IOP Conf. Series: Earth and Environmental Science **137** (2018) 012093 doi:10.1088/1755-1315/137/1/012093

The current situation and environmental conditions of green mussel farming in the gulf of Thailand

T Keawtawee[1], P Songsangjinda[2], Y Sangnoi[1] and A Uppabullung[1]

[1]Department of Aquatic Science, Faculty of Natural resources, Prince of Songkla University, Songkhla, Thailand .
[2] Coastal Aquaculture Research and Development Division, Department of Fisheries, Kaset-Klang,Chatuchak, Bangkok, Thailand.

E-mail: teeyaporn.k@psu.ac.th

Abstract. This study investigated the current situation and environmental conditions of green mussel *Perna viridis* farming in Surat Thani, Phetchaburi and Samut Prakan provinces where were located in the gulf of Thailand. Samples were collected during April, August and November in 2014. Based on the results of this study, there were three major types of mussel culture patterns in Thailand: bouchot culture, longline culture (rope culture), and raft culture. Mussel farmers encountered problems on decreasing of larvae mussel in the water column, water quality degradation, high production cost and farmer's lack of negotiation power to control the price. The water quality of the mussel farms, such as dissolved oxygen (DO), pH, salinity, electrical conductivity (EC), fecal coliforms bacteria and the total coliforms bacteria met the standard for aquaculture. However, the nutrient, such as ammonium (NH_4-N), nitri-nitrogen (NO_2-N), nitrate-nitrogen (NO_3-N) and soluble reactive phosphorus (PO_4-P) were higher than the value of marine aquaculture standard. The results of the contamination of *Salmonella* spp. bacteria were not found in the mussel's tissue, however *Escherichia* coli was found at very low level.

1. Introduction

Green mussel is widely distributed in the coastal waters of the Asia-Pacific region [1]. It is one of the most valuable mariculture organisms produced with the largest quantity and profitable products for the country [2,3] . The culture of green mussel has been carried out in Thailand for more than 60 years. Green mussels aquaculture farms are located at intertidal areas and they are usually close to estuaries. Therefore, the chance of exposure to many contaminants from land-based activities through the riverine system as well as sea-based sources is high [4]. The aim of this study is to investigate the current situation and environmental condition in the mussel farming in the gulf of Thailand.

2. Methodology

The thirteen green mussel farms were from three provinces: Surat Thani, Phetchaburi and Samut Prakan provinces, located in the gulf of Thailand. Research samples were collected in April, August and November in 2014. Water quality, including dissolved oxygen (DO), pH, salinity and electrical conductivity (EC) was measured in the field by YSI multi-probe meter model Horiba U-52G. Water samples were collected using water sampler and put into plastic bottles and an ice compartment before being transported to the laboratory for further analysis. In the laboratory, the water samples were

filtered with GF/C filter paper for total ammonia (TAN), nitrite nitrogen (NO_2-N), nitrate nitrogen (NO_3-N) and soluble reactive phosphorus (PO_4-P) analysis. The green mussels were washed externally with a brush and distilled water to minimize contamination of tissue. Then, they were immediately put into a plastic bag and an ice compartment before transportation to the laboratory for further analysis. In the laboratory, the samples were stored frozen until the analysis was undertaken. Before dissection, the mussel samples were thawed at a room temperature (28 ± 1°C) with the posterior margin facing downwards in order to allow excess water to drain away. About 25-30 mussels from each sampling site were selected and dissected by removing the byssus and the shell before analyses. Contamination of the total coliforms and fecal coliforms bacteria in sea water and *Escherichia coli* and *Salmonella* spp. bacteria in mussel's tissue was investigated by using most probable number method (MPN Method).

3. Results and Discussions

There are three major types of green mussel culture patterns in Thailand: bouchot or bamboo poles culture (figure 1a-b), longline culture or rope culture (figure 1c-d) and raft culture (figure 1e). Thai mussel farmers encountered problems in decreasing larvae mussel in the water column, problems of water quality degradation, high production cost and farmers' lack of negotiation power to control the price.

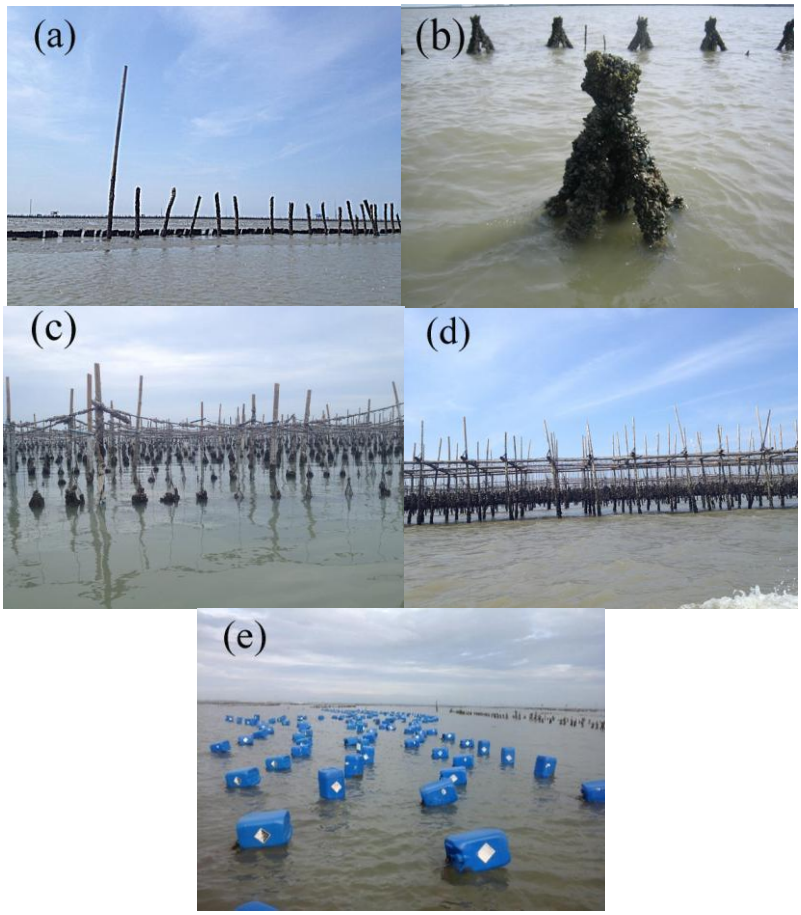

Figure 1. Types of green mussel culture patterns in Thailand. Bouchot or bamboo poles culture (figure 1a-b), longline culture or rope culture (figure 1c-d) and raft culture (figure 1e).

The results of water quality in green mussel farms including dissolved oxygen (DO), pH, salinity and electrical conductivity (EC) were 6.30-9.80 mg/L, 6.79-8.88, 20.0-31.5 ppt and 34.2-50.7 ms/cm, respectively. The range of TAN concentration in April, August and November were 0.68-1.61, 1.32-13.88 and 1.80-6.25 mgN/L, respectively (table 1). The highest average of NO_2-N and NO_3-N concentrations were in August (1.16 mgN/L) and in April (1.50 mgN/L) at Samut Prakan province. The results showed that almost all nutrient concentrations were higher than the value of marine aquaculture standard in Thailand (table 1). The total coliforms bacteria concentrations in sea water were lower than 100 MPN/100 mL in all stations except in August at Phetchaburi and Samut prakan, which were 1600 and higher than 16000 MPN/mL, respectively. The concentration of fecal coliforms bacteria in the sea water samples were lower than the value of marine aquaculture standard in Thailand (70 CFU/mL), in all stations (table 2). *Escherichia coli* and *Salmonella* spp. bacteria were not found in the mussel's tissue and the level in the mussel's tissue from all stations was ver low (table 2). These results showed that green mussel were safe from fecal coliforms, *Salmonella* spp. and *E.coli* bacteria.

Table 1. Water qualities in sea water of green mussel farms in Surat Thani, Phetchaburi and Samut Prakan during April, August and November, 2014.

Water qualities		Surat Thani	Phetchaburi	Samut Prakan
Total Ammonia (mgN/L)	April	0.81-1.01	0.79-1.43	0.68-1.61
	August	1.32-1.52	2.48-4.76	4.69-13.88
STD: 0.1 mgN/L	November	1.80-2.20	3.23-4.37	4.25-6.25
NO2-N (mgN/L)	April	0.11-0.13	0.09-0.15	0.08-0.11
	August	0.02-0.04	<0.002-0.004	0.49-1.16
STD: 0.05 mgN/lL	November	<0.002-0.004	<0.002-0.002	<0.002-0.036
NO3-N (mgN/L)	April	0.53-0.83	0.39-0.83	0.26-1.50
	August	0.08-1.03	0.73-1.45	<0.02-0.65
STD: 0.06 mgN/L	November	<0.20	<0.5	<0.20-0.23
PO4-P (mgP/L)	April	<0.05	<0.05-0.07	0.07-0.08
	August	<0.03	0.05-0.12	<0.03-0.15
STD: 0.045 mgN/L	November	0.09-0.11	<0.05-0.07	<0.05-0.13
TSS (mg/L)	April	15.45-30.85	27.70-111.80	20.55-64.30
	August	24.80-104.85	38.75-79.63	16.15-138.00
	November	15.80-37.33	18.25-35.80	17.25-22.47

STD: Standard value of marine aquaculture standard in Thailand.

Table 2. Bacterial contamination in sea water and green mussel's tissue in Surat Thani, Phetchaburi and Samut Prakan during April, August and November, 2014.

Bacterial contamination		Surat Thani	Phetchaburi	Samut Prakan
Total coliforms bacteria in sea water (MPN/100ml)	April	<1.1	<1.1	<1.1
	August	<1.8	<1.8-1600	<1.8->16000
STD: 100 MPN/100 ml	November	17-70	<1.8-23	<1.8-20
Fecal coliforms bacteria in sea water (CFU/ml)	April	<1.8	<1.8-6.8	<1.8-4.0
	August	ND	<1.8-23	<1.8
STD: 70 CFU/ml	November	4.5-13	<1.8-4.5	<1.8
Samonella spp. in mussel's tissue	April	ND	ND	ND

(MPN/25g)	August	ND	ND	ND
STD: Not detectable	November	ND	ND	ND
E.coli in mussel's tissue	April	<3.0	<3.0-23.0	<3.0-23.0
(MPN/g)	August	<1.8	<1.8-2.0	<1.8
STD: 100MPN/g dry weight	November	2.0-4.5	<1.8-1.8	<1.8

ND: Not detectable, STD: Standard value of marine aquaculture standard in Thailand.

In addition, the heavy metals contamination in the green mussel farms should be investigated as the green mussel's aquaculture farms are located in intertidal areas and they are usually close to estuaries. Therefore, the chance of exposure to many contaminants and heavy metals in sea water and mussel's soft tissue is high [5,6,7].

4. Conclusions

The results indicate that the concentration of the nutrients in sea water was high. However, green mussel farming in the gulf of Thailand is safe from fecal coliforms, *Salmonella* spp. and *E.coli* bacteria.

5. References

[1] Tanabe S 2000. *Poll. Bull*. **40** 651.
[2] Saraya A 1982 *Bivalve culture in Asia and the Pacific country reports: Thailand in Proc* (Singapore : Asia Pasific workshop)
[3] Mccoy, EW and Chongpeepain T 1988 Bivalve mollusc culture research in Thailand (Philippines : ICLARM Technical Reports 19 International Center for living Aquatic Resources Management Manila)
[4] Yap C K, Ismail A and Tan S G 2004 *Food Chemistry* **84** 569–575
[5] Goldberg E D, Bowen V T, Farrington J W, Harvey G, Marti J H, Parker P L, Risebrough R W, Robertson W, Schneider W and Gamble E 1978 *Envi. Conserv.* **5** 101–125
[6] Gorell JM, Johnson CC, Rybicki BA, Peterson EL, Kortsha GX, Brown GG and Richardson RJ 1997 *Neurology* **48** 650–658
[7] Grienke U, Silke J and Tasdemir D 2014 *Food Chem.***142** 48–60

Acknowledgments

This study was funded by the Office of Standard Development, National Bureau of Agricultural Commodity and Food Standards (ACFS). The writer would like to thank the staff of the Department of Fisheries and the owner of the green mussel Farms for their valuable help during the fieldwork.