Original Research Paper Management

PERFORMANCE EVALUATION OF ADD PURIFYING AGENT DISINFECTION ON LAND-BASED AQUACULTURE FARMS

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ABSTRACT

Land-based aquaculture is primary based on intensive farming due to limited water and land resources. With the characteristic of high stocking density, it will also result in a huge amount of excretion wastes and sources of infectious diseases. The deteriorated water environment will generate water bacteria and virus, thus causing reduced production volume of fish and shrimps due to virus infection. Therefore, in this study the green product of water purification No. 1 disinfectant is added into the pool water of aquaculture farm for sterilization efficacy assessment test. This is for the investigation of the impacts of different doses of purifying agents on the elimination of corynebacterium under different conditions of aquaculture environments. The water purification No.1 purifying agent is compared with common purifying agent to understand the pros and cons of the latest generation of disinfectant. The experimental results indicate that the concentration of 0.3PPM will lead to the best sterilization performance. Another experiment is conducted with the control group of BKC80% purifying agent under the same conditions of temperature, salinity, and concentration, and the result proves that the sterilization performance of water purification No.1 purifying agent is better than the control group of BKC80%. Thus we know that the addition of No.1 purifying agent can lead to effective reduction of virus and enhanced production volume.

KEYWORDS : Library and Information Center (LIC), Dimensions, Scale, Service Quality

INTRODUCTION

Management master Peter Drucker predicted in his book "Managing in the Next Society" that "At the same time, new and unexpected industries will no doubt emerge, and fast. One is already here: biotechnology. And another: fish farming. Within the next fifty years fish farming may change us from hunters and gatherers on the seas into" marine pastoralists " Therefore, fish farming will be massive potentialities in the future. (Drucker, 2003)". According the investigation of Food and Agriculture Organization (F.A.O) of United Nation, the growth of capture fishery has been gradually reduced in recent years. Currently marine fish has been reduced by 1/3. There was a supply shortage of 37 million tons of edible fish in the world in 2015 (Hwei-Zheng Lin, 2006). On the contrary, according to the estimation of aquaculture supply volume by Food and Agriculture Organization (FAO) in 2001, by 2010 the share of total fishery production volume accounted for by aquaculture would be increased from 20% to 40%, which would gradually replace the capture fishery. The trend of aquaculture becoming the source of human edible animal protein will be getting more and more obvious.

Among various countries with aquaculture fisheries, the aquacultu re industry in Taiwan has been ranked among the top. Taiwan is surrounded by the sea and equipped with unique aquaculture climate and environment, thus its aquaculture export trading has been ranked among the top countries in the world. However, along with climate change, aquaculture industry in Taiwan has adopted profit-oriented management in response to cost competition, which is based on intensive farming management with reduced cost and enhanced efficiency. Even though it can create short-term production profit, there will also be the long-term effects of high stocking density, greater investment (more feed, energy, and management investment), greater amount of excretion wastes, and the tendency of disease spreading. With poor management and deterioration of aquaculture environment, fresh water and sea water for aquaculture often contain bacteria and viruses, thus leading to frequent disease epidemic and high mortality rate of fish. Therefore, in recent years the aquaculture technologies in Taiwan have been heading towards green aquaculture with emphasis on producing the healthy, safe, and pollution free aquaculture products. However, water purification is the most important part of production of green aquaculture. The primary cause of the severe issue of drug residues of aquaculture nowadays is poor water quality management, which has led to fish diseases thus leading to even more usage of prohibited drugs. This vicious cycle has dramatically affected the environmental ecology and aquatic food safety. The convention aquaculture water quality disinfection and purification treatments are mostly based on the addition of purifying agents such as benzalkonium chloride, chloride, hydrogen peroxide or poridone iodine. However, these purifying agents often come with certain side effects which can cause significant environmental impact and safety hazards. Under current trend of environmental protection and safety appeal, there must be an alternative with green product feature in order to provide better performance.

The water quality disinfection and purification of aquaculture requires purifying agents based on recipes with strong sterilization capability and weak side effect. This is an urgent and essential demand of aquaculture industry under the current trend of environmental protection and food safety. Therefore, in this study it has been proposed to use water purification No.1 purifying agent as the raw material for water purification. This is the latest generation of disinfectant composed of peroxide with green product features of strong sterilization capability, fewer side effects, and reduced environmental hazards. It has been used in aquaculture for years, yet there has not been a complete mechanism for the use of this purifying agent No.1, especially the optimal addition, which is yet to be investigated. This is one of the motivations for us to be dedicated to this study. Figuring out the optimal addition of water purifying No. 1 is one of the directions to be investigated in this paper; another motivation of this study is to find out whether or not there is specific evidence proving water purifying No.1 performs better than the common chemical purifying agent BKC80%, and this is also an issue of concern among companies which would like to use this product.

Experiment

(1) Material: water purifying No.1

(A): The disinfectant used in this experiment, "water purifying No.1", is provided by Lee Wang Company. It is composed of: peroxygen compound, polyacetylated amino compound, stabillzers, catalyst, sequestrant, and surfactant.

(B).BKC80%: another disinfectant used in this experiment, "BKC80%", is provided by Shan Yong Hang Company. BKC80%: Benzalkonium chloride is simply known as BKC; its Chinese name is "Benzalkonium chloride".

Table 1. Comparison of water purifying No.1 and BKC

ProductItem	Water purifying No.1	Benzalkonium chloride (BKC)
oxygenation	High: 0.01/L	It causes lack of oxygen

Toxicity(LD 50) Rat (ingestion)	1800-4300mg/kg	300mg/kg
Trace standard	Food additive use range and dosage standard are based on free effective chlorine residue in drinking water＜ 0.05ppm。	Toxic, which cannot be used by equipment of food factory.
Volatility	Low	High and pungent
Corrosiveness	None	Medium
Immediately Dangerous to Life or Health Concentration (IDLH)	None	200PPM
Biodegradability	Good	Poor

(2) Experimental bacteria strain and its culture

The V. alginolyticus pathogen used in this experiment is isolated from sick white shrimp (Liu et al., 2004). Pathogens were cultured in TSB medium, and the salt concentration of this medium is 2.5% NaCl. The temperature is set at 27℃ during the 24-hour culture period. After culture, it will be centrifuged for 20 minutes in the centrifuge (HITACHI, CF16RX, Tokyo, Japan) at 8000 rpm and 4oC. After centrifuge, the upper clear liquid is removed, and it is rinsed by 0.85% of sterilization NaCl solution before collecting pathogen under the identical centrifuge condition to be used in the subsequent experiment.

(3) Sterilization design

The sterilization agents include the water purifying No.1/BKC80% provided by (A) company, and the pre-determined sterilization concentrations are 0 (control group), 0.1 and 0.3 ppm. The sterilization test is conducted in a 1-liter flask to observe the impacts of salinity and temperature on sterilization agents of water purifying No.1/BKC80%. Flasks containing sterilized sea water with different salinity (10 and 35 ppt) are placed in incubators of different temperatures (20 and 30oC). There are 3 repeated experiment groups for each condition, so there are a total of 12 groups including the control group. As for BKC80%, there are 3 repeated experiment groups for each condition, so there are a total of 12 groups including the control group.

After all the experimental conditions are set up, the cultured V. alginolyticus is added to each experimental group for the concentration to be 106 cfu/ml. And then pre-determined water purifying No.1 concentrations/BKC80% concentrations are added into the flask of each experimental group. 2 hours later, water is sampled from these groups for analysis of the number of bacteria.

The analysis of the number of bacteria is based on the plate count method. The properly diluted water sample is evenly spread onto the vibrio selective medium TCBS agar (thiosulfate-citrate-bile salts-sucrose). It is placed in the constant temperature (27 oC) incubator for 24 hours before the colonies are counted, and then it can be converted to the actual number of bacteria in the water sample to evaluate the sterilization effectiveness.

Experimental results and discussions

I. Collection of experimental data:

The results of sterilization by sterilization agents water purifying No.1/ BKC80% with respect to Vibrio alginolyticus under different salinities and temperatures are as shown in Table 1 and Table 2. The sterilization effectiveness is presented by sterilization rate based on one-hour and two-hour observations as shown in the equation below:

Sterilization rate=[(Original colony count-colony count after experiment)/ Original colony count]*100% Original colony count: the colony count obtained before the experiment Colony count after experiment: the colony counts observed after one-hour and two-hour experiments. The higher sterilization rate indicates better performance of water purifying agent.

The results of sterilization of sterilization agent water purifying No.1 with respect to V. alginolyticus are as shown in Figure 1~4. The results of experiments indicate good and significant sterilization effectiveness of water purifying No.1 with respect to V. alginolyticu. With temperatures at 20 oC or 30 oC, or salinity at 10 ppt or 35 ppt, the treatment by 0.1 or 0.3ppm are all leading to significant decline of number of bacteria in the water. This result indicates that water purifying No.1 used under aforementioned conditions can achieve the expected sterilization effectiveness

Table 1. Observed statistics of sterliziation rate of water purifying No.1

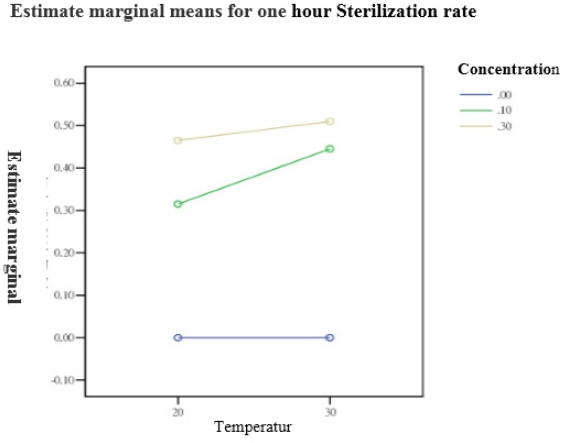
Temperature (oC)	Salinity (ppt)	Concentration (ppm)	Original colony count	1 hour colony count	1 hour sterilization rate	2 hour colony count	2 hour sterilization rate
30	10	0	3.3	3.3	0%	3.3	0%
		0.1	3	0.8	73%	0.5	83%
		0.3	5.8	0.4	93%	0.23	96%
	35	0	11.4	11.4	0%	11.4	0%
		0.1	10.5	0.7	93%	0.4	96%
		0.3	11	0.2	98%	0.1	99%

Table 2. Observed statistics of sterliziation rate of BKC80%

Temperature (oC)	Salinity (ppt)	Concentration (ppm)	Original colony count	1 hour colony count	1 hour sterilization rate	2 hour colony count	2 hour sterilization rate
30	10	0	3.3	3.3	0%	3.3	0%
		0.1	3	2.8	7%	2.7	10%
		0.3(ppm)	5.8	5.3	9%	5.2	10%
	35	0(ppm)	11.4	11.4	0%	11.4	0%
		0.1(ppm)	10.5	10	5%	9.8	7%
		0.3(ppm)	11	10.6	4%	10.4	5%

The preset conditions of this experiment are rather restricted. Especially the highest concentration of water purifying No.1 is only 0.3 ppm. The experimental results indicate that the water purifying No.1 with concentration at 0.3 ppm is the one with the best sterilization effectiveness which can truly effectively inhibit the growth of V. alginolyticus. In addition, this experiment is only targeting the V. alginolyticus isolated by this laboratory, and it obviously indicates that the sterilization agent water purifying No.1 is also effective against other bacteria strains. The statistical analyses of data of both 1-hour and 2-hour experiments indicate that the sterilization performance of water purifying No.1 is the best when the concentration is at 0.03PPM.

Estimate marginal means for one hour Sterilization rate Concentration



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ConcentrationFigure 1 Sterilization effectiveness of water purifying No.1 at different temperatures and different concentrations after 1 hour of experiment

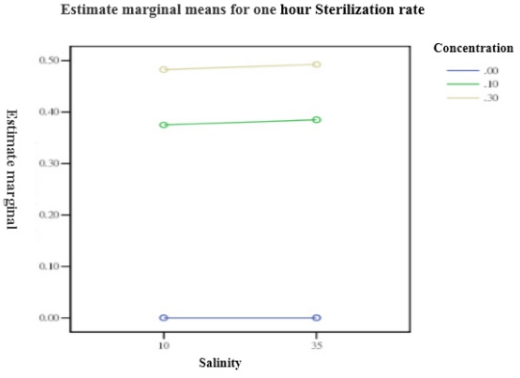

Figure 2 Sterilization effectiveness of water purifying No.1 at different salinities and different concentrations after 1 hour of experiment

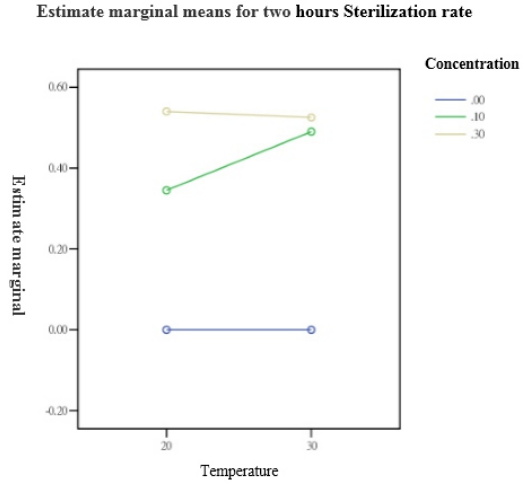

Figure 3 Sterilization effectiveness of water purifying No.1 at different temperatures and different concentrations after 2 hours of experiment

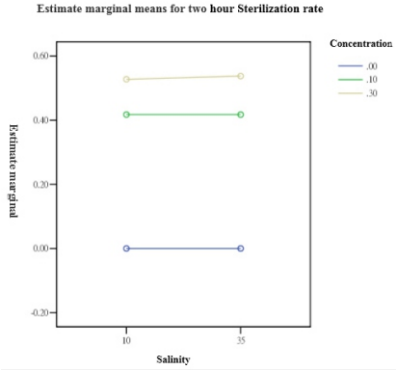

Figure 4 Sterilization effectiveness of water purifying No.1 at different salinities and different concentrations after 2 hours of experiment

III: Statistical analysis of comparison between water purifying No.1 and BKC80%

Based on the sterilization result of sterilization agent water purifying No.1 with respect to *V. alginolyticus* in this experiment, a control group of BKC80% is also set up under the same conditions of temperature, salinity and concentration. The preset conditions of this experiment are rather restricted. The highest concentration is only 0.3 ppm. The experimental results are as shown in Figure 4-10, which shows that under all kinds of conditions, the sterilization agent water purifying No.1 performs better against *V. alginolyticu than BKC80%.*

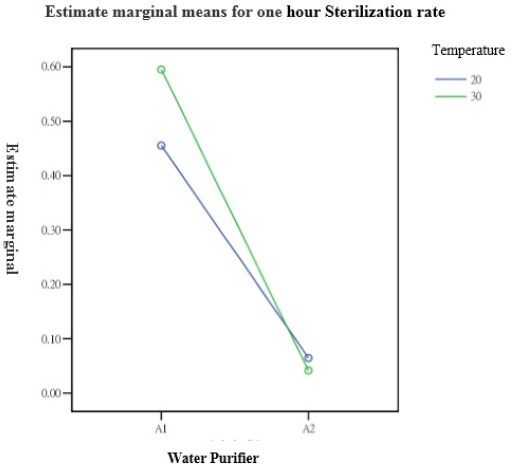

Figure 5 Sterilization effectiveness of water purifying No.1 (A1) and BKC% (A2) at different temperatures after 1 hour of experiment

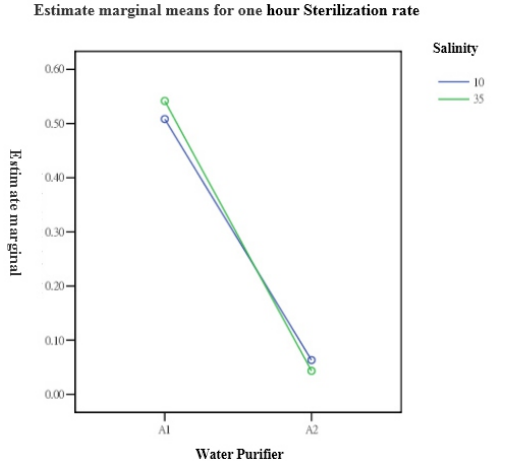

Figure 6 Sterilization effectiveness of water purifying No.1 (A1) and BKC% (A2) at different salinities after 1 hour of experiment

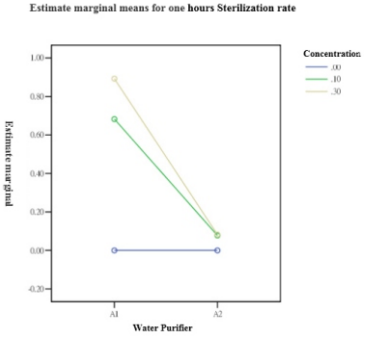

Figure 7 Sterilization effectiveness of water purifying No.1 (A1) and BKC% (A2) at different concentrations after 1 hour of experiment

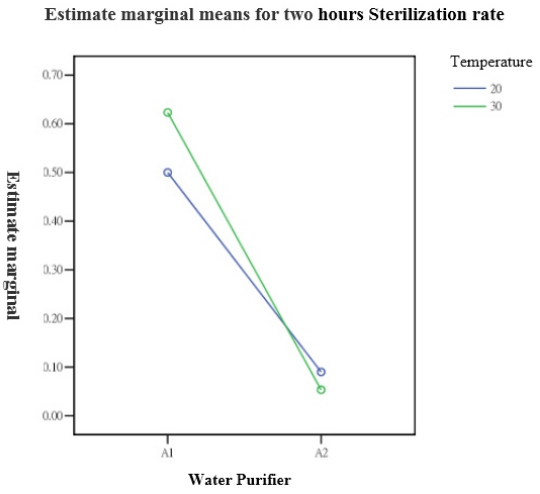

Figure 8 Sterilization effectiveness of water purifying No.1 (A1) and BKC% (A2) at different temperatures after 2 hours of experiment

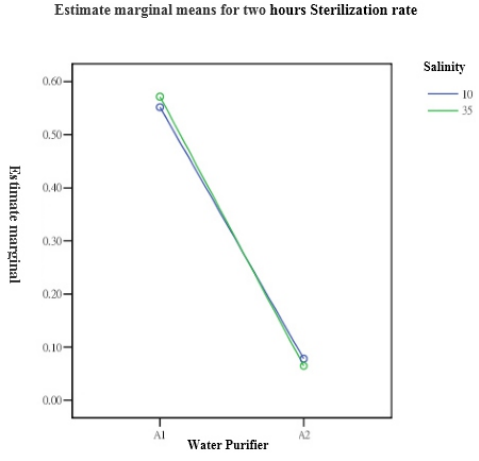

Figure 9 Sterilization effectiveness of water purifying No.1 (A1) and BKC% (A2) at different salinities after 2 hours of experiment

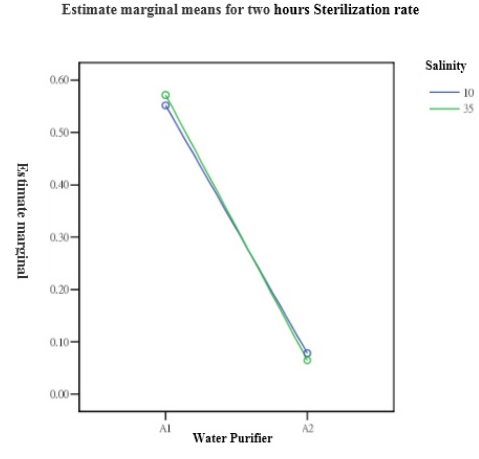

Figure 10 Sterilization effectiveness of water purifying No.1 (A1) and BKC% (A2) at different concentrations after 2 hours of experiment

I. Water purifying No.1 and BKC80%

CONCLUSIONS

In densely populated Taiwan with limited water and land resources, aquaculture industry has adopted profit-oriented management in response to cost competition, which is based on intensive farming management with reduced cost and enhanced efficiency. Companies in this industry failed to properly handle the aquaculture system, water quality condition, feed ingredient, stocking density, and drug feed control, thus leading to deteriorati on of land-based aquaculture farm, and increased usage of drugs against worsening bacteria and viruses in fish. The government also failed on market control, thus resulting in issues of drug residues in aquaculture products. The solution of this problem will rely on promotion of green aquaculture by cooperation between government and industry.

The water quality management of green aquaculture emphasizes on zero toxicity and zero pollution. Therefore, environmental friendly water purifying agents in coordination with other water purifying circulation system have been the essential part of green aquaculture. The utilization of revitalized water quality method to promote fish health to allow them to grown in a natural environment will result in reduction of bacteria and viruses in fish body, thus leading to reduced drug usage and residual drug in fish body. This is how we can improve environmental protection and food safety.

As the research subject of this paper, water purifying No.1 is a green product which is harmless to the environment, so it should be promoted in green aquaculture. Its environmental friendly appeal of zero toxicity and zero pollution is an important requirement of water quality purifying agent for green aquaculture. Our study and experiments have led to the following specific conclusions.

The experiments under different conditions of aquaculture environment have revealed that the water purifying No.1 with concentration at 0.3 ppm is the one with the best sterilization performance, which can indeed effectively inhibit the growth of V. alginolyticus.

Targeting the features and performance of water purifying No.1, the comparison has been made with common purifying agent BKC80% under the same conditions of temperature, salinity and concentration. And the result indicates the significant performance of water purifying No.1 when it comes to eliminating coryneba cterium.

REFERENCES

[1] Babb, J.R., Bradley, C.R., Ayliffe, G. (1980): Sporicidal activity of glutaraldehydes and hypochlorites and other factors influencing their selection for the treatment of medical equipment. Journal of Hospital Infection 1(1),63-75.
[2] Baldry, MGC. (1983): The bactericidal, fungicidal and sporicidal properties of hydrogen peroxide and peracetic acid. Journal of Applied Bacteriology 54(3),417-423.
[3] Baldry, M.G.C., and J.A.L. Fraser (1998): Dinsinfection with peroxygens.Critical Reviews in Analytical Chemistry22(1), 91-116.
[3] Best, M., Sattar, S.A., Springthorpe, VS (1990): Efficacies of selected disinfectants against Mycobacterium Tubercolosis. Journal of Clinical Microbiology 28(10),2234-2239.
[4] Casemore, D.P., Blewett, D.A., Wright, S.E.(1988): Cleaning and disinfection of equipment for gastrointestinal endoscopy: interim recommendations of a Working Party of the British Society of Gastroenterology. Gut 29(8),1134-51.
[5] Bradley, C.R, Babb, J.R., Ayliffe, G.A.J. (1995) Evaluation of the Steris System 1 peracetic acid endoscope processor. Journal of Hospital Infection 29(2),143-151.
[6] Corrado, O.J., Osman, J., Davies, R.J. (1986) Asthma and rhinitis after exposure to glutaraldehyde in endoscopy units. Human Toxicology 5(5),325-328.
[7] Drucker P.F. (2003) Mangement in the next society St.Martins Press. 1-224.
[8] Dunsmore, D.G., Making, D., Arkins, R. (1985) Effect of residues on five disinfectants in milk on acid production by strains of lactic starters used for cheddar cheesemaking and on organoleptic properties of the cheese. Journal of Dairy Research52(2),287-297.
[9] Dwyer, D.M., Klein, E.G., Istre, G.R. (1987) Salmonella newport infections transmitted by fiberoptic colonoscopy. Gastrointest Endosc 33(2), 84-87.
[10] Fleming, S.J., Foreman, K., Shanley, K. (1991) Dyaliser reprocessing with renalin. Am J Nephrol 11(1), 27-31.
[11] Gilbert, P., Das, J.R., Jones, M.V. and Allison, D.G. (2001) Assessment of resistance towards biocides following the attachment of micro-organisms to, and growth on, surfaces. Journal of Applied Microbiology 91(2), 248-254.