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2020

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## Preface

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## Papers

### Earth and Environmental Science

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The grow-out of abalone (*Haliotis squamata*) at different shelter shape on growth and survival and its marine environmental influences at Lembongan Bay coastal waters

I Ardi, E Setiadi, Rasidi and W S Pranowo

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Stocking density of Rotifera, *Hexarthra mira* on water quality and production

I Ardi, S Cahyaningsih and E Setiadi

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**OPEN ACCESS** 012003

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The effect addition of kappa carrageenan flour to the level of gel strength and acceptability of dumpling from threadfin bream fish (*Nemipterus nematophorus*) surimi

D M Astutik, L Sulmartiwi, E Saputra and D Y Pujiastuti

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012004

Maximizing production of a male offspring in *Moina macrocopa* culture through manipulation of rice bran suspension concentration

A S Mubarak, D Jusadi, M Zairin Jr and M A Suprayudi

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012005

The Concept of the Right to Management of Coastal Communities in the Regional Autonomy Era: Experience from Community Assistance to Obtain the Right to Manage Sea Cucumbers in Sunsak Bay, East Lombok.

A Wahyono and M Illiyani

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012006

Selective breeding technique: Pandu and Kunti tilapia (*Oreochromis niloticus*) broodstock candidates at PBIAT Janti, Klaten-Central Java

S H Samara, A W Fathurrozi and Sutarno

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Potential of *Caulerpa racemosa* extracts as sunscreen creams

E B Ersalina, A A Abdillah and L Sulmartiwi

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Histopathology of the gill of Vaname Shrimp (*Litopenaeus vannamei*) infested by protozoan ectoparasite

S R Pribadi, P D W Sari and S Subekti

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The effect of iron powder as oxygen absorber active packaging on fish oil total oxidation value

E N Hidayah, RR J Triastuti and A A Abdillah

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012010

The occurrence of endoparasite helminth on Threadfin Bream (*Nemipterus japonicus*) from the fish auction place Mayangan, Probolinggo, East Java

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D S Octatriana, P D W Sari and G Mahasri

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012011

Comparative study of marine fish freshness based on the handling method in Puncak Permai modern market and Simo Gunung traditional market, Surabaya

M Sari, J Triastuti, H Pramono and Sudarno

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Determination of minimum inhibitory and minimum bactericidal concentration of ketapang (*Terminatia catappa*) leaves extract against *Vibrio harveyi*

A Kharisma, W Tjahjaningsih and Setiawati Sigit

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012013

The larasati tilapia (*Oreochromis niloticus*) fingerling rearing activity in PBIATJanti, Klaten, Central Java: its performance through survival rate

RV Prasetya, Sutarno and M B Santanumurti

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Use of hydrogen peroxide to improve potential redox land preparation of land towards increasing production of traditional shrimp vanname (*Litopenaeus vanname*) in Wringin Putih, Muncar, Banyuwangi

D D Nindarwi, L A Sari, P D Wulansari, S H Samara and M B Santanumurti

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The effect of feed larvae *Chironomus* sp. and high pellet protein to seedling goldfish (*Carassius auratus*)

K H Dwiardani, L A Sari, P. D. W. Sari, D. D. Nindarwi and S. Arsad

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The maggot flour substitution potency (*Hermetia illucens*) in artificial feed formulation on growth and survival rates of African catfish (*Clarias gariepinus*)

M S Islam, Agustono and M Lamid

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012017

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Influence addition of noni (*Morinda citrifolia*) in the commercial feed on protein and lipid retentions of sangkuriang catfish (*Clarias* sp.).

F Azizah, M Arief and W P Lokapirnasari

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012018

The growth, protein content, and fatty acid of catfish meat (*pangasius* sp.) With the addition of different lysine doses in commercial feed

E Aristasari, R A Nur 'Aini, W Nopita, Agustono, M Lamid and M A Al-Arif

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012019

Evaluation of hatching rate, growth performance, and survival rate of cantang grouper (*Epinephelus fuscoguttatus* × *lanceolatus*) in concrete pond at Situbondo, East Java, Indonesia

N S Anita and N N Dewi

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012020

The effect of temperature, salinity and antimicrobial agent on growth and viability of *Aeromonas hydrophila*

M F Ulkhaq, D S Budi and N N Rahayu

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Utilization of agar *Gracilaria* sp. as a natural thickener on liquid bath soap formulation

L R Dita, Sudarno and J Triastuti

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Correlation Between Glucose Level And Protozoan Ectoparasite Infestation Level Of Humpback Grouper (*Cromileptes altivelis*) Nursery In UPBL Situbondo, East Java

G Mahasri, I N D Yodharta, D Novalisa and A T Mukti

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Study of heavy metal content cadmium (Cd) in various sizes of blood shells (*Anadargranosa*) in coastal Bancaran Bangkalan, Madura

E S Ulfah, B S Rahardja and K T Pursetyo

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Identification and prevalence of ectoparasites on the fry of Asian sea bass (*Lates calcalifer*), white shrimp (*Litopenaeus vannamei*), and blue swimming crab (*Portunus pelagicus*)

Budianto, H Suprastyani, Q A'yunin and Z Nadlifah

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Effect of dense stocking of *Gracilaria sp* on growth and survival of milkfish (*Chanos chanos forskal*) on polyculture culture systems

W Isroni, A S Bahri and A A Amin

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The effect of *Dunaliella salina* extract on NFkB expression in Cantang Grouper (*Epinephelus fuscoguttatus x E. lanceolatus*) exposed by *Viral Nervous Necrosis*

Rani Yuwanita, A Yuniarti, SSP Rahardjo, Q Ayu'nin and AM Madyaratri

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The Effectiveness of Vaccines in Gurame (*Osphronemus goramy*) and Challenged *Aeromonas hydrophila*

S U Setyaningsih, R Kusdarwati, Rozi and D Handijatno

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Utilization of By Product *Kappaphycus alvarezii* as Earthquake Resistant Material Lightweight Concrete

A A Musthofa, M Z A Bahtiar, F M Ibrahim and A A Abdillah

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The effect of density as *Skeletonema costatum* bioremediation agent of copper (Cu) heavy metal concentration

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Effectiveness of Heat Shock (40°C) With Different Duration for Tetraploid Formed in Mutiara Catfish (*Clarias sp.*) Juvenile

S Nuswantoro, MS Widodo, F Fariedah and E Artarini

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## Histopathological analysis of *Pangasius* sp. infected by *Edwardsiella tarda* causes Edwardsiellosis disease

Q A'yunin, Budianto, S Andayani and R Yuwanita

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## The use of bromelain enzyme on artificial hatching media as an effort to hatch Nile tilapia (*Oreochromis niloticus*) eggs outside the mother's mouth

F Fariedah, M S Widodo, S Nuswantoro and Sholikhin

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## Effects of different feed doses of Majapahit leaves (*Crescentia cujete* L.) on the growth of Nile tilapia (*Oreochromis niloticus*)

S Rahmaningsih, Jumiati and S Awwaliyah

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## Vaname shrimp (*Litopenaeus vannamei*) post-harvest marketing analysis in traditional pond systems at Turi District, Lamongan, East Java, Indonesia

M S A Ningsih, Prayogo and A M Sahidu

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## Effect of probiotic duration and dose of coffee peel fermentation (*Coffea* sp.) on crude protein and crude fiber as an alternative fish feed ingredient

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## The effect of depuration on lead levels of the cockles *Anadara* sp. by using activated carbon as a filter

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## Growth performance and survival rate of Boeseman's rainbowfish (*Melanotaenia boesemani*) in natural spawning technique at Depok, West Java, Indonesia

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Masculinization of guppies (*Poecilia reticulata*) using water of coconut hybrid variety with the immersion method of pregnant female

G Meiliana, L Sulmartiwi and L Lutfiyah

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The effect of commercial nutrients to increase the population of *Skeletonema costatum* on laboratory and mass scales

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Cultivation technique of *Chanos chanos* modular system and semi intensive at the center for brackish water aquaculture (BBPBAP) Jepara, Central of Java

M Nisa and K Kismiyati

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Effect of *Spirulina platensis* supplementation in the diet to sperm performance of silver rasbora (*Rasbora argyrotaenia*)

M W D Putri, Prayogo and D S Budi

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The variances of hematology of gurami (*Osphronemus gouramy*) which is vaccinated and challenged by *Aeromonas hydrophila*

D Alfaniah, R Kusdarwati, Rozi and D Handijatno

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Antibacterial activity test of mahkota dewa leaf extract (*Phaleri amacrocarpa*) against bacteria *Aeromonas hydrophilla* by in vitro

R A Sarendah, Sudarno and R Kusdarwati

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The effect of kersen (*Muntingia calabura* L) leaf extract on bacteria *Aeromonas salmonicida smithia* in vitro

N Kartika, Sudarno and D Handijatno

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Growth and survival rate of silver barb, *Rasbora argyrotaenia* under different concentrations of sardinelle fish oil addition in fish feed

S A Dewi, A S Mubarak and A T Mukti

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Substitution of fermented soybean juice dregs on catfish (*Pangasius pangasius*) feed formulation toward specific growth rate, efficiency of feed, feed conversion ratio, digestibility of crude protein, and energy

Z N Arifiina, A P Anjarwati, M Lamid and Agustono

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012047

Addition of lemuru fish oil in feed on the gonadal maturity level of female silver barb, *Rasbora argyrotaenia*

L Agustin, L Sulmartiwi and A S Mubarak

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The use of mangrove leaves flour *Avicenia rumphiana* as antioxidant feed additive in commercial feed towards growth and survival rate of Nile tilapia fry *Oreochromis niloticus*

D Wulansari, L Sulmartiwi and M A Alamsjah

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The effect of combination *Bifidobacterium sp* and *Lactobacillus acidophilus* probiotic on egg yolk cholesterol, HDL, and LDL

W P Lokapirnasari, A M Sahidu, L Maslachah, A B Yulianto and R Najwan

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The effect of using different polar solvents on the stability of thermal extraction phycoyanin from *Spirulina platensis*

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Substitution of fermented maggot (*Hermetia illucens*) flour on commercial feed towards protein retention and energy retention in tambaqui (*Colossoma macropomum*) meat

N Wantika, Budiana, E Suryani, L Rubi'ah, N Dzatalini, Rusdiatin, Y T Nila, M B Santanumurti, S H Samara,

D D Nindarwi *et al*

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Nile tilapia (*Oreochromis niloticus*) fish hatchery technique: the survival rate evaluation in IBAT Pandaan, Pasuruan, East Java

T A Putri, S Maya and M B Santanumurti

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Observed snapshot condition of waters during El Niño Southern oscillation (ENSO) 2015-2017 events in the Maluku Channel

A Bayhaqi, D Surinati and H B Prayitno

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The effect of concrete tanks for the breeding technique of the sand sea cucumber (*Holothuria scabra*)

D A N Sitoresmi and K T Pursetyo

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Morphometric asymmetry of *Barbodes binotatus* (cyprinidae) collected from three different rivers in Java

S S Astuti, A M Hariati, W E Kusuma and D G R Wiadnya

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Chlorophyll and carotenoids analysis spectrophotometer using method on microalgae

M Rinawati, L A Sari and K T Pursetyo

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The effect of catfish and chicken cultivation waste to *Daphnia* sp. culture

N H Holy and L A Sari

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*Neobenedenia girellae* infestation on cobia (*Rachycentron canadum*) in Hurun Bay Lampung, Indonesia

R D B Putri, A R Rivaie, S Subekti and P D W Sari

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Ecotourism development through legality of mangrove processed products dan river tracing in Cemara Beach, Banyuwangi, East Java, Indonesia

E W Setyaningrum, Z Erwanto, K P Prapti, A L Jayanti, A T K Dewi and H D Susanti

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The effect of various concentration of quail egg yolk on spermatozoa motility of kancra fish (*Tor soro Valenciennes*, 1842) post cryopreservation

M Laeni, Abinawanto, J Subagja and A H Kristanto

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The fertilization of *Tor soro* fish (Valenciennes, 1842) using post cryopreservation sperm: the effect of skim milk as a cryoprotectant

E R Harjanti, Abinawanto, O Z Arifin and A H Kristanto

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Honey effect on sperm motility of kancra fish (*Tor soro Valenciennes*, 1842) after 48 hours freezing

B S D Putri, Abinawanto, O Z Arifin and A H Kristanto

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The spermatozoa viability of kancra fish (*Tor soro Valenciennes* 1842) 48-hour after freezing: effect of brown sugar as natural cryoprotectant

M A B Pamungkas, Abinawanto, O Z Arifin and A H Kristanto

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Feed additive of curcuma flour (*Curcuma xanthorrhiza*) in commercial feed to growth rate and feed efficiency of tambaqui (*Colossoma macropomum*)

I Oktavianti, Agustono and M Lamid

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012065

The spermatozoa motility of kancra fish (*Tor soro Valenciennes*, 1842) after the frozen process: the application of egg yolk as a cryoprotectant

N Vardini, Abinawanto, J Subagja and A H Kristanto

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012066

Sperm motility of kancra fish (*Tor soro*, Valenciennes 1842) after frozen: the effect of soybean milk as a natural cryoprotectant

R Fatriani, Abinawanto, O Z Arifin and A H Kristanto

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Effect of date palm (*Phoenix dactylifera* l.) on spermatozoa viability of kancra fish (*Tor soro* Valenciennes 1842) 48 hours post cryopreservation

D P Alifiani, Abinawanto, J Subagja and A H Kristanto

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Effect of *Bacillus* spp. and *Nitrosomonas* sp. in commercial feed as a probiotic agent to increase growth performance and feed efficiency of sangkuriang satfish (*Clarias gariepinus*)

A A Yaqin, Sudarno and Rozi

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The effect of giving commercial feed, beloso trash fish (*Saurida tumbil*), kurisi trash fish (*Nemipterus nematophorus*), and mixed trash fish on growth of cantang grouper (*Epinephelus fuscoguttatus-lanceolatus*) in floating net cage

M A Nugraha and Rozi

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The Percentage of embryo viability after 48h sperm cryopreservation: effect of various natural cryoprotectant

S Lestari, Abinawanto, A Bowolaksono, R Gustiano and A H Kristanto

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Degree of nematode endoparasite infection in asian swamp eel (*Monopterus albus*) from Banyuwangi regency

D I Bakti, G Mahasri, M F Ulkhaq, Kismiyati, D S Budi and Suciyono

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Effect of different bacterial strain in probiotics on the growth performance of Nile Tilapia (*Oreochromis niloticus*)

T D Sholihuddin, M Arief and H Kenconojati

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Infection analysis of *Rhadinorhynchus bicircumspinis* in barramundi (*Lates calcarifer*) from pond and floating net cage in Situbondo waters.  
D N Putri, S Subekti, M F Ulkhaq, R Kusdarwati, D S Budi and H Kenconoajati  
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Population growth and fishery status of the *Lorjuk* shellfish (*Solen* sp.) on Pamekasan beaches, Indonesia  
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Prevalence and intensity of protozoan ectoparasite infestation on nursery of humpback grouper (*Cromileptes altivelis*) in hatchery and floating net cage  
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Morphology, morphometrics, and some qualitative parameters of silver rasbora (*Rasbora argyrotaenia*) sperm  
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Inventory of ectoparasites in pacific white shrimp (*Litopenaeus vannamei*) that cultivated with high density  
G D Pamenang, L Sulmartiwi, G Mahasri, N D Rahayu and B Angwarmas  
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Growth of Cantang Hybrid Grouper Juvenile (*Epinephelus fuscoguttatus* x *Epinephelus lanceolatus*) With Different Feeding Frequency  
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The effect of fucoxanthin as coloring agent on the quality of Shrimp Paste  
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## The harmful effect of commercial powder detergent on water flea (*Daphnia* sp.)

H Kenconoajati, Suciyono and M H Azhar

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## Hematological parameters of Catfish (*Clarias* sp) vaccinated by *Aeromonas hydrophila* with different application methods

V N Nadiro, I Puspitasari, T A Setyastuti and A Santika

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## Detection potential fishing zones of Longtail tuna (*Thunnus tonggol*) using fisheries and remotely sensed data in the waters around Madura Island

A F Syah and M Sholeh

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## Evaluation of aqueous extract of robusta coffee (*Coffea canephora*) leaves for controlling *Argulus japonicus* infestation on common carp seed

N Afifah, Kismiyati and H Kenconoajati

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## The different effects of heat shock duration and initial period on hatching rate, abnormality rate, egg yolk absorption, and survival rate of spotted barb (*Puntius binotatus*) larvae

A T Mukti, M Ahmadi, Widjiati and E M Luqman

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## Addition different algae (*Spirulina*) flour to artificial feed on color quality and growth of Koi fish (*Cyprinus carpio-Koi*)

D A Sudirman, M Arief and A H Fasya

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## Tuna fisheries in fisheries management area Republic of Indonesia 572

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N Suyasa, P Rahardjo, D R Puji and A Widagdo



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Optimization of spermatozoa cryopreservation of Albino pangasius catfish: cryoprotectants with various concentrations and different equilibration times

U Hasanah, Abinawanto, A Alimuddin and A Boediono

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The relation between quality of the sediment (nitrate, phosphate) and *Avicennia sp* density, case study; Mangrove Center Bengkak, Banyuwangi Regency, East Java

Suciyono, B S Rahardja, A I Prayoga, H Kenconoati and M F Ulkhaq

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Length weight relationships and condition factor of sweet river prawn, *Macrobrachium esculentum* (Thalwitss, 1891) in the downstream Rongkong watershed

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Blood glucose and digestive tract andoparasite helminth infection of cantang grouper (*Epinephelus lanceolatus x Ephelus fuscoguttatus*) from traditional ponds in the Kampung Kerapu of Lamongan East Java

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Inventory of ectoparasite helminth on the Hybrid Grouper (*Epinephelus fuscoguttatus x Epinephelus lanceolatus*) from traditional ponds in the Kampung Kerapu Lamongan East Java Indonesia

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Biology, Ecology and Aquaculture potential of *Osteochilus spilurus* (Bleeker 1851) in East Belitung, Indonesia

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Antiproliferation effects of *Glycine max* Linn ethanolic extract on induced mammary gland carcinoma in albino rats

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Structure communities of macrozoobenthos in mangrove tourism area, Wongsorejo sub-district, Banyuwangi regency, East Java

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Probiotic enriched *Daphnia* sp: the nutritional profile and enzymatic activities

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Effect of different carbon doses of tapioca (*Manihot esculenta*) flour on vegetative cells and spore production of *Bacillus megaterium*

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Enrichment of feed for growth of cantang grouper (*E. fuscoguttatus* x *E. lanceolatus*) in floating cages

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The efficacy of probiotic with different storage to decrease the total organic matter, ammonia, and total *Vibrio* on shrimp pond water

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Addition of lemuru fish oil in the diet on the fat retention and fatty acid profile of silver barb (*Rasbora argyrotaenia*)

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Addition of Lemuru Fish Oil to Protein Retention and Feed Utilization Efficiency of silver barb *Rasbora argyrotaenia*

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Study on mangrove canopy cover in Lembeh Island, North Sulawesi

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The immune responses of *Oreochromis niloticus* under different form of *Bacillus* supplementation

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Response of kutuklin hemagglutinin protein adhesion in koi fish (*Cyprinus carpio*) infected by *Myxobolus* sp.

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Effect of different filter media use on aquaponics system on ammonium (NH<sub>4</sub><sup>+</sup>), nitrite (NO<sub>2</sub>) and nitrate (NO<sub>3</sub>) concentrations of catfish (*Clarias* sp.) aquaculture

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Different addition of molasses on feed conversion ratio and water quality in catfish (*Clarias* sp.) rearing with biofloc-aquaponic system

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Preliminary study: the effect of cryopreservation on the gastrula-staged embryo of African catfish (*Clarias gariepinus*)

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Composition analysis of organic and inorganic waste and the impacts of coastal city in Palu-Central Sulawesi

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Growth rate and survivorship of *Acropora* sp. fragments that transplanted on the artificial substrate made from *fly ash* and *bottom ash*

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Comparison of water quality and its influences on phytoplankton abundance based on water characteristics in coastal of Banyuwangi Regency, Jawa Timur, Indonesia

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The differences of depth on the species composition of spiny lobster puerulus on south Pacitan Regency East Java

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The effect of addition of fish bone meal on the concentration of nitrogen (N), phosphorus (P), and potassium (K) in seaweed liquid organic fertilizer of *Gracilaria* sp.

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Identification and prevalence infection of helminth in the gastrointestinal tract swamp eel (*Synbranchus bengalensis*) which marketed in Surabaya, East Java

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Isolation and identification of bacteria in gastrointestinal of eel (*Anguilla bicolor*) that has potential as probiotic

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Effect of fucoidan concentration from *Sargassum* sp. on skin lotion antioxidant activities

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Correlation between water quality and prevalence on Koi (*Cyprinus carpio*) which infested by *Argulus* in Mungkid Subdistrict and Muntilan Subdistrict, Magelang Regency, Central Java

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The effectiveness of activated carbon as adsorbent in the oil purification process fish by-product of the fish canning industry

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Effect of Mengkudu's (*Morinda citrifolia*) distillation with differential fruit ripeness to control *Argulus* on *Carassius auratus auratus*.

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Effect of eggs immersion in tannin solution against embryonic development of common carp fish (*Cyprinus carpio* L.)

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The effect of giving fermented rice bran suspension on fecundity and production of *moina macrocopa* offspring per parent

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Concentration of fermented tilapia feces suspension by decomposer bacteria as a feed to induce *moina macrocopa* sexual reproduction

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Correlation between Osteoprotegerin Serum Levels and Arterial Stiffness Assessed by Cardio-ankle Vascular Index (CAVI) in Hypertensive Patients

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## Hypoxic Preconditioning Effects of Bone Marrow-derived Culture Mesenchymal Stem Cells on CD31+ Expression, Vascular Endothelial Growth Factors-a (VEGF-A) and Stromal-derived Sactors-1 Alpha (SDF-1 $\alpha$ )

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## Correlation between Wall Motion Score Index (WMSI) and Anatomical M-mode (AAM) Systolic Thickening with Functional Capacity in Heart Failure among Post-myocardial Infarction Patients

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## Effects of Garlic Extract (allicin) on Proliferation of Endothelial Progenitor Cells (EPC) in Patients with Stable Coronary Artery Disease

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## Association between White Blood Cell to Mean Platelet Volume Ratio (WMR) with Troponin for Refractory Angina Prediction in NSTEMI-ACS patients

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## Correlation between Global Longitudinal Strain (GLS)-Left Ventricle and TEI Index (TI) with Seattle Heart Failure Model (SHFM) Score in Chronic Heart Failure Patients with Systolic Dysfunction

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## Potential concentration of heavy metal copper (cu) and microalgae growth *Spirulina plantesis* in culture media

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## Potential concentration of heavy metal copper (cu) and microalgae growth *Spirulina plantesis* in culture media

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**Abstract.** Water is an important environmental component for life. Heavy metal water pollution comes from many industries. Heavy Metals Copper (Cu) is one of several other heavy metals that are harmful to living things. One way to anticipate the increased pollution of heavy metals Copper (Cu) in waters is bioremediation using microalgae. This study aims to determine the ability of *Spirulina plantesis* in absorbing heavy metals Copper (Cu) and to determine the influence of heavy metal Copper (Cu) on the growth of *Spirulina platensis*. This study used an experimental method with Completely Randomized Design (RAL) consisting of four treatments and five replicates, namely A (*S. platensis* 0 ppm), B (*S. platensis* 1 ppm), C (*S. platensis* 3 ppm), D (*S. Platensis* 5 ppm). The results showed that *Spirulina platensis* was able to absorb heavy metal of Copper (Cu) so that it can be used as a heavy metal bioremediation agent. On treatment B (1 ppm) absorption of 87,719%, C (3 ppm) equal to 97,886% and D (5ppm) equal to 95,872 % Growth with the addition of Cu affects *Spirulina platensis* growth

### 1. Introduction

Water is essential for life environment. Living creatures on this earth can not be separated from the need of water. The quality and quantity of water can be a threat if they are not available in the correct condition [1]. If this condition is left unchecked, the future will worsen the condition of the environment and harm to human health due to increased pollution status and accumulation of heavy metals in biota [2].

Cu is one kind of some other heavy metals that are harmful to living things. A heavy metal pollutant for plants, animals and human health. In humans, copper poisoning can lead to hepatic cirrhosis, brain damage and a decline in kidney function [3]. Based on Threshold Limit Values (TLV) are Regulation of the Government of the Republic of Indonesia No. 82 of 2001 on water quality management and water pollution control with Cd metal content limit should not exceed 0.02 mg/L in a body of water.

Bioremediation is one of the alternatives for dealing with heavy metal toxicity. Bioremediation is the use of microorganisms that have been selected to be grown on a specific pollutants in an effort to reduce levels of pollutants [4]. Microalgae is the lowest level plants that have a very important role in





aquatic ecosystems as primary producers and suppliers of oxygen waters. Microalgae are a good bioremediator [5].

*Spirulina platensis* is one type of algae with a single cell which belongs to a class Cyanophyceae. These algae has a high ability to bind metal ions from solution and adsorb heavy metals because the algae are functional groups that can perform the binding with metal ions. The functional groups, especially carboxyl groups, hydroxyl, amine, sulfidril imadazol, sulfate and sulfonate contained in the cytoplasm of the cell wall. *Spirulina platensis* has the ability to absorb heavy metals. For that to know the ability of *Spirulina platensis* in different concentrations decline and the impact of concentration on growth. Therefore, this study was conducted to determine a decrease in the concentration of heavy metals (Cu) to the culture medium and to determine the effect of the concentration of copper (Cu) on the growth of *Spirulina platensis*.

## 2. Materials and methods

### 2.1. Place and time of research

This study was conducted from April to May 2017 in the Faculty of Fisheries and Marine Laboratory, University of Airlangga. Examination of the content of copper (Cu) in water culture medium *Spirulina platensis* conducted in Research and Industry Standards (Baristand) Surabaya.

### 2.2. Tools and materials

The equipment used in this research is autoclave, filter bag, digital scale, measuring flask, measuring cup, syringe, 1L treatment glass bottle, volume pipette, 40 watt fluorescent lamp, microscope, drop pipette, sedgewick rafter, hand tally counter, thermometer, pH meters, DO meters, refractometers, and aeration equipment. The tool used to check the content of Copper (Cu) is the Simatsu AA 6200 Flame Atomic Absorption Spectrometry (ASS) with a Limit Of Quantification (LOQ) <0.0078.

The research materials used were sea water, chlorine, Na-Thiosulfate, liquid soap, aluminum foil, heavy metal Copper (Cu), aquades, pure culture *Spirulina platensis* obtained from the Central Office of Brackish Aquaculture Fisheries (BBPBAP) Jepara, and Walne media .

### 2.3. Work procedures

This research was conducted experimentally, the research design used was a Completely Randomized Design (CRD) consisting of four treatments with five replications, namely:

- A: *S. platensis* without the addition of Cu
- B: *S. platensis* with the addition of Cu 1 ppm
- C: *S. platensis* with the addition of Cu 3 ppm
- D: *S. platensis* with the addition of 5 ppm Cu

Provision of heavy metals Copper (Cu), amounting to 1.3, and 5 ppm based on the results of research Prambodo et al. [6] that *Spirulina platensis* was able to reduce the concentration of Copper (Cu) and grow in culture media that were given 1.3, and 5 ppm heavy metals.

### 2.4. Tools and media of sterilization of culture

Equipment is used before sterilization, all tools are first washed with liquid soap and rinsed thoroughly. Then the equipment was put into a 1 atm pressure autoclave, at 121°C for 15 minutes [7]. For 1 L treatment bottles and analytical sample bottles washed thoroughly with liquid soap then soaked with chlorine, rinsed and dried.

Further sterilization of sea water will be used as a culture medium *Spirulina platensis*, The sea water is filtered by the filter bag and then sterilized using 60 ppm chlorine solution for 24 hours and neutralized with a solution of 20 ppm Na-thiosulfate until no smell of chlorine [8].

### 2.5. Preparation of solutions stock Cd

Manufacture of heavy metal stock solutions Cu. 1 ppm Copper (Cu) solution made is a stock solution with a concentration of 10 ppm. Stock solution is made by weighing 5 mg of CuSO<sub>4</sub> then dissolving it in 500 ml of distilled water in a measuring flask. The volume of solution taken to obtain a concentration of 1 ppm in Copper (Cu) stock solution is 50 ml. For a concentration of 3 ppm weighing 1.66 mg of CuSO<sub>4</sub> then dissolving in 500 ml distilled water in a volumetric flask. The volume taken to obtain 3 ppm in Copper (Cu) stock solution is 16.6 ml. At 5 ppm Cu stock solution makes 1000 ppm

stock solution. Generate a calculation of 5 mg which is then dissolved in 500 ml of distilled water. The volume of the ocean taken to obtain Copper (Cu) concentration of 5 ppm is 0.5 ml.

Taking copper stock (Cu) which will be treated using the following formula [9].

$$V1 \times N1 = V2 \times N2$$

Information :

V1: volume of stock sought (mL)

N1: sought stock concentration (mg/L)

V2: known stock volume (mL)

N2: known stock concentration (mg/L)

#### 2.6. *Phytoplankton nannochloropsis oculata and chlorella vulgaris cultures*

Culture media used in this study were 500 ml sterilized sea water and aerated. *Spirulina platensis* seedlings were inserted in bottles of each treatment with a density of  $1 \times 10^5$  cells / ml based on Nisak [10]. Furthermore, in each culture medium each treatment was added with as much as 0.5 mL/L walne fertilizer. Culture is carried out for 7 days.

#### 2.7. *Measurement of copper (Cu) on culture media Spirulina platensis*

Measurement Cudone before the start of culture on day 0 and after maintenance of *Spirulina platensis* culture on day 7. The content of Cu in sea water in a test media by Flame Atomic Absorption Spectrometry (ASS) Simatsu AA 6200 with Limit Of Quantification (LOQ)  $< 0.0078$  in Research and Industry Standards (Baristand) Surabaya.

#### 2.8. *Percentage calculation of absorption and density of phytoplankton*

Data retrieval absorption capability of Copper (Cu) is performed on day 0 and day 7. According Wiyarsi and Priyambodo [11], calculation of absorption efficiency using the following formula:

$$\text{Eff} = \frac{t0 - t7}{t0} \times 100\%$$

Information :

Eff: Absorption efficiency (mg /L)

t0 : Metal concentrations at baseline (mg / L)

t7 : Metal concentrations at the end of the study (mg / L)

Calculation of density performed daily for seven days to determine the growth of phytoplankton by using Sedgewick rafter.

$$\frac{nA + nB + nC + nD + nE}{5 \times 4 \times 10^5}$$

$$N = n \left( \frac{s}{lp} \right) \times \left( \frac{p}{v} \right)$$

Information :

N = Density of *Spirulina platensis* (units / ml)

N = Number of plankton in the 10 field of view (Units)

S = Number of field perspective on Sedgewick Rafter

Ip = Amount used visual field

Subsample P = Volume (ml)

V = sample volume (ml)

### 2.9. Data analysis

Analysis of data using Analysis Of Variance (ANOVA) to determine the differences between treatments. If the treatment is given provide a significantly different effect will be continued with Duncan Multiple Range Test (*Duncan's Multiple Range Test*) To determine differences among treatments one with the other treatments [12].

## 3. Results and discussion

### 3.1. Results

#### 3.1.1. Ability *nannochloropsis oculata* and *chlorella vulgaris* in absorbing heavy metal Cadmium

Results of analysis of the heavy metal content of copper (Cu) beginning and end of the culture medium *Spirulina platensis* for seven days showed a decrease in the concentration of heavy metals copper (Cu), The content and the percentage of water absorption of Cu in maintenance media can be seen in Table 1.

**Table 1.** The content and the percentage of water absorption of Cu in maintenance media.

Treatments	Percentage $\pm$ SD
A	0 <sup>a</sup> $\pm$ 0
B	87.72 $\pm$ 2.01
C	97.88 $\pm$ 0.60
D	95.87 $\pm$ 0.54

Description: Description: A (*S. platensis* 0 ppm), B (*S. platensis* 1 ppm), C (*S. platensis* 3 ppm), and D (*S. platensis* 5 ppm). Different superscripts in the same column indicate significant differences ( $p < 0.05$ ).

Statistical test results analysis of variants (ANOVA) interval of 95% on *Spirulina platensis* to heavy metals copper (Cu) showed results significantly different ( $P < 0.05$ ). The highest percentage amount obtained in the treatment of heavy metals the addition of copper (Cu) ) 3 ppm with an average percentage of 97.886%. Meanwhile, the lowest in treatment without the addition of the heavy metals copper (Cu) is 0%. While for the treatment of 1 ppm and 5 ppm respectively has a percentage reduction of heavy metals copper (Cu) 87.719% and 95.872%.

#### 3.1.2. Growth of *Spirulina platensis*

*Spirulina platensis* growth is calculated every day until the seventh day. In this growth, we also calculated density of *Spirulina platensis*. All treatments are calculated density is well treated by the addition of heavy metal and without the addition of heavy metals, growth data retrieval aims to determine the absorption of heavy metals and heavy metal influence on *Spirulina plantesis*. Average density data of *Spirulina platensis* are presented in Table 2.

**Table 2.** The average growth of *Spirulina platensis* for 7 days.

Treatments	Density of <i>S. plantesis</i> ( $10^3$ cell/m) in day to-						
	1	2	3	4	5	6	7
A	1	1.216	1.342	3.362	3.904	4.902	5.044
B	1	1.196	1.294	3.422	3.516	4.734	4.904
C	1	1.008	0.984	1.454	3.198	3.556	4.220
D	1	1.026	1.248	1.796	3.070	2.658	3.146

Note: A (*S. plantesis* 0 ppm), B (*S. plantesis* 1 ppm), C (*S. plantesis* 3 ppm), and D (*S. plantesis* 5 ppm)

#### 3.1.3. Water quality

The results of the measurement range of the average water quality culture media *Spirulina platensis* during the study are presented Table 3.

**Table 3.** The average value of water quality culture media *Spirulina platensis*

Parameter	Range
Temperature	29-33
DO (mg/L)	5-6
pH	7
Salinity (ppt)	30

### 3.2. Discussion

The results of water measurements in *Spirulina plantesis* culture media containing heavy metals Copper (Cu) of 1, 3, and 5 ppm have decreased the concentration of heavy metals. In 1 ppm heavy metals, the reduction of heavy metals to 0.13 ppm, for 3 ppm the reduction of heavy metals to 0.05, while in the 5ppm treatment the reduction of heavy metals to 0.188. Based on the analysis of initial and final heavy metal content of Copper (Cu) on *Spirulina plantesis* culture media during the study showed a decrease in the content of heavy metals Copper (Cu). The decrease occurred because the heavy metal Copper (Cu) undergoes a binding process with a functional group by *Spirulina plantesis*. Based on the table above shows that the best percentage is the absorption of heavy metals with a concentration of 3 ppm. The difference in absorption was 2,650 with a percentage of 97,886%.

The process of reducing the concentration of Cu in water that occurs in the treatment of Cu 1 ppm, 3 ppm and 5 ppm shows that there is absorption of Cu in the water by *Spirulina plantesis* cells. Percentage reduction in Cu content of 87.719%, 97.886%, and 95.872%, this is supported by the statement of Soeprbowati and Hariyati [5] states that *Spirulina plantesis* which is cultured into heavy metals can reduce concentrations up to 88% in Pb, 85% in Pb, 85% in Cd, 89% in Cu, and 88% in Cr.

The growth of *Spirulina plantesis* was observed for 7 days by the growth of *Spirulina plantesis* experienced a final phase (stationary phase) within a period of 6 days. This study was conducted 7 days because it was to determine cell changes after *Spirulina platensis* experienced the final phase (stationary phase) and accumulated heavy metal Cu in the cells.

The relationship of the maximum growth rate of *Spirulina plantesis* with the treatment of different heavy metal concentrations of Cu shows that the treatment with the addition of 1 ppm heavy metal is needed for growth but the higher the concentration of heavy metal Cu given, the lower the density of *Spirulina plantesis*. Torres [13] said heavy metals Cu is an essential metal and micronutrients needed for growth and development.

At 5 ppm addition of heavy metal Cu growth was inhibited but *Spirulina plantesis* did not experience death. This occurs due to heavy metal Cu concentrates where heavy metals inhibit respiration for photosynthetic microalgae. In addition, the sensitivity of microalgae to different heavy metals of each species interferes with physiological processes and inhibits photosynthesis. Pollutants entering mesophyll cells will affect the molecular level causing changes in stomatal response, chloroplast structure, CO<sub>2</sub> fixation [14].

The peak of growth in each treatment also experienced differences. *Spirulina plantesis* without the addition of Cu (A) reached the peak of population on the 7th day with a density of  $5.0 \times 10^5$ . *Spirulina plantesis* with the addition of Cu 1 ppm (B) reached the peak of the population that is on the 7th day with a density of  $4.9 \times 10^5$  and the addition of 3 ppm  $4.22 \times 10^5$  compared with the addition of Cu 5 ppm which is less that is  $3.1 \times 10^5$ .

The results of water quality data during the study showed that the condition of water quality parameters of culture media such as temperature, DO, pH, salinity are still in optimal condition. The temperature during *Spirulina platensis* culture that lasted 7 days ranged from 29 to 33°C. DO is dissolved oxygen found in waters where dissolved oxygen is used for respiration. During the study dissolved oxygen (DO) was obtained in the range of 4-6 mg / l. This condition is still optimum for the growth of *Spirulina platensis*. The degree of acidity (pH) when culture is at 7-8. Culture salinity at 30 ppt.

### 4. Conclusion

*Spirulina plantesis* can absorb Heavy Metal Copper (Cu) in all treatments. The best absorption of treatment C is by giving 3 ppm heavy metals with a percentage reaching 97.886%. Heavy metal Copper (Cu) affects the growth of *Spirulina plantesis* in the treatment of 5 ppm Copper (Cu) because this concentration is toxic to the growth of *Spirulina plantesis*. The results of the study are expected to be used to reduce waste containing heavy metal Copper (Cu) in the waste management installation before being discharged free of charge so that the waters remain sustainable and can be utilized sustainably. And research needs to be done with other heavy metals or combine heavy metals to be absorbed.

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