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Nandanam, Chennai - 600 035, Tamil Nadu, India
Tel. : +91 44 2435 1006
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Oxygen Dissolved Nanobubble Technology Improved the Quality of Pacific White Shrimp Cultivation

Gunanti Mahasri[1], Ade Irmalia Harifa and Sudarno

Department of Fish Health Management, Faculty of Fisheries and Marine, Universitas Airlangga, Surabaya 60115, Indonesia.

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Abstract

This study aims to determine the effect of nanobubble on dissolved oxygen to reduce Presumptive Vibrio Count (PVC) in Pacific White Shrimp (*Litopenaeus vannamei*) aquaculture system. The results of the analysis showed that the use of nanobubble had a significant effect (p<0,05) in dissolved oxygen and reduce PVC while it had no significant difference in PVC on aquaculture media. The use of nanobubble technology provided optimal dissolved oxygen for Pacific White Shrimp aquaculture and lower PVC value of *Vibrio* sp. in the hepatopancreas compared to aerators treatment.

Key words: Nanobubble, Dissolved Oxygen, Quality, Pacific White Shrimp

The high loss due to *Vibrio* sp. bacterial infection is one of the challenges on Pacific White Shrimp. One of the technologies developed to improve the quality of aquaculture is nanobubble since it can be made available for a long time so as to maintain the dissolved oxygen in the waters remains stable and related to the respiratory and metabolic systems (Mahasri *et al.*, 2018; Takahashi and Chiba, 2007). The purpose of this study was to determine its effect on dissolved oxygen (DO) and Presumptive Vibrio Count (PVC) on Pacific White Shrimp.

Materials and Methods

This study used 240 of Pacific White Shrimp (7-10 cm, 4-6 g) and 30 of each treatment. The treatments were A1 (nanobubble), A2 (aerator), B1 (0 days), B2 (10 days), B3 (20 days) and B4 (30 days). The dissolved oxygen was measured by DO meter tool. PVC was a calculation method to determine the number of *Vibrio* sp. bacteria

[1]*Corresponding author* : Email : mahasritot@gmail.com

Table I. DO on the aquaculture media of Pacific White Shrimp (Meant ± SD)

Treatments	Duration (days)	Dissolved Oxygen ± SD
Nanobubble	0	$11.08^{e} \pm 0.72$
	10	$9.63^{d} \pm 0.24$
	20	$9.04^{cd} \pm 0.21$
	40	$9.41^{c} \pm 0.36$
Aerator	0	$3.4^{a} \pm 0.30$
	10	$5.41^{b} \pm 0.22$
	20	$4.85^{b} \pm 0.42$
	40	$5.06^{b} \pm 0.26$

Means bearing different superscripts in a column differs significantly ($p < 0.05$)

Table II. PVC of *Vibrio* sp. bacteria on the aquaculture media of Pacific White Shrimp (Meant ± SD)

Treatments	Duration (days)	PVC ± SD
Nanobubble	0	$2.65^{c} \pm 0.04$
	10	$1.75^{abc} \pm 0.13$
	20	$1.2^{a} \pm 0.31$
	40	$2.13^{bc} \pm 0.08$
Aerator	0	$3.4^{a} \pm 0.04$
	10	$5.41^{b} \pm 0.08$
	20	$4.85^{b} \pm 0.22$
	40	$5.06^{b} \pm 0.11$

Means bearing different superscripts in a column differs significantly ($p < 0.05$)

in the sample. PVC *Vibrio* sp. measurement was conducted in TCBS media growth and calculated with SNI01-2332.3-2006 method (Letchumanan *et al.*, 2005). The targets were hepatopancreas and water media. They were taken based on a previous study (Kusdarwati *et al.*, loc cit)). Data analysis of DO and PVC used ANOVA (Analysis of Variance) and Duncan Multiple Range Test (Kusriningrum, 2008).

Results and Discussion

The results of DO measurement in the aquaculture media of Pacific White Shrimp could be seen in Table I. It showed significant differences between nanobubble with aerators treatments ($p < 0.05$).

The nanobubble application in the Pacific White Shrimp showed higher and more stable DO compare with aerator. Nanobubble had a bubble size that contained oxygen gas in the water which was < 200 nm (Ebina *et al.*, 2013). It was due to its float rate at a level of 0.361 feet per second or 3610 times faster than microbubble that floated at rate of 0.0001 feet per second (Takahashi and Chiba, loc cit).

The result of *Vibrio* sp. PVC on aquaculture media is showed in Table II. It indicated a nonsignificant difference between nanobubble treatment with aerator ($p > 0.05$).

The result of *Vibrio* sp. PVC hepatopancreas is showed in Table III. It indicated a significant difference between nanobubble treatment with aerator ($p > 0.05$). The application of nanobubble on PVC of *Vibrio* sp in aquaculture media showed nonsignificant different than aerator. The bubbles from aerator and nanobubble would capture solids and pollutants suspended in the water and lift them to the surface. They were able to penetrate small cavities in contaminants so that they could wrap and lift the pollutants to the surface. It would maintain the water quality and organic matters in water (Maimunah and Kilawati, 2014). The pollutant or organic matter that accumulated in water was decomposed and decrease the ammonia level which posed a

Table III. PVC of *Vibrio* sp. bacteria on the hepatopancreas of Pacific White Shrimp (Meant ± SD)

Treatments	Duration (days)	PVC ± SD
Nanobubble	0	$3.65^{bc} \pm 0.04$
	10	$3.25^{cd} \pm 0.01$
	20	$2.65^{ab} \pm 0.04$
	40	$2.53^{a} \pm 0.03$
Aerator	0	$3.55^{bc} \pm 0.03$
	10	$3.06^{c} \pm 0.05$
	20	$2.9^{bc} \pm 0.02$
	40	$3.7^{c} \pm 0.03$

Means bearing different superscripts in a column differs significantly ($p < 0.05$)

threat to aquatic organisms (Mukti *et al.*, 2014). Poor water quality could cause stress on shrimp and disrupted its growth and body's resistance to infectious disease (Diansari *et al.*, 2013).

The application of nanobubble on PVC of *Vibrio* sp in hepatopancreas showed a significantly different than aerator. The increased oxygen in the medium increased the metabolism of Pacific White Shrimp so it could accelerate the deleterious effects of the pathogen in its body (Barbieri *et al.*, 2016). Characteristics of *Vibrio* sp. was an opportunistic pathogen, it could develop as pathogen if its environmental conditions and host deteriorate (Utami, 2016). The nanobubble application could improve the quality of the aquaculture system by maintaining a balance between the environment, host (shrimp) and pathogen. Prevention was the most effective action compared to treatment since it was carried out before the outbreak occurred and less cost (Mahasri, 2016).

Summary

The application of nanobubble has improved the quality of aquaculture by maintaining a balance between the environment, host and the pathogen.

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