Eastern Anatolian Journal of Science
Volume III, Issue I, 1-5
ISSN: 2149-6137

Biocide Use and Its Potential Risks in Aquaculture in Turkey

IBRAHIM CENGIZLER[1], NECDET AYTAC[2] and RUHAY ALDIK[3]

[1]*Cukurova University, Faculty of Fisheries, Aquaculture Department, Adana, Turkey*
[2]*Cukurova University, Faculty of Medicine, Public Health Department, Adana, Turkey*
[3]*Cukurova University, Faculty of Fisheries, Aquaculture Department, Adana, Turkey*

Abstract

Aquacultural production is a rapidly growing industry in our country, as well as all over the world. It consisted 73.8 million tons fish production of 167.3 worldwide in 2014, as 240.3 thousand tons fish production of 672.2 in Turkey in 2015; resulting ın an increasing impact on sea and fresh water ecosystems.

As the sector expands, there is an increasing use of the disinfectants, chemicals and antifouling products in the production areas. Regulations have been made about these chemicals for the potential risks upon the enviromental and human health. In order to prevent contamination, the directive 98/8 of the European Union has permitted the use of disinfective agents (iodoforms, haloorganic compounds, aldehydes, metal salts, hydrogen peroxide) in caviar, ponds and equipments, while the use of other chemicals has been subjected to special permission. Biocide applications has been found to be more harmful in marine environment. Particularly, biocides as DCOID, chlorothalonil, dichlofluanid, diuren and zineb which are exist in antifouling paints, used for prevention of the equipments in aquacultural production are considered to be highly toxic chemicals.

Three possible risks may be considered about the use of biocides in production,

1. Biocides accumulating in fish and shellfish may contaminate predator and human consumers,
2. Resistance may develop in bacteriae
3. Pollution of natural ecosystem (natural resources of production: river, lake fishery, marine)

Knowing the presence of biocides in water environments and its related risks, and ensuring the safe use of water profile are considered essentially important for protecting aquatic organisms and public health. More scientific research in this issue is needed.

Keywords: aquacultural production, biocide, risk, public health

Introduction

Aquaculture is a very fast growing sector in our country as it is in the whole word especially in recent years. In the world, total production of fish was reported 167,3 million tons, of which 73,8 million tons were obtained by aquaculture in 2014. In Turkey, total production is 672,2 thousand tons according to 2015 data. 240,3 tons of this was obtained by aquaculture (K. www.tarim.gov.tr). This rapid growth has brought with it a greater burden on freshwater and marine ecosystems. It is inevitable that the crop grown in intensive aquaculture areas will encounter more health problems. In this case, more disinfectants, drug and antifouling ptoducts are required to be used. Broadly speaking, biocide use is becoming more and more popular in the aquaculture. Another interesting point is that the EU directive 98/8 EC Biocidal products prepared in accordance with directive entered into force on 31.12.2009. Pesticides, which are the 17th product type of this regulation, are products used for fish control, are not licensed in our country as it is in many European countries for ecological protection (EUROPEAN PARLIAMENT and OF THE COUNCIL 1998). Some disinfectants and antifouling products unfortunately are still used unlicensed.

Received: 20.12.2016
Revised: 15.03.2017
Accepted:18.03.2017
Corresponding author: İbrahim Cengizler, PhD
Cukurova University, Faculty of Fisheries,
Aquaculture Department, Adana, Turkey
E-mail: icengiz@cu.edu.tr
Cite this article as: İ. Cengizler, N. Aytaç and R. Aldık, Biocide Use and Its Potential Risks in Aquaculture in Turkey, Eastern Anatolian Journal of Science, Vol. 3, Issue 1, 1-5, 2017.

The Biocide Used in Aquaculture

Aquaculture not only includes fish farming, but also aquatic life such as mollusc, crustacean and water plants (MUÑOZ et al. 1996). The rapid growth of the sector has begun to influence the environment and natural resources significantly (DIEBERG and KIATTISIMUKUL 1996; CENGIZLER 2006). Products other than fish farming in our country are not yet widespread. For this reason, fish farming will be in the foreground.

Chemical and biological products used in aquaculture are; antibacterials, antiparasitics, antiseptics and anesthetics, disinfectants, pesticides, antifauling products and feed additives (CENGIZLER 2006). These will be examined individually, especially in aquaculture (sea and fresh water); antibacterials, antiparasitics and pesticides are important because of their inherent environmental and human health risks.

According to the data of 2015 in our country, a total of 2377 aquaculture facilities are found, 427 of them are in the sea and 1950 are in the inland waters(www.bsgm.gov.tr). If the biocides used for the treatment and prophylactic purposes of diseases occuring in these facilities are to be considered according to the order of importance;

1. Antibacterials
2. Antiparasitics
3. Disinfectants
4. Antifaulin agents

Antibacterials

Antibacterial compunds have been shown to be the most widely used compounds. According to a research done in Elazığ province trout cultivations, all 39 facilities are found to be using antibacterial medicines (YANEN 2016). The reason of this is that the use of antibiotics and antibiogram tests are not prescribed, only medication is recommended. In a research carried out abroad, it was determined that 17 kinds of medicine were used from 10 different antibacterial medicine groups in Pangasius cultivation in Vietnam (RICO et al. 2013). In our country, medicine diversity in marine fish farming is not much, but its use is widespread. The most risky aspect is the use of random antibacterial medicines without antibiograms and the mixing of the medicine with the estimated dose or addition to the water. Despite its benifits in the aquaculture, the sediment accumulates and the medicine becomes aquatic life and a threat to human health (GUARDIOLA et al. 2012). In fact, the medicine in the water column is rapidly diluted and undergoes photodegradation. Sediment sludge is a good preservative for waste medicine. The stomach of fish is also an important waste medicine source. In a survey conducted; it has been shown that oxytetracyclin, widely used in aquaculture, is absorbed only by 7-9% in the intestines of rainbow trout and is thrown by gaita by 90% (CRAVEDI et al. 1987). The aerobic degradation of organic sunstances in the aquatic environment, the formation of non-toxic substances such as cobalt dioxide and nitrates, the presence of antibacterial residues in the environment causes anaerobic degradation rather than aerobic degradation, results in final products which are toxic (DONALD 1996).

Antiparasitics

Around the wolrd, around 13 compounds are commonly used for external and internal treatment of parasites and fungi which do not cause mortalities but cause a lot of damage (RICO et al. 2013). Organo-phosphate compunds are used in the control of ectoparasites crustaceans and in the treatment of trematodes. In our country, the use of antiparasitesis are not common. However, dichlorophosphate for Lepeophtherius salmonis, an ectoparasite in marine fish, and Larnea and Angulus parasites in freshwater, is used (YANEN 2016). The most commonly used one praziquantel, is given by incorporating the food. About the use of antiparasitic medicines, the toxic effect of non-target organisms has been the subject of debate. One of the few proofs about it; after the treatment of 300ppm Neguvon given to Salmon grown in cage in Norway, there were unexpected deaths of lobsters (*Homorus gammarus*) around the cage. Subsequent experiments have started deaths at a 0.5ppm NEvugon dose after 24hours (EGIDIUS and MØSTER 1987). In our country, there is also use of antiparasitic medicines in sea cage cultivation. But it is advantageous if it is not widespread.

Disinfectants

Disinfectants used in aquaculture systems may have undesirable effects on non-target organisms. In a survey, 15 different disinfectants were used in 89% disinfection, 10% treatment and 1% operational in aquaculture enterprises (fish and crustacean

production) in China, Bangladesh, Thailand and Vietnam, four major producer country in Asia (RICO et al. 2013). The use of disinfectants for treatment and protection is also common in our country. Especially formaldehyde, copper sulfate, iodine potassium permanganate, sodium hydrochlorite are preferred because they are cheap and easy to obtain. Use is more conservative. However, the residues are discharged by discharge water. The frequency of use ranges from one week to three months. Dilution rates of diluted waste are unknown.

Antifaulants

As it is known, in the marine environments, the growth of vocal organs on the surfaces of unnatural substratum (such as net cage, ship siege) in water is an event (RAILKIN 2004). Figure 1 shows two examples of biofuels organisms (WILLEMSEN 2005). Especially in marine net cages, biofouling organisms can develop at different densities depending on the region of the cage, the local environmental condition and the season. Production of Biofouling organisms is a limiting factor. It can change the flow of water as it damages the equipment, and it can also directly damage the crustacean. For this reason, it is necessary to combat with biofouling organisms (LANE and WILLEMSEN 2004). This is also a problem for navigation. In order to combat the aquaculture, either mechanical cleaning is performed, biocidal layer is applied to the nets and other materials. The use of biocide is still the most common method. The biocides used are: copper, DCOIT, chorothalonil, dichlofluanid, diuren and zineb. These biocides passively diffuse into the aquatic organisms through the gill, epithelial tissue and digestive tract. Different concentrations can cause death. There is antifouling products usege in our country, but there is not enough information and publications.

Figure 1. Barnekle fauling on oyster (top), Hidroyid fauling on nylon net (below) (Willemsen).

The Effects of Biocides on Human Health

Biocidals pass into human body trhout skin and respiration during usage, and to the athers via digestive system or air with contaminated food (PIMENTEL et al. 2013).

Studies have shown that biocides are harmful to human skin, digesitve, respiratory, nervous, reproductive and endocrine systems and are carcinogenic (SANBORN et al. 2007). They also cause birth defects, low birth weight and stillbirth (BALDI et al. 2010).

Conclusions and Recommendations

Biocides used in aquaculture;

1. Cultivated organism,
2. Aquatic organism and surrounding area,
3. Accumulated in present day, it can directly or indirectly harm human beings.

The development of resistant bacteria, especially in EU use, threatens human and animal health.

Recommendations for the use of antibiotics:

1. An antibiogram should be made for the pathogens, if this is not possible, it should be selected from

previous applications and a medicine which is economically and easily obtained.

2. The EU should be stored in appropriate conditions. The expiration date must be observed, and licensed ones should be used.

3. The correct dose and recommended duration should be observed.

4. If the fish is unappetizing, avoid using oral medication.

5. Avoid using the same antibacterial agent for protective purposes, rotation should be applied.

6. Antibacterial resistance occurrences should be routinely monitored.

7. It must be kept away from the polyp.

8. Each medicine usege must be recorded.

Unfortunately, in our country, there is no detalied legal regulation regarding biocidal use in aquaculture. In addition, there is no regular monitoring. There was no research related to the subject. Raising awareness of producers in the aquaculture sector, which is one of the fastly developing sector in our country, seems to be important. For example; you should know that the antibacterial product will be consumed with a 500day/ degree (if the water temperature is 20 degree, 500/20=25days, only 25days after the medication use, sale maybe offered).

References

BALDI, I., GRUBER, A., RONDEAU, V., LEBAILLY, P., BROCHARD, P., FABRIGOULE, C. (2010), Neurobehavioral effects of long-termexposure to pesticides: results from the 4-year follow up of the PHYTONER study. Occup. Environ. Med. 68 (2), 108–115. http://dx.doi.org/10.1136/oem.2009.047811. PMID 21097948.

CENGİZLER, I. (2006), Balık Hastalıkları Ders Kitabı. Çukurova Üniversitesi Su Ürünleri Fakültesi Yayınlan, Yayın No:7 Adana, ., 2000 117s.

CRAVEDI J.P., CHOUBER G., DELOUS G. (1987), Digestibility of chloramphenicol, oxolinicacid and oxytetracycline in rainbow trout and influence of these antibiotics on lipid digestibility. Aquaculture, 1987 60:133-141.

DIERBERG F.E., KIATTISIMUKUL W. (1996), Issues, impacts, and implications of shrimp aquaculture in Thailand. Environ. Manag. 1996;20:649–666.

DONALD P., WESTON. (1996), Ecological Effects of the Use of Chemicals in Aquaculture Proceedings of the Meeting on the Use of Chemicals In Aquaculture in Asia 20-22 May 1996; Tigbauan, Iloilo, Philippines.

EGIDIUS E., MØSTER B. (1987), Effect of Neguvonand Nuvantreatment on crabs (*Cancer pagurus, C. maenas*), lobster (*Homarus gammarus*) and blue mussel (*Mytilus edulis*). Aquaculture 1987., 60:165-168.

EUROPEAN PARLIAMENT AND OF THE COUNCIL (1998), Directive 98/8/EC of the European Parliamentand of the Council of 16 February Concerningthe Placing of Biocidal Products on the Market. Official Journal of the European Communities L 123/1 of 24.04.98. 1998.

GUARDIOLA FA, CUESTA A, MESEGUER J, ESTEBAN MA., (2012), Risks of Using Antifouling Biocides in Aquaculture. International Journal of Molecular Sciences. 2012;13(2):1541-1560. doi:10.3390/ijms13021541.

LANE A., WILLEMSEN P.R. (2004), Collaborative effort looks into biofouling. Fish Farming International September 2004: 34-35.

MUÑOZ I., MARTÍNEZ BUENO M.J., AGÜERA A., FERNÁNDEZ-ALBA A.R. (1987), Environmental and human health risk assessment of organicmicro-pollutants occurring in a Spanish marine fish farm. Environ. Pollut.2010;158:1809–1816.

PIMENTEL, D., CULLINEY, T.W., BASHORE, T. (2013), Public Health Risks Associated with Pesticides and Natural Toxins in Foods. IPM World Textbook. Regents of the University of Minnesota.

RAILKIN A.I. (2004), Marine biofouling: colonization process and defenses. 2004. ISBN 0-8493-1419-4. CRC Press.

RICO, A., PHU, T., SATAPORNVANIT, K., MIN, J., SHAHABUDDIN, A. M., HENRIKSSON, P. J. G., VAN DEN BRINK, P. J. (2013), Use of veterinary

medicines, feed additives and probiotics in four majör internationally traded aquaculture species farmed in Asia. Aquaculture, 412–413, 231–243. DOI: 10.1016/j.aquaculture.2013.07.028.

SANBORN M, KERR KJ, SANIN LH, COLE DC, BASSIL KL, VAKIL C. (2007), Non-cancer health effects of pesticides. Systematic review and implications for family doctors. *Can Fam Physician*(2007) 53:1712–20.

WILLEMSEN P.R. (2005), biofoulingin european aquaculture: ıs there an easy solution? TNO Scienceand Industry, Corrosion and Fouling Prevention, PO Box 505, 1780 AM, Den Helder, The Netherlands, peter.willemsen@tno.n.2005

YANEN R., 2016. Keban Baraj Gölü (Elazığ)'nde Yer Alan Alabalık Üretim Tesislerinde Kullanılan Medikamentler, Aşılar Ve Etkinliklerinin Araştırılması ,Yüksek Lisans Tezi Çukurova Üniv. Fbe, 2016 Adana Yayınlanmamış.