Zagazig J. Agric. Res., Vol. 48 No. (3) 2021 817-827

Animal, Poultry and Fish Production Research

Available online at http://zjar.journals.ekb.eg

http:/www.journals.zu.edu.eg/journalDisplay.aspx?Journalld=1&queryType=Master

EFFECTS OF POLY CULTURE SHRIMP, *Litopenaeus vannamei* WITH KEELED MULLET, *Liza carinata* AT DIFFERENT DENSITIES COMPARED TO THE MONOCULTURE SYSTEM ON PHYSICO-CHEMICAL WATER QUALITY

Abdo Sh. Hassan[1*], A.M. Helal[1], A.A. El-Darawany[2] and Ayyat M. Salah[2]

1. Fish Rearing Lab, Aquac. Division, Nat. Inst. Oceanography and Fisheries (NIOF), Egypt

2. Anim. Prod. Dept., Fac. Agric., Zagazig Univ., Egypt

Received: 17/03/2021 ; Accepted: 20/06/2021

ABSTRACT: The present study was conducted to evaluate the effect of polyculture shrimp, *Litopenaeus vannamei* with keeled mullet, *liza carinata* at different densitiescompared to the monoculture system on Physico- Chemical water quality. In a complete randomized design, 15 glass aquaria (80×30×40 cm - 96 L) randomly distributed into in 5 treatments group (in triplicates). Each aquaria was stocked with 12 aquatic animals. In first experimental group was stocked with *L. carinata* only as monoculture (T_1; Fish 100%). Similarly, second experimental group was stocked with *L. vannamei* only as monoculture (T_2; Shrimp 100%). Experimental treatments of T3-T5 groups were stocked with both *L. carinata* and *L. vannamei* in polyculture at densities of (fish 25%: shrimp 75%), (fish 50%: shrimp 50%) and (fish 75%, shrimp 25%), respectively. Over the 12-weeks period, all water quality parameters were observed within the acceptable range for both *L. carinata* and *L. vannamei* either monoculture or polyculture systems. The results showed that water salinity was ranged between 30.15 to 32.30ppt, water temperature from 25.32 to 30.90°C, dissolved oxygen(6.17 to 7.09 mgL^{-1}) and pH (7.07 to 7.83)without any statistical differences ($P \geq 0.05$).The concentration of phosphorous (PO_4) ranged from 00.05±0.02 - 0.009±0.002 mg/l. The highestPO_4 values was recorded for (T1) followed (T5). The highest TAN values was recorded for (T1) followed (T5), while the lowest values were recorded in either T3 or T2. The same trend was observed for NO_3. The concentration of NO_2 ranges from 0.001 to 0.09 mg/L. The results of present study suggested that a clear effect of mixed culture of *L. carinata* with *L. vannamei* in polyculture system to purify the water pond through food residues or undigested food and improve physico-chemical water quality.

Key word: Polyculture, monoculture, water quality, shrimp, keeled mullet.

INTRODUCTION

Aquaculture continues to pioneer the advancement of intensive cultivation technology in order to increase the production and to meet people's protein needs. The use of various natural products in aquaculture as immune stimulants has been reported to be effective in reducing the evidence of disease in fish and shrimp aquaculture and increasing production (**Manoppo *et al*., 2015; Sharawy *et al*., 2020**).

Intensive development of the aquaculture industry has been accompanied by an increase in environmental impacts. Aquaculture has negative environmental, social and economic impacts in the absence of appropriate control programs. Ecosystems are not always as fragile as could be considered, instead, they have a remarkable capacity of resiliency (**Frankic and Hershner, 2003**).

The production process generates substantial amounts of polluted effluent, containing uneaten feed and feces (**Piedrahita, 2003; Sugiura *et al*.,**

Corresponding author: Tel. : +201027661210
E-mail address: abdo_shabrawy@yahoo.com

2006). High levels of nutrients cause environmental deterioration of the receiving water bodies (**Thompson *et al*., 2002**).

Shrimp farming has been historically related to negative environmental impacts including alteration of wetlands, land subsidence, pollution of agricultural lands and coastal waters by pond effluents and sludge, increased of pathogens into coastal environment, and subsequent loss of goods and services generated by natural common property resources (**Paez-Osuna, 2001; Paez-Osuna *et al*., 2003; Azad *et al*., 2009**).

Several studies have concentrated on the design and development of alternative farming systems for the integrated culture of aquatic organisms **(Pacheco-Vega *et al.*, 2018)**. Researchers have been experimenting with co-culturing shrimp with a number of species, including tilapia **(Muangkeow *et al*., 2007; Yuan *et al*., 2010)**, milkfish (**Jaspe *et al*., 2011**), mullet (**Costa *et al*., 2013)**, and seaweeds (**Lombardi *et al*., 2006; Cruz-Suárez *et al*., 2010**). In most cases, water quality, overall production, and survival were improved compared to monoculture (**Liu *et al*., 2014**).

The polyculture system is highly productive and can be very lucrative, with a low environmental impact (**Vinatea, 1999; Valenti, 2002**).

The polyculture as integrated practiced system in aquaculture via stocking of fish species of different food habits proved to be an important management tool in utilizing efficiently the natural food resources in the fish pond. Synergistic interactions among fish species are manifested by higher growth and yield in poly-culture than in monoculture. The bases for these interactions are the increase of available food resources and the improvement of environmental conditions **(Shaker *et al.*, 2013)**. Although, polyculture is not yet common practice. The perceived low profitability of extensive aquaculture systems, in which poly-culture are mostly performed is considered to be a downside.

Hoang *et al. (*2020) concluded that the combination of shrimp and fish in polyculture and biofloc has additive effects at the level of animal production and synergistic effects at the level of some water quality parameters.

Akiyama and Angawati (1999) reported that the polyculture of penaeid shrimps with omnivorous fishes such as tilapia showed an improvement in water quality as fish fed on organic wastes **(Cruz *et al*., 2008).**

Martinez-Porchas *et al*. (2010)reported that shrimp polyculture is not yet a common practice among farmers; however, this activity represents an important alternative to solving and minimizing some of the problems that shrimp aquaculture has faced in the past two decades (environmental pollution, diseases, and decreasing prices).

The intensive monoculture shrimp faces two major problems. Firstly, water quality deterioration caused by a high concentration of metabolites and secondly, low nutrient utilization efficiency and high water exchange within or outside the pond system **(Avnimelech, 2007)**. Wastewaters, containing high nitrogen and phosphorus concentrations, are often discharged directly into canals and rivers leading to oxygen depletion and eutrophication **(Anh *et al*., 2010)**. This has raised several concerns about the persistence of toxic compounds in aquatic environments and in harvested animals as well **(Business, 2003)**. However to reduce the outbreak or spread of shrimp disease and water quality degradation, many remediating actions have been suggested. One of the most practical methods is Integrated Multi-Trophic Aquaculture (IMTA) system as polyculture which caters for an enhanced nutrient recycling relative to conventional farming systems, as species with different trophic levels are used, providing also an opportunity for diversification and increased yield of both crustaceans and fish, according to **(Troell *et al*., 2009; Barrington *et al*., 2010)**, as well as appears to prevent shrimp disease outbreaks **(Liu *et al*., 2014)**.

Water must be tested with different physic-chemical parameters. Selection of parameters for testing of water is solely depends upon for what purpose we going to use that water and what extent we need its quality and purity. Water does content different types of floating, dissolved, suspended and microbiological as well as bacteriological impurities. Some physical test should be performed for testing of its physical appearance such as temperature, color, odour, pH, turbidity, TDS etc, while chemical tests should be perform for its BOD, COD, dissolved oxygen, alkalinity, hardness and other characters **(Patil *et al.*, 2012)**.

This study was conducted to determine the effect of the polyculture of shrimp, *Litopenaeus vannamei* with Keeled mullet, *Liza carinata* at different densities on water quality compared to the monoculture system of both Liza carinata and litopenaeus vannamei.

MATERIALS AND METHODS

Experimental Design

The present study was carried out in Fish Rearing Laboratory at National Institute of Oceanography and Fisheries (NIOF), Gulfs of Suez & Aqaba's Branch, Suez Governorate, Egypt. The experimental period of 12 weeks started during September to November 2019.

Shrimp, *Litopenaeus vannamei* post larvae (Pl) with an average initial body weight of 0.33±0.01 g were obtained from Birkat Ghalioun - Kafr El Sheikh Governorate, Egypt, while the fry of keeled mullet, *Liza carinata* with an average initial body weight of 5.60 ± 0.11g were obtained from El Hag-Zaghloul farm, Suez Governorate, Egypt. The fish and shrimp Pl's were stocked separately into three glass aquaria (each with 96 L) at Fish Rearing Laboratory, Gulfs of Suez & Aqaba's Branch, National Institute of Oceanography and Fisheries (NIOF), Suez, Egypt. Both of fish and shrimp Pl's were acclimated separately for two weeks to laboratory conditions.

In a complete randomized design, 15 glass aquaria (80×30×40 cm - 96 L) randomly distributed into in 5 treatments group (in triplicates).Each aquaria was stocked with 12 aquatic animals. In first experimental group was stocked with *L. carinata* only as monoculture (T_1; Fish 100%). Similarly, second experimental group was stocked with *L. vannamei* only as monoculture (T_2; Shrimp 100%).Experimental treatments of T3-T5 groups were stocked with both *L. carinata* and *L. vannamei* in polyculture at densities of (fish 25%: shrimp 75%), (fish 50%: shrimp 50%) and (fish 75%, shrimp 25%), respectively.

Aquaria's were cleaned and disinfected before the experimental trails. The system were installed in an environmental-controlled laboratory and held under natural light (12:12 h light: dark schedule). Continuous aeration was provided by an air blower, Heaters were placed in the glass aquaria to obtain the optimum temperature for both fish and shrimp.

Experimental Tank Management

Fish in all treatments were fed commercial diet (35 % crude protein and 5.98 % crude fat, Skretting Egypt Company, Belbies, Egypt).Fish and shrimp were fed at a rate of 5% and 7% of the live body weight, respectively in monoculture system, while in polyculture system shrimp was not fed and fish only fed at a rate of 5% of the live body weight. The daily ration was divided into two equal amounts and offered two times a day (08:30, and 15:00 h).Samples from each replicate aquaria were weighed biweekly and the amount of daily allowance was adjusted accordingly.

Water Quality

Water temperature (°C), dissolved oxygen (DO, mg/l), pH, salinity (ppt), total ammonia nitrogen (TAN, mg/l), nitrite nitrogen (NO_2), nitrate nitrogen (NO_3) and phosphate (PO_4) were monitored during the trial, to maintain water quality at the optimum range for fish and shrimp. Water temperature was recorded daily at 13.00 h using a mercury thermometer suspended at 30-cm depth. DO was measured at 05.00 h using YSI model 56 oxygen meter and pH at 09.00 h by using a pH meter. Salinity, TAN, NO_2, NO_3, and PO_4 using multi-spectrophotometers (JENWAY 6100) were measured three times a week according to **APHA (1998)**.

Statistical Analysis

Data were statistically analyzed by ANOVA using One-way software (Spss 26.0 for windows). Duncan's multiple range test was used to compare differences between treatment means when significant F values were observed (**Duncan, 1955**), at $P \leq 0.05$ level.

RESULTS AND DISCUSSION

Physical Water Parameters

Over the 12-weeks period, all physical water quality parameters were observed within the acceptable range for both *L. carinata* and *L. vannamei* either monoculture or polyculture systems (**Van Wyk and Scarpa, 1999**). The results showed that water salinity was ranged between 30.15 to 32.30ppt, water temperature from 25.32 to 30.90°C, dissolved oxygen (6.17 to 7.09 mgL^{-1}) and pH (7.07 to 7.83) without any statistical differences ($P \geq 0.05$) (Figs. 1-4).

Physical parameters of water play a significant role in the biology and physiology of aquatic animals. The results in this study showed that was range PH values (7.07 to 7.83) in all treatments, Both species, fish and shrimp, tolerate pH varying between 6.0 and 9.0 (**Boyd, 1990; Arana, 1997**), while the ideal and satisfactory pH ranges for fish farming varies from 7.0 to 8.5, and from 6.5 to 9.5 (**Sipaúba-Tavares**, **1994**), marine shrimp ideal pH ranges from 8.0 to 8.5 (**Igarashi, 1995**), and water temperature from 25.32 to 30.90°C, within the range recommended by **Brock and Main (1994)**.

The results in present study indicate that water Salinity was ranged between 30.15 to 32.30 ppt. **Aghuzbeni *et al*. (2017)** found that, the integrated culture of shrimp and mullet has shown to be successful in productive and water quality ways. Some studies on the polyculture of penaeid shrimps with omnivorous fishes such as tilapia showed an improvement in water quality as fish fed on organic wastes (**Akiyama and Angawati, 1999; Cruz *et al*., 2008**). **(Fitzsimmons, 2001)** demonstrated that beneficial effects of culturing shrimp with other aquatic species result in positive conditions on the primary and secondary species **(Jaspe *et al*., 2011)**. Improving pond water quality by controlling phytoplankton growth, reducing the accumulation of organic matter, antibacterial effect and the prevalence of viruses (**Jatobá *et al*., 2011**). Juarez-**Rosales *et al*. (2019)** reported that the white shrimp (10 org/m^2) can be co-cultured with Nile tilapia at a stocking high density (4 org/m^2), leading to improved water quality.

Chemical Water Parameters

The results noted that elevated values were recorded for all chemical parameters at the beginning of the experiment due to higher concentration in the watersource used, then decreased in the second week.

Regarding to the mono and polyculture systems, an increase in chemical water parameters was observed at the end of the experiment in *L. carinata* monoculture system as a result of increased weight of fish (not shown) and consequently increased waste output (dissolved outputs, faces and uneaten feeds) compared to either *L. vannamei* monoculture or experimental polyculture systems.

Phosphorous (PO_4)

The result showed that the concentration of phosphorous (PO_4, Fig. 5) ranged from 0.05 ± 0.02 - 0.009±0.002 mg/l. The highestPO_4 values was recorded for (T1) followed (T5), while the lowest values were recorded in either (T2) or (T3).

Total ammonia nitrogen (TAN), nitrite (NO_2) and nitrate (NO_3)

The result showed that the concentration of TAN (Fig. 6) ranged from 0.02 - 0.72 mg/l. The highest TAN values was recorded for (T1) followed (T5), while the lowest values were recorded in either T3 or T2. The same trend was observed for NO_3(NO_3–N, Fig. 7). The concentration of NO_2 (NO_2 -N) ranges from 0.001 to 0.09 mg/L, with highest values recorded for T1compared to other experimental treatments (Fig. 8).

Water chemical quality parameters in all treatments stayed in a suitable range for white shrimp and mullet growth (**Van Wyk and Scarpa, 1999**). The chemical water quality parameters including TAN, nitrite, nitrate, phosphate were significantly different between treatments which was significantly influenced by type of culture aquatic animals especially polyculture system.

Polyculture system that is mixing of two or more species does not require significant extra investment money or human efforts because the secondary species are simply added within the same space of pond. Generally, many benefits have been achieved in shrimp polyculture systems when using fish, bivalves and seaweeds. The benefits include the diminution of ecological

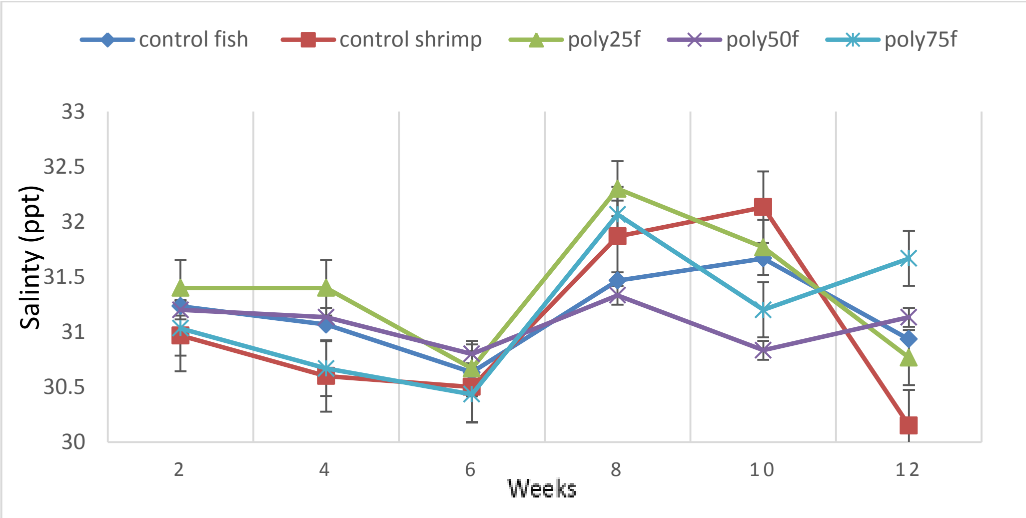

Fig. 1. Water salinity valuesin experimental treatment over a 12-week period

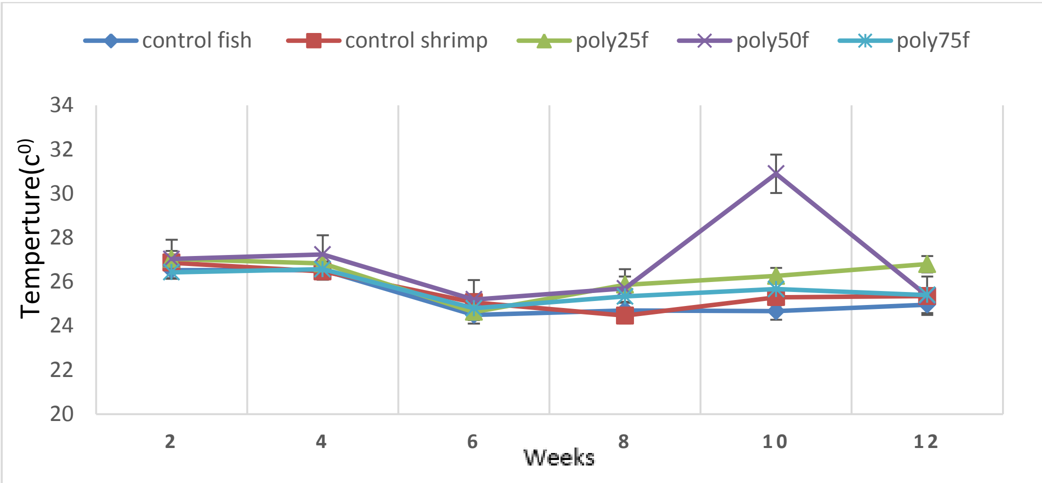

Fig. 2. Water temperature (C^o) recorded in experimental treatment over a 12-week period

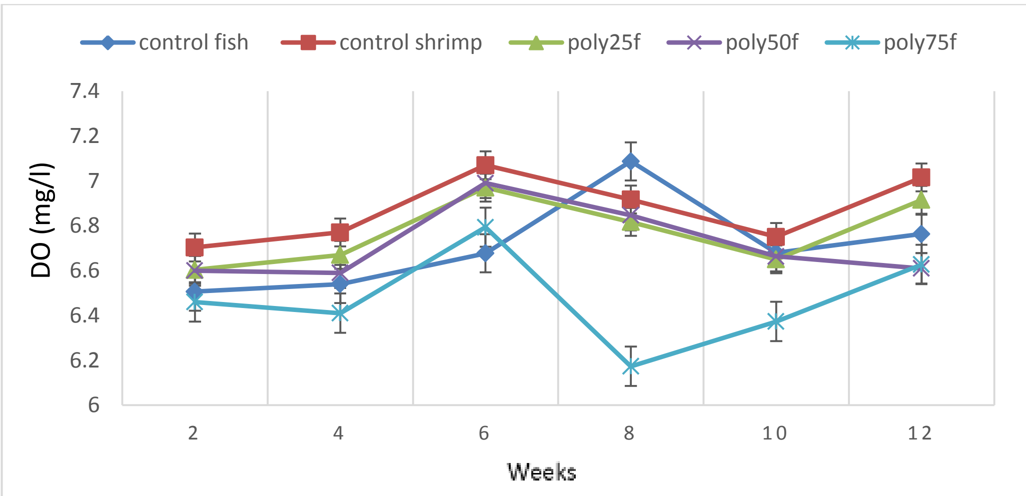

Fig. 3. Water dissolved oxygen (mg/l) values recorded in experimental treatment over a 12-week period

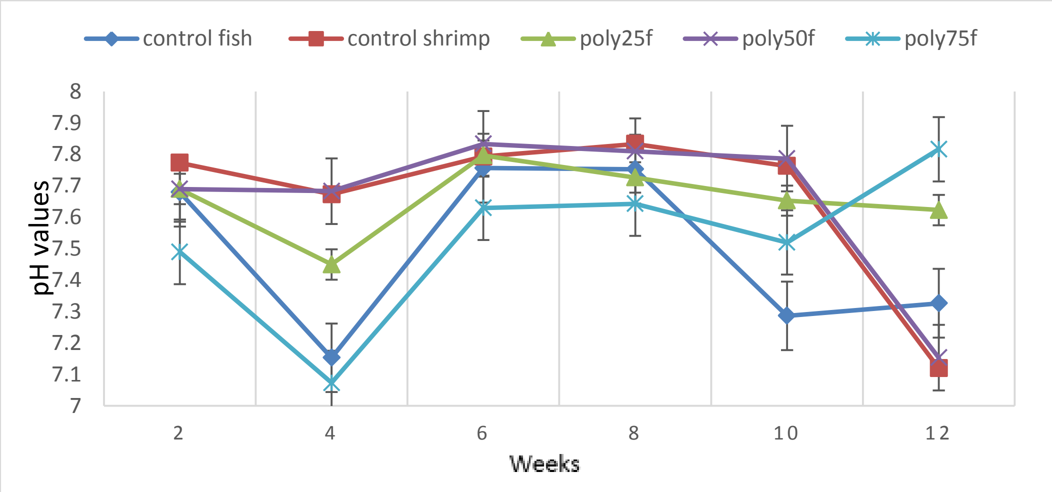

Fig. 4. Water pH values recorded in experimental treatment overa 12-week period

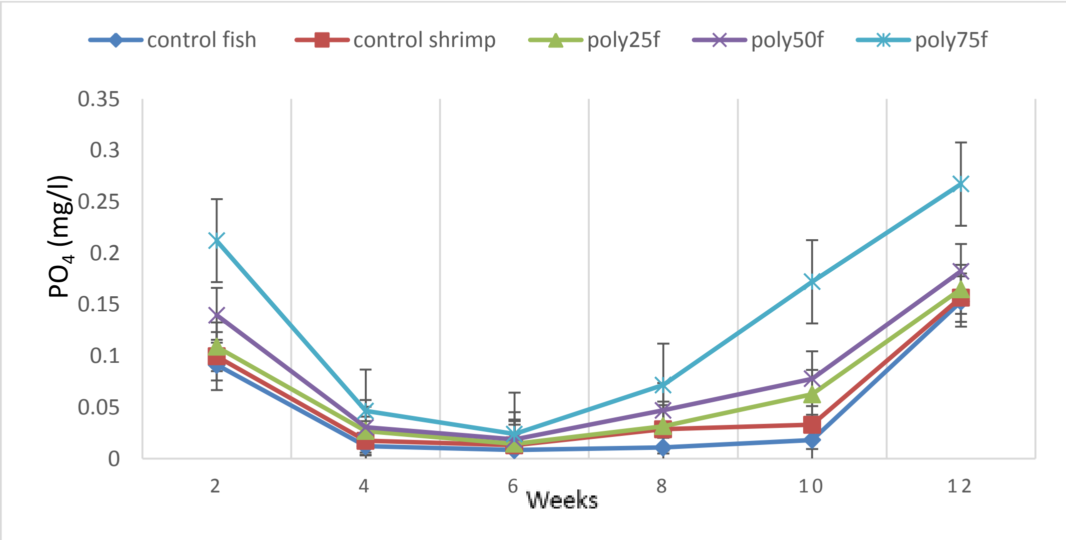

Fig. 5. WaterPO_4 (mg/l) values recorded in experimental treatment overa 12-week period

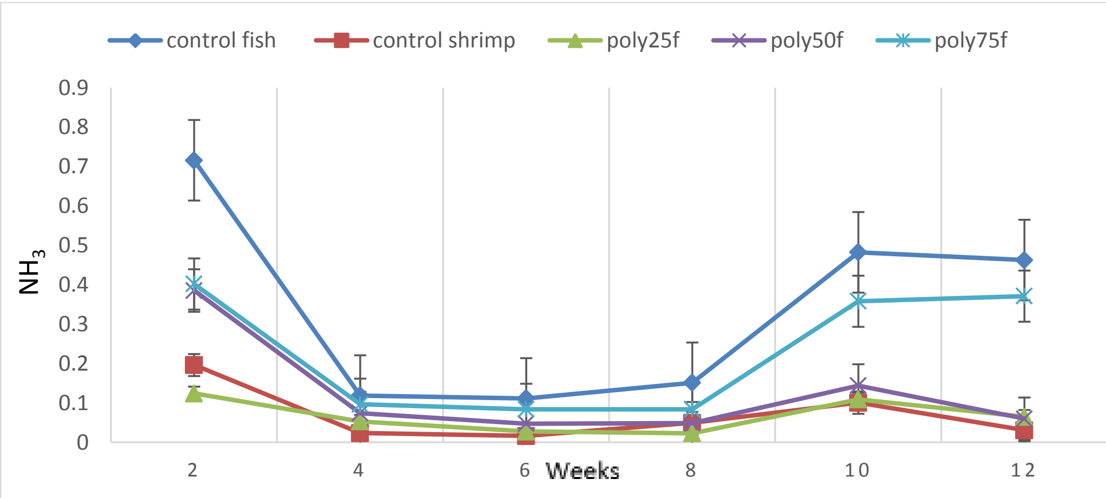

Fig. 6. Water TAN(mg/l) values recorded in experimental treatment overa 12-week period

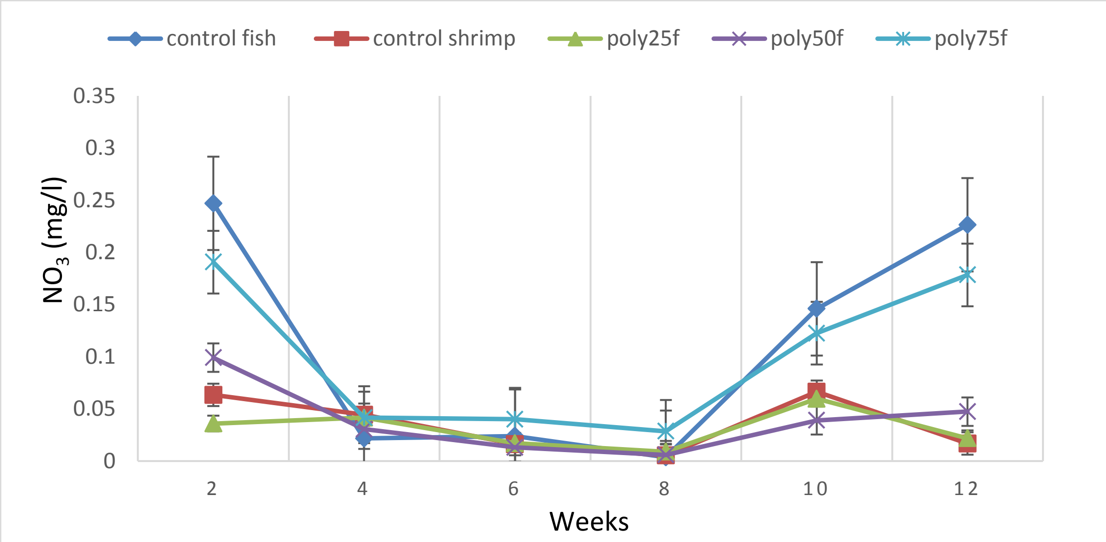

Fig. 7. WaterNO$_3$ (mg/l) values recorded in experimental treatment overa 12-week period

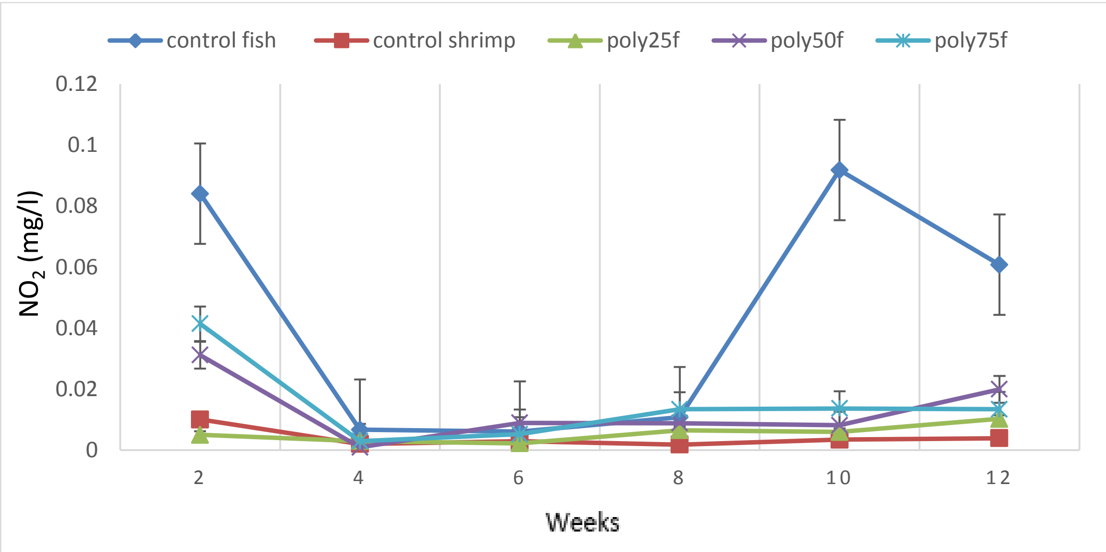

Fig. 8. WaterNO$_2$(mg/l) values recorded in experimental treatment overa 12-week period

impacts and maintenance of water quality which subsequently improve total biomass of shrimp **(Muangkeowet *al.*, 2007; Troell *et al.*, 2009). Tampy *et al.* (1988)**, reported that polyculture of *Chanos chanos* and *Penaeus monodon* increased the mean weight values of harvested shrimps. In the present study, the concentration of TAN , nitrite, and nitrate was recorded higher in monoculture *L. carinata* (T1) and polyculture *L. carinata* with *L. vannamei* (T5), associated with reduced the concentration of TAN and nitrite, and lowest in polyculture (T3), (T4) ,and monoculture shrimp (T2) and therefore there is a relationship between the number of fish and shrimp in the pond, according to what he mentioned, **Liu *et al.* (2014)**, reported that it appears that polyculture may have a possibility to improve shrimp efficiency and water quality. Although the mullet is present with shrimp, the shrimp tends to grow similar to the monoculture, and the mullet grows better in poly-culture. It is not clear in which way mullet contributes to shrimp growth (independent from the presence of flocks). The results showed is a clear effect of mixed culture in shrimp ponds as it works to purify the water pond through food residues or undigested food. **Hoang *et al.* (2018)** indicate that gray mullet can be co-cultured with white shrimp at the fish stocking density of 10% shrimp biomass to improve water quality, overall productivity and nutrient utilization efficiency.

Conclusion

There are a positive relationship between the number of fish in all treatment and the values of Total ammonia nitrogen, Nitrite, Nitrate and Phosphate. While there are a reverse relationship between the number of shrimp in all treatment and the values of Total ammonia nitrogen, Nitrite, Nitrate and Phosphate.

Acknowledgements

The Authors would like to thank the Administration of NIOF specially, Aquaculture Division and rearing fish lab. for support along the experimental period. Authors also, express their gratitude to **Prof. Dr. Zaki Sharawy** for his valuable help and support along the experimental period.

REFERENCES

Aghuzbeni, S.H.H., S. Hajirezaee, A. Matinfar, H. Khara and M. Ghobadi (2017). A preliminary study on polyculture of western white shrimp (*Litopenaeus vannamei*) with mullet (*Mugil cephalus*): an assessment of water quality, growth parameters, feed B.A.A. Borges, *et al*. Aquaculture 524 (2020) 735234 intake efficiency and survival. J. Appl. Anim. Res. 45 (1). https://doi.org/ 10.1080/ 9712119.2016.1150845. (247–25).

Akiyama, D.M. and A.M. Anggawa (1999). Polyculture of shrimpand tilapia in East Java. Tech Bull AQ 47-1999. Ame. Soybean Ass. (ASA)

Anh, P.T., C. Kroeze, S.R. Bush and A.P.J. Mol (2010). Water pollution by intensive brackish shrimp farming in south-east Vietnam: causes and options for control. Agric. Water Manag., 97 (6): 872–882.

APHA, A.W.W.A. (1998). Water environment federation. Standard Methods for the Examination of Water and Wastewater, 12th Ed. Ame. Public Health Ass., Washington, DC.

Avnimelech, Y. (2009). Biofloc Technology. A Practical Guide Book. The World Aquac. Soc., Baton Rouge, La, USA.

Avnimelech, Y. (2007). Feeding with microbial flocs by tilapia in minimal discharge bioflocs technology ponds. Aquac., 264 (1): 140–147.

Azad, A.K., K.R. Jensen and C.K. Lin (2009). Coastal aquaculture development in Bangladesh: unsustainable and sustainable experiences. J. Environ. Manag., 44: 800-809.

Barrington, K., N. Ridler, T. Chopin, S. Robinson and B. Robinson (2010). Social aspects of the sustainability of integrated multi-trophic aquaculture. Aquac. Int., 18 (2): 201–211.

Boyd, C.E. (1990) Water quality in ponds for aquaculture. Auburn. Alabama: Alabama Agric. Exp. Station, 482.

Brock, J.A. and K.A. Main (1994). Guide to the common problems and diseases of cultured Paenaeus vannamei. Honolulu: The Oceanic Inst., 242.

Business, R. (2003). Vietnamese Shrimp Aquaculture-Impacts and Improvement. Environmental Justice Foundation, London, UK. by tilapia in biofloc tanks, using N-15 tracing. Aquac., 287: 163–168

Costa, L.C.d.O., J.A.A. Xavier, L.F.d.M. Neves, A.M.V.D. Azambuja, W. Wasielesky Junior and M.R.C. Figueiredo (2013). Polyculture of Litopenaeus vannamei shrimp and Mugil platanus mullet in earthen ponds. Rev. Bras. Zootec., 42 (9): 605–611.

Cruz, P.S., M.N. Andalecio, R.B. Bolivar and K. Fitzsimmons (2008). Tilapia–shrimp polyculturein Negros Island, Philippines: a review. J. World Aquac. Soc., 39 (6): 713–725.

Cruz-Suárez, L.E., A. León, A. Peña-Rodríguez, G. Rodríguez-Peña, B. Moll and D. Ricque-Marie (2010). Shrimp/Ulva co-culture: a sustainable alternative to diminish the need for artificial feed and improve shrimp quality. Aquac., 301 (1): 64–68.

Duncan, D.B. (1955). Multiple ranges and multiple T- test. Biomet., 11: 1-42.

Fitzsimmons, K. (2001). Polyculture of tilapia and penaeid shrimp. Glob. Aquacult. Advocate, 4 (3): 43-44.

Frankic, A. and C. Hershner (2003). Sustainable aquaculture: developing the promise of aquaculture. Aquac. Int., 11 (6): 517-530.

Hellio, C., A.M. Pons, C. Beaupoil, N. Bourgougnon and Y. Le Gal (2002). Antibacterial, antifungal and cytotoxic activities of extracts from the fish epidermis and epidermal mucus. Int. J. Antimicrob. Agents, 20 (3): 214–219.

Hoang, M.N., P.N. Nguyen and P. Bossier (2020). Water quality, animal erformance, nutrient budgets and microbial community in the biofloc-based polyculture system of white shrimp, Litopenaeus vannamei and gray mullet, Mugil cephalus. Aquac., 515: 734610.

Hoang, M.N., P.N. Nguyen, D.V. Le, D.V. Nguyen and P. Bossier (2018). Effects of stocking density of gray mullet Mugil cephalus on water quality, growth performance, nutrient conversion rate, and microbial community structure in the white shrimp Litopenaeus vannamei integrated system. Aquac., 496: 123–133.

Igarashi, M.A. (1995). Estudo sobre o cultivo de camarões marinhos. Fortaleza: SEBRAE, 66.

Jaspe, C.J., C.M. Caipang and B.J.G. Elle (2011). Polyculture of white shrimp, Litopenaeus vannamei and milkfish, Chanos chanos as a strategy for efficient utilization of natural food production in ponds. Anim. Biol. Anim. Husb., 3 (2): 96–104.

Jatobá, A., F.N. Vieira, C.C. Buglione-Neto, J.L. Pedreira-Mouriño, B.C. Silva, W.Q. Seiftter and E.R. Andreatta (2011). Diet supplemented with probiotic for Nile tilapia in polyculture system with marine shrimp. Fish Physiol. Biochem., 37: 725-732.

Juarez-Rosales, J., J.T. Ponce-Palafox, A.D. Roman-Gutierrez, E.M. Otazo-sanchez, G. Pulido-Flores and S.G. Castillo-vargasmachuca (2019). Effects of white shrimp (*Litopenaeus Vannamei*) and tilapia nilotica(Oreochromis Niloticus var.spring) in monoculture and co-culture systems on water quality variables and production in brackish low -salinity water earthen ponds during rainy and dry seasons. Spanish J. Agric. Res., 17 (3): 0605. https://doi.Org/10.5424/ sjar/2019173-14938.

Kubitza, F.T. (2000). Tecnologia e planejamento na produção comercial. Jundiaí: F. Kubitza,. 285.

Liu, L., Z. Hu, X. Dai and Y. Avnimelech (2014). Effects of addition of maize starch on the yield, water quality and formation of bioflocs in an integrated shrimp culture system. Aquac., 418: 79–86.

Lombardi, J.V., H.L. de Almeida Marques, R.T.L. Pereira, O.J.S. Barreto and E.J. de Paula (2006). Cage polyculture of the Pacific white shrimp Litopenaeus vannamei and the Philippines seaweed Kappaphycus alvarezii. Aquac., 258 (1): 412–415.

Magarinos, B., F. Pazos, Y. Santos, J.L. Romalde and A.E. Toranzo (1995). Response of Pasteurella piscicida and Flexibacter maritimus to skin mucus of marine fish. Dis.Aquat. Org., 21 (2): 103–108.

Manoppo, H., M.E.F. Kolopita and R. Malutunduh (2016). Growth promoter effect of garlic (*Allium sativum*) on carp (*Cyprinus carpio* L). Int. J. Pharm. Tech. Res., 9(4): 283-288.

Manoppo, H., U.N. Manurung and R.A. Tumbol (2015). Efficacy of baker’s yeast as immunostimulant in Nile tilapia (*Oreochromis niloticus*). Int. J. Chem. Tech. Res., 8 (2): 559-565.

Martinez-Porchas M., L.R. Martinez-Cordova, M.A. Porchas-Cornejo and J. Lopez-Elias. (2010). A. Shrimp polyculture: a potentially profitable, sustainable, but uncommon aquaculture practice. Rev Aquac., 2: 73-85.

Muangkeow, B., K. Ikejima, S. Powtongsook and Y. Yi (2007). Effects of white shrimp, *Litopenaeus vannamei* (Boone), and Nile tilapia, *Oreochromis niloticus* L., stockingdensity on growth, nutrient conversion rate and economic return in an integratedclosed recirculation system. Aquac., 269 (1-4): 363–376.

Nya, E.J. and B. Austin (2009). Use of dietary ginger, Zingiber officinale Roscoe, as an immunostimulant to control Aeromonas hydrophila infections in rainbow trout, Oncorhynchus mykiss (Walbaum). J. Fish Diseases, 32:971-977.

Pacheco-Vega, J.M., M.A. Cadena-Roa, J.A. Leyva-Flores, O.I. Zavala-Leal, E. Pérez-Bravo and J.M.J. Ruiz-Velazco (2018). Effect of isolated bacteria and microalgae on the biofloc characteristics in the Pacific white shrimp culture. Aquac. Rep., 11: 24–30.

Paez-Osuna, F. (2001). The environmental impact of shrimp aquaculture: causes, effects, and mitigating alternatives. J. Environ. Manag., 28: 131-140.

Paez-Osuna F., A. Gracia, F. Flores-Verdugo, L.P. Lyle-Fritch, R. Alonso-Rodriguez, A. Roque and A.C. Ruiz-Fernandez (2003). Shrimp aquaculture development and the environment in the Gulf of California ecoregion. Marine Pollution Bulletin, 46: 806- 815.

Payung, C.N., R.A. Tumbol and H. Manoppo (2017). Dietary ginger (*Zingiber officinale*) enhance resistance of Nile tilapia (*Oreochromis niloticus*) against Aeromonas hydrophila. AACL Bioflux, 10(4):962-968

Piedrahita, R.H. (2003). Reducing the potential environmental impact of tank aquaculture effluents through intensification and recirculation. Aquac., 226 : 35- 44.

Ross, B. and L.G. Ross (1983). The oxygen requirements of *Oreochromis niloticus* underadverse conditions. In: International symposium on tilapia in aquacultura, 1983, Nazareth, srael. Proc.... Tel Aviv, Israel: Tel Aviv Univ.,134-143.

Patil, P.N., D.V. Sawant and R.N. Deshmukh, (2012). Physico-chemical parameters for testing of water- A review. Int. J. Environ. Sci., 3 (3): 1194- 1207.

Shaker, I.M., M.Y. Abou Zeid and A. Batran (2013). Effect of using periphyton substrate (bamboo stems) on water quality, phytoplankton, zooplankton, periphyton and growth performance for tilapia, mullet and catfish in earthen ponds. Abbassa, Int., J. Aqua., 6 (1): 108-139.

Sharawy, Z., M. Ashour, E.M. Abbas, O.A. Ashry, M.F. Helal, H. Nazmi, M.S. Kelany, A. Kamel, M. Hassaan, J. Waldemar Rossi, E. El-Haroun and A. Goda (2020). Effects of dietary marine microalgae, Tetraselmis suecica on production, gene expression, protein markers and bacterial count of Pacific white shrimp Litopenaeus vannamei. Aquac. Res., 51(6): 2216-2228.

Sipauba-Tavares, L.H. (1994). Limnologia aplicada à aquicultura. Jaboticabal: Fundação Universidade Estadual Paulista, 70.

Sugiura, S.H., D.D. Marchant, T. Wigins and R.P. Ferraris (2006). Effluent profile of commercially used low-phosphorus fish feeds. Environ. Pollut. 140 : 95-101.

Tampy, D.M., S. Jose, M.V. Mohan and M.S.I. Hoya (1988). Short-term biculture oftiger prawn Penaeus monodon fabricios and milkfish Chanos chanosForsskal in a lowsalinepond. The first Indian Branch Managalore, 139–141.

Tendencia, E.A., M.R. dela Peña, A.C. Fermin, G. Lio-Po, C.H. Choresca Jr. and Y. Inui (2004). Antibacterial activity of tilapia Tilapia hornorum against Vibrio harveyi. Aquac., 232 (1-4): 145–152.

Thompson, F.L., P.C. Abreu and W. Wasielesky (2002). Importance of biofilm for water quality and nourishment in intensive shrimp culture. Aquac., 203 : 263–278.

Troell, M., A. Joyce, T. Chopin, A. Neori, A.H. Buschmann and J.-G. Fang (2009). Ecological engineering in aquaculture-potential for integrated multi-trophicaquaculture (IMTA) in marine offshore systems. Aquac., 297 (1): 1–9.

Valenti, W.C. (2002). Aquicultura sustentável. In: Congresso De Zootecnia, 12., Vila Real, Portugal, 2002. Anais.. Vila Real: Associação Portuguesa dos Engenheiros Zootécnicos, 111-118.

Van Wyk, P. and J. Scarpa (1999). Water quality requirements and management. Farming Marine Shrimp in Recirculating Freshwater Systems, 128–138.

Vinatea, L.A.A. (1999). Aquicultura e desenvolvimento sustentável: subsídios para a formulação de políticas de desenvolvimento da aquicultura brasileira. Florianópolis: Ed. da UFSC, 310.

Yuan, D., Y. Yi, A. Yakupitiyage, K. Fitzimmons and J.S. Diana (2010). Effects of addition of red tilapia (*Oreochromis* spp.) at different densities and sizes on production, water quality and nutrient recovery of intensive culture of white shrimp (*Litopenaeusvannam*ei) in cement tanks. Aquac., 298 (3): 226–238.

Zhen-Xiong Q., L. De-Shang, Z. Man-Ping and D. Shuang-Lin (2001). Comparativestudies on nitrogen budgets of closed polyculture systems. Chin. J. Oceanol., 19:233–242.

تأثير الاستزراع المتعدد الأنواع بين الجمبري الفانمى*Litopenaeus vannamei* مع سمك السهيلى، *Liza carinata* بكثافات مختلفة مقارنة بنظام الاستزراع الأحادي على جودة المياه الفيزيائية والكيميائية

عبده الشبراوى حسن[1] - عمرو منير هلال[1] - عبدالحليم على محمد[2] - محمد صلاح عياط[2]

1- معمل تربيةالأسماك- شعبة تربية الاحياء المائية- المعهدالقومي لعلوم البحاروالمصايد (NIOF) - مصر

2- قسم الإنتاج الحيواني – كلية الزراعة – جامعة الزقازيق - مصر

أجريت الدراسة الحالية لتقييم تأثير استزراع الجمبري متعدد الأنواع بين الجمبري الفانميى *Litopenaeus vannamei* مع سمك السهيلى *Liza carinata* بكثافات مختلفة مقارنة بنظام الاستزراع الأحادي على جودة المياه الفيزيائية والكيميائية. في تصميم عشوائي كامل ، تم توزيع 15 حوض زجاجي (80 × 30 × 40 سم - 96 لتر) بشكل عشوائي في 5 معاملات تجريبية (ثلاث مكررات لكل معاملة). تم تخزين كل حوض بعدد 12حيوان مائي. في المجموعة التجريبية الأولى تم تربية أسماك السهيلى بنظام الاستزراع الأحادي(T1).وبالمثل ، تم تربية الجمبرى الفانميى في المجموعة التجريبية الثانية بنظام الاستزراع الأحادي(T2).بالنسبة الى المعاملات التجريبية من الثلاثة الى الخامسة (T3-T5) فقد تم تربية لكل من أسماك السهيلى والجمبرى الفانميى في نظام استزراع متعدد الأنواع بكثافة (25% سهيلى: 75% جمبري)، (50% سهيلى: 50% جمبري) و (75٪ سهيلى: 25% جمبري) ، على التوالى. خلال فترة تربية لمدة 12 أسبوعاً ، لوحظت جميع معايير جودة المياه ضمن النطاق المقبول لكل من أسماك السهيلى والجمبرى الفانميى سواء كانت أحادية النوع أو متعددة الأنواع. أظهرت النتائج أن ملوحة الماء تراوحت بين 30.15 إلى 32.30 جزء فى الف ودرجة حرارة الماء من 25.32 إلى 30.90 درجة مئوية والأكسجين المذاب (6.17 إلى 7.09 مجم/ لتر) ودرجة الحموضة (7.07 إلى 7.83) دون أي فروق ذات دلالة إحصائية ($P \geq 0.05$) . تراوح تركيز الفوسفور (PO_4) من 0.02±0.05 -0.002±009. ملجم/لتر. تم تسجيل أعلى قيم للفوسفور فى المعاملة(T 1) متبوعةبـ (T5). تم تسجيل أعلى قيم للامونيا الكلية (TAN) لـ (T1) تليها (T5) ، بينما سجلت أدنى قيم فيT_3 أوT_2 . ولوحظ نفس الاتجاه بالنسبة لثاني أكسيد النيتروجينNO_3 . يتراوح تركيزNO_2 من 0.001 إلى 0.09 ملجم/لتر. أشارت نتائج الدراسة الحالية إلى وجود تأثير واضح للاستزراع المتعدد بين أسماك السهيلى والجمبرى الفانميى في نظام الاستزراع متعدد الأنواع لتنقية مياه الحوض من بقايا الطعام أو الطعام غير المهضوم وتحسين جودة المياه الفيزيائية والكيميائية.

المحكمـــــون:

1- أ.د. أشرف محمد عبدالسيمع جوده أستاذ تربية الأسماك – المعهد القومي لعلوم البحار والمصايد.

2- أ.د. جمال الدين علي عبدالرحمـــن أستاذ تغذية الحيوان – كلية الزراعة – جامعة الزقازيق.