, Can Tho University, Can Tho City, Viet Nam
Second Author – Pham Quang Vinh, National Agro - Forestry - Fisheries Quality Assurance Department – Can Tho City, Can Tho City, Viet Nam
Third author – Nguyen Le Anh Dao, College of Aquaculture and Fisheries, Can Tho University, Can Tho City, Viet Nam
Fourth author – Le Quoc Viet, College of Aquaculture and Fisheries, Can Tho University, Can Tho City, Viet Nam
Last author – Nguyen Quoc Thinh, College of Aquaculture and Fisheries, Can Tho University, Can Tho City, Viet Nam
Correspondence Author – Tran Minh Phu, College of Aquaculture and Fisheries, Can Tho University, Can Tho City, Viet Nam. Email: tmphu@ctu.edu.vn, Tel: +84908512101, Fax: +84 2923830323