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The use of baker's yeast to promote growth of carp (*Cyprinus carpio* L)

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Abstract : This research was carried out to examine the effect of baker's yeast cells supplemented in feed on growth performance of carp (*Cyprinus carpio* L). Fingerlings (mean weight 3.42±0.77 g)were obtained from Freshwater Aquaculture Board in Talelu, Minahasa Regency. Fish were put in oxygenated-plastic bags and transported to the Laboratory of Aquaculture Technology at the Faculty of Fisheries and Marine Science, Sam Ratulangi University. Before running the experiment, the fish were acclimatized for two weeks in two 2x1x1 m^3concrete tanks, each was equipped with one inlet pipe, out let, and aerator. During acclimatization process, fingerlings were fed with commercial feed (pellet) at 5% of body weight per day, twice a day at 09.00 am and 16.00 pm. After acclimatization, fish was captured from the adaptation tanks and randomly distributed into 15 aquaria (five triplicated experimental treatments) measuring 0.6 x 0.4 x 0.4 m^3each with a density of 25 fishes/aquarium. Commercial pellet was supplemented with baker's yeast cells as immunostimulant at 5, 10, 15 and 20 g/kg pellet while control pellet was not supplemented with yeast cell. Fish was fed with treatment pellets for four consecutive weeks at 5% of body weight per day, twice daily at 09.00 am and 16.00 pm. Water exchange as much as one-third was conducted once every three days to maintain an optimal water quality. Fish weight was measured at the end of feeding period. The result showed that baker's yeast cells supplemented in feed significantly influenced the growth of fish ($p<0.01$). The highest weight gain was achieved in fish fed pellet supplemented with 5 - 10 g yeast/kg pellet. Thus, adding baker's yeast cells into commercial fish feed improved growth of carp.
Keywords: baker's yeast, Cyprinus carpio, fingerling, growth, weight gain.

Introduction

The culture of carp (*Cyprinus carpio* L) has long been implemented in the Province of North Sulawesi, Indonesia. This fish has become the most popular culture species in this region with high economic value and high demand. But since the last decade, the production has decreased significantly due to two major problems, slow growth and disease outbreak[1].Farmers suffered from significant economic losses and many of them had left the culture activities.

The growth of fish can be enhanced through the use of high quality feed that meet the fish requirement [2,3], probiotic [4, 5]and biofloc [6,7].Recently, scientists have focused their researches on the use of immunostimulants to improve growth performance and to enhance disease resistance of fish[8].Research results showed that in spite of enhancing the immune response, the use of immunostimulant was also potential to promote growth of fish

and crustacean. Immunostimulantdoes not leave any residue in fish body and environment and not harmful for human health[9]. In contrary, the use of antibiotics in aquaculture has resulted in bioaccumulation, pollution, antibiotic-resistant pathogens, immunosuppression, and high expenditure [10].Antibiotic was also dangerous for human health because its residue could be accumulated in the fish body and be transferred to people who eat the fish. Intensive use of antibiotic also has resulted in the increase of antibiotic-resistance pathogen [11].

Various natural products have been proved as source of immunostimulant, growth promoting substanceand antibacterial including seaweed [12], medicinal plants such as garlic [13-15],*Massa medicata*, *Crataegi fructus*, *Artemisia capillaries* and *Cnidium officinate*[16], neem (*Azadirachta indica*)[17], ginger (*Zingiber officinale*)[18-20], *Astragalus radix* and *Scutellaria radix*[21],*Solanum tribolatum*[22],bacterial[23,24]and yeast such as *Candida aquaetextoris*, *Hanseniaspora opuntiae* C21 [25], *Saccharomyces cerevisiae*[26,27]. Baker's yeast is a natural product from baker's yeast industry that contains various immunostimulating compounds such as β-glucan, nucleic acid, mannan oligosaccharides, and chitin[28]. Supplementation of baker's yeast cell in feed has been proved to enhance both growth and immunity of fish [29-31] and shrimp[32]. This research was carried out to examine the effect of baker's yeast cells supplemented in feed on growth performance of carp (*C. carpio* L).

Materials and Methods

Fish

Carp (*C. carpio* L) fingerlings as much as 500 individuals with an average weight of 3.42±0.77 g were obtained from Freshwater Aquaculture Board in Talelu, Minahasa Regency. Fish were put in oxygenated-plastic bags and transported to Aquaculture Technology Laboratory at the Faculty of Fisheries and Marine Science, Sam Ratulangi University. Before running the experiment, the fish were acclimatized for two weeks in two 2x1x1 m^3concrete tanks. Each concrete tank was equipped with one inlet pipe, out let, and aerator. During acclimatization process, fingerlings were fed with commercial fish food (pellet) at 5% of body weight per day, twice a day at 09.00 am and 16.00 pm.

Yeast and fish feed

Baker's yeast (*S. cerevisiae*) used as immunostimulant was bought from department store. Fish food used was commercial pellet containing 35% crude protein, crude lipid 2%, fiber 3%, ash 13% and water content 12%.

Experimental design

The research used Complete Randomized Design with five treatments, each with three replications. The treatments consisted of 0 (control feed), 5, 10, 15 and 20 g of yeast cell per kg of pellet.

Feed preparation

Commercial pellet was supplemented with baker's yeast cells as immunostimulant. Yeast cell was first weighed at 5, 10, 15 and 20 g using a digital balance. After being weighted, each yeast cell dose was suspended in some pure water (1:10 v/w), mixed thoroughly into one kilogram of pellet using a hand plastic sprayer. The mixture was then air-dried at room temperature. After dry, feed was put in plastic bags, and stored in refrigerator at 4^oC for further use. Control pellet was not supplemented with yeast cell.

Experimental procedure

After acclimatization, fish was captured from the adaptation tanks and randomly distributed into 15 aquaria(five triplicated experimental treatments)measuring 0.6 x 0.4 x 0.4 m^3each. The density of fish in each aquarium was 25 individuals. Fish was fed with treatment pellets four consecutive weeks at 5% of body weight per day, twice daily at 09.00 am and 16.00 pm. During the experiment, water temperature was stable at 28^oC and pH 6.5 – 7.5. Water exchange as much as one-third was conducted once every three days to maintained an optimal water quality. Fish weight was measured at the end of feeding period. Weight gain was calculated as follows:

$W_G = Wt - Wo$

Where:
W_G = weight gain (g)
Wt = weight of fish measured at the end of experiment (g)
Wo = initial weight of fish (g)

Statistical analysis

Data obtained were expressed as mean±Std. Deviasi. One-way analysis of variance (ANOVA) was used to evaluate the effect of yeast on fish growth while the difference effect between means was analyzed by Duncan Test using SPSS 22 for windows. Significant level was set at 0.05

Result and Discussion

Baker's yeast cells supplemented in feed significantly influenced the growth of fish ($p<0.01$). The growth and weight gain of fish after feeding the treatment pellets for four weeks were presented in Table 1. Fish fed with pellet supplemented with yeast cells at 5 and 10 g/kg of pellet had the biggest weight gain and were significantly different as compared to control fish. At higher doses (15 and 20 g yeast/kg pellet), the growth of fish were slower, weight gains seemed to be smaller, and were statistically not different as compared to that of control fish. This indicated that doses and time of administration are important to be taken into account in applying an immunostimulant as growth-promoting substances and immunomodulator in aquaculture [33].The efficacy of immunostimulant by oral method might decrease with long-term administration and overdoses of immunostimulants might suppress immunity and growth in fish[9]. If the dose was high and given in a long duration, the immunostimulant might not promote growth but conversely depress growth. Thus for the effective use of immunostimulants, dosages, method of administration, administration time and the physiological condition of fish need to be considered [9,34].

Table 1. Weight gain of carp fed pellet supplemented with baker's yeast cells for four successive weeks

Yeast cells (g/kg pellet)	Fish Weight (g)	Weight Gain (g)
0	5.12	1.70 ± 0.68^{a}
5	6.81	3.39 ± 1.27^{c}
10	7.07	3.65 ± 1.29^{c}
15	5.95	2.53 ± 0.61^{b}
20	5.72	2.29 ± 1.12^{ab}

Different super scribes in the same column were significantly different

This research found that supplementation of yeast cells in fish feed was able to promote growth of fingerling carp. Similar result was observed in our previous *in situ* study in which Nile tilapia (average weight 31.83 g) fed pellet supplemented with 10 g yeast cell/kg of pellet for four weeks had the highest weight gain. But if the feeding duration was only two weeks, supplementation of yeast cells did not affect the growth of fish[35]. In our laboratory research, Niletilapia fed diet supplemented with 20 g baker's yeast/kg pellet for four weeks had the biggest weight gain compared to control fish [36].Another studywas carried out to evaluate the use of commercial live baker's yeast, *S. cerevisiae*, as a growth and immunity promoter for Nile tilapia[31]. After the 12-week experimental period, the growth-promoting influences of bakers' yeast were observed with fish and the optimum growth, feed utilization, and protein turn-over were obtained with 1.0–5.0 g yeast/kg diet. Supplementation of yeast also increased protein deposition in fish body. Biochemical parameters were improved in fish fed yeast up to 1.0 g/kg diet. Total fish mortality 10-days after IP injection with *A. hydrophila* and its count after incubation with fish serum decreased with the increase of yeast level in fish diets. The lowest fish mortality and bacterial counts were obtained in fish fed 5.0 g yeast/kg. In Rohu (*Labeo rohita*), the effect of baker's yeast as growth promoter and immunomudulator (*S. cerevisiae*)had been investigated[29]. Fishwere fed for eight weeks with a formulated diet as control diet and the same diets supplemented with 5%, 7.5% and 10% baker's yeast as an experimental diets. At the end of the experimental period, fishes of all the tanks were challenged with pathogenic bacteria *A. hydrophila*. The results show that yeast cell wall was able to enhance the innate immunity and also had a positive co-relation with growth parameters. Through the absorption of yeast

wall particle, the immune function and disease resistance of the entire organism is stimulated. The effect of dietary whole yeast cell (*S. cerevisiae*) on growth performance, immunity and disease resistance was also reported in rainbow trout (*Onchorhynchus mykiss*). Yeast supplemented for 30 days period significantly promoted growth performance compared tocontrol group [28]. Treated fish also had higher immune response and lower mortality.In Nile tilapia (mean weight 28.78 g), four weeks oral administration of baker's yeast cell improved immunity of Nile tilapia cultured outdoor by increasing total leucocyte count and phagocytosis activity of phagocytic cells. The highest value of these two parameters was observed in fish treated with 5 g yeast cells. The immune parameters declined as the administration time elongated [33].Another report showed that incorporation of baker's yeast cells at 5 g yeast cells/kg of feed also increased the resistance of Nile tilapia to *A. hydrophila*[37]. In gilthead sea bream (*Sparus aurata* L.), supplementation of 5 or 10 g yeast/kg feed was able to enhance cellular innate immune response [26].

Supplementation of live baker's yeast cells into fry Nile tilapia diet induced growth performance, feed utilization and immunity, and is promising as an alternative method to antibiotics for disease prevention in tilapia aquaculture[31]. Yeast-by product from baker's yeast industry may be used as feed supplement and has positive effect on growth and nonspecific immune response of several fish species [38]. Yeast cell contains 0.9% free nucleotide and extract yeast contains 2.3% [39]. Many reports showed that supplementation of nucleotide in feed was able to induce growth, immunity and resistance of fish and shrimp to pathogens[, 27].In grouper (*Epinephelus malabaricus*), fish fed diet supplemented with nucleotides for eight weeks had better growth and immune responses compared to control fish[40]. In Atlantic Salmon, fish fed nucleotide-supplemented diets having a 15–22% weight advantage after 8 weeks of feeding. The growth benefits described following feeding with nucleotide-supplemented diets, even after just 3 weeks, could be due in part to an increase in the mucosal surface area of the gut due to significantly enhanced intestinal fold morphology [8]. A research on shrimp (*Litopenaeus vannamei*) showed that weight gain of shrimp fed nucleotides-supplemented feed (400 mg/ kg of feed) was bigger than control shrimp [41].[Thus baker's yeast cell may promote growth by enhancing digestibility of food and protein resulted in better growth and feed efficiency [42].

Conclusion

The present study provides information that baker's yeast cell added to commercial fish feed was able to promote growth of carp. The highest weight gain was achieved in fish fed pellet supplemented with 5-10 g yeast per kg of pellet.

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References

1. Manoppo H, Kolopita MEF, Malatunduh R. Growth promoter effect of garlic (*Allium sativum*) on carp (*Cyprinus carpio* L.). International Journal of PharmTech Research, 2016, 9 (4): 283-288
2. Higgs DA, Sotton JN, Kim H, Oakes JD, Smith J, Biagi C, Rowshandeli M, Devlin RH. Influence of dietary concentration of protein, lipid and carbohydrate on growth, protein and energy utilization, body composition, and plasma titers of growth hormone and insulin-like growth factor-1 in non-transgenic and growth hormone transgenic coho salmon, *Oncorhynchus kisutch* (Walbaum). Aquaculture, 2009, 286: 127-137
3. Sink TD, Lochmann RT, Pohlenz C, Buentello A, Galtin III D. Effects of dietary protein source and protein-lipid source interaction on channel catfish (*Ictalurus punctatus*) eggs biochemical composition, egg production and quality, and fry hatching percentage and performance. Aquaculture, 2010, 298: 251-259
4. de La Banda IG, Lobo C, Leon-Robio JM, Tapia-Paniagua S, Balebona MC, Morinigo MA, Moreno-Ventas X, Lucas LM, Linares F, Arce F, Ariji S. Influence of two closely related probiotics on juvenile

Senegalese sole (*Solea senegalensis*, Kaup 1858) performance and protection against *Photobacterium damselae* subsp. *piscicida*. Aquaculture 2010, 306: 281-288.

5. Das S, Ward LR, Burke C. Screening of marine *Streptomyces* spp. for potential use as probiotics in aquaculture. Aquaculture, 2010, 305: 32-41
6. Kuhn DD, Lawrence AL, Boardman GD, Patnaik S, Marsh L, Flick Jr GJ. Evaluation of two types of bioflocs derived from biological treatment of fish effluent as feed ingredients for pacific white shrimp, *Litopenaeus vannamei*. Aquaculture 2010, 303: 28-33
7. Crab R, Defoirdt T, Bossier P, Verstraete W. Biofloc technology in aquaculture: Beneficial effects and future challenges. Aquaculture, 2012, 356-357: 351-356
8. Burrels C, Williams PD, Soutthgate PJ, Wadsworth SL. Dietary nucleotide: A novel supplement in fish feed. 2. Effects on vaccination, salt water transfer, growth rates and physiology of Atlantic salmon (*Salmo salar* L.). Aquaculture, 2001,199 : 171-184
9. Sakai M. Current research status of fish immunostimulant. Aquaculture, 1999, 172 : 63-92
10. Babu DT, Antony SP, Joseph SP, Bright AR, Philip R.. Marine yeast *Candida aquaetextoris* S527 as a potential immunostimulant in black tiger shrimp *Penaeus monodon*. Journal of Invertebrate Pathology, 2013, 122: 243-252
11. Wu YR, Gong QF, Fang H, Liang WW, Chen M, He RJ. Effect of *Sophora flavescent* on non-specific immune response of tilapia GIFT (*Oreochromis niloticus*) and disease resistance against *Streptococcus agalactiae*. Fish & Shellfish Immunology, 2013, 34 : 220- 227
12. Ganeshamurthy R, Dhayanithi NB, Kumar TTA, Kumaresan S. Evaluation of antibacterial activity and immunostimulant of red seaweed *Chondrococcus hornemanni* (Kuetzing, 1847) against marine ornamental fish pathogen. J. of Coastal Life Medicine, 2014, 2(1): 64-69
13. Shalaby AM, Khattan l YA, Abdel RAM. Effects of garlic (*Allium sativum*) and chloramphenicol on growth performance, physiological parameters and survival of Nile tilapia (*O. niloticus*). J. Venom. Anim. Toxins incl. Trop. Dis., 2006, 21 (2): 172-201
14. Sihombing NTM, Silalahi J, Suryanto D. Antibacterial activity of aqueous garlic ((*Allium sativum*) extracts and virgin coconut oil and their combination against *Bacillus cereus* ATCC 14579 and *Escherichia coli* ATCC 8939. International Journal of ChemTech Research, 2014, 6 (5): 2774-2782
15. Ali SM, Nashwa MAA, Mohamed FM. Effect of garlic on the survival, growth, resistance and quality of *Oreochromis niloticus*. 8th Int. Symposium on Tilapia in Aquaculture, 2008.
16. Ji SC, Takaoka O, Jeong GS, Lee SW, Ishimaru K, Seoka M, Takai K. Dietary medicinal herbs improve growth and some non-specific immunity of red sea bream *Pagrus major*. Fisheries Science, 2007, 73: 63-69
17. Talpur AD, Ikhwanuddin M. *Azadirachta indica* (neem) leaf dietary effect on the immunity response and disease resistance of Asian sea bass, *Lates calcarifer* challenged with *Vibrio harveyi*. Fish & Shellfish Immunology, 2013, 34 : 254-264
18. Nya EJ, Austin B. Use of ginger, *Zingiber officinale* Roscoe, as an immunostimulant to control *Aeromonas hydrophila* infection in rainbow trout, *Oncorhynchus mykiss* (Walbaum). Journal of Fish Disease, 2009, 32: 971-977
19. Malik SN. Evaluation of Antibacterial and Antioxidant Activity of Ginger Rhizome and Ziziphus Leaves. International Journal of PharmTech Research, 2015, 7 (4): 554-259
20. Punitha SMJ, Babu MM, Sivaram V, Shankar VS, Dhas SA, Mahesh TC, Immanuel G, Citarasu T. Immunostimulating influence of herbal biomedicines on nonspecific immunity in Grouper *Epinepheleus tauvina* juvenile against *Vibrio harveyi* infection. Aquaculture International, 2008, 16: 511-523
21. YinG,JeneyG,RacsT,XuP,JunX,JeneyZ.EffectoftwoChineseherbs (*Astragalusradix*and *Scutellaria radix*) on nonspecific immunesystemof tilapia, *Oreochromisniloticus*. Aquaculture, 2006, 253:39-47
22. Divyagnaneswari M, Christybapita D, Michael RD. Enhancement of nonspecific immunity and disease resistance in *Oreochromis mossambicus* by *Solanum trilobatum*Leaf fractions. Journal Fish & Immunology, 2007, 23: 249-259.
23. Hang BTB, Milla S, Gillardin V, Phuong NT, Kestemont P. In vivo effects of *Escherichia coli* lipopolysaccharide on regulation of immune response and protein expression in striped catfish (*Pangasianodon hypophthalmus*). Fish & Shellfish Immunology, 2013, 34: 339-347
24. Flores-Miranda MdC, Luna-Gonzales A, Campa-Cordova AI, Gonzales-Ocampo HA, Fierro-Coronado JA, Partida-Arangure BO. Microbial immunostimulants reduce mortality in white leg shrimp (*Litopenaeus vannamei*) challenged with *Vibrio sinaloensis* strains. Aquaculture, 2011, 320: 51-55

25. Ma Y, Liu Z, Yang Z, Li M, Liu J, Song J. Effects of dietary life yeast *Hanseniaspora opuntiae* C21 on the immune and disease resistance against *Vibrio splendidus* infection in juvenile sea cucumber *Apostichopus japonicus*. Fish & Shellfish Immunology, 2013, 34: 66-73
26. Ortuno J, Cuesta A, Rodriguez A. Oral administration of yeast, *Saccharomyces cerevisiae*, enhance the cellular innate immune response of gilthead sea bream (*Sparus aurata* L.). Veterinary Immunology and Immunopathology, 2002, 85: 41-50
27. Biswas G, Korenaga H, Nagamine R, Kono T, Shimokawa H, Itami T, Sakai M. Immune stimulant effects of a nucleotide-rich baker's yeast Eextract in the kuruma shrimp, *Marsupenaeus Japanicus*. Aquaculture, 2012, 366-367: 40-45.
28. Tukmechi A, Andani HRR, Manaffar R, Sheikhzadeh N. Dietary administration of beta-mercapto-ethanol treated *Saccharomyces cerevisiae* enhanced the growth, innate immune response and disease resistance of the rainbow trout, *Oncorhynchus mykiss*. Fish and Shellfish Immunology, 2011, 30: 923-928
29. Tewary A, Patra BC. Oral administration of baker's yeast (*Saccharomyces cerevisiae*) acts as a growth promoter and immunomodulator in *Labeo rohita* (Ham.). Journal of Aquaculture Research and Development, 2011, 2:1-7
30. Li P, Galtin III DM. Evaluation of brewer's yeast. *(Saccharomyces cerevisiae)* as a feed supplement for hybrid striped bass *(Marone chrysops x M. saxatillis)*. Aquaculture, 2003, 219: 681-692
31. Abdel-Tawwab M, Abdel-Rahman AM, Ismael NEM. Evaluation of commercial live baker's'yeast, *Saccharomyces cerevisiae*as a growth and immunity promoter for fry Nile tilapia *Oreochromis niloticus* (L) challenged *in situ* with *Aeromonas hydrophila*. Aquaculture, 2008, 280: 185-189.
32. Sarlin PJ, Philip R. Efficacy of marine yeast and baker's yeast as immunostimulants in *Fenneropenaeus indicus*: A comparative study. Aquaculture, 2011, 321: 173-178
33. Manoppo H, Manurung UN, Tumbol RA. Efficacy of baker's yeast as immunostimulant in Nile tilapia (*Oreochromis niloticus*). International Journal of ChemTech Research, 2015, 8 (2): 559-565
34. Sajeevan TP, Philip R, Singh ISB.Dose/frequency: a critical factor in the administration of glucan as immunostimulant to Indian white shrimp *Fenneropenaeus indicus*. Aquaculture, 2009, 287: 248-252
35. Bugis A, Manoppo H. Peningkatan pertumbuhan ikan nila (*Oreochromis niloticus*) melalui pemberian immunostimulan ragi roti (*Saccharomyces cerevisiae*). Ejournal Budidaya Perairan, 2014, 2(3): 1-7
36. Manurung UN, Manoppo H, Tumbol RA. Evaluation of baker's yeast *(Saccharomyces cerevisiae)* in enhancing non specific immune response and growth of Nile tilapia *(Oreochromis niloticus)*. Ejournal Budidaya Perairan, 2013, 1(1): 8-14
37. Manoppo H, Tumbol RA, Manurung UN. Incorporation of baker's yeast cells as immunostimulant in feed enhance resistance of Nile tilapia to *Aeromonas hydrophila*. International Journal of PharmTech Research, 2015, 8 (5): 797-802
38. Olivia-Teles A, Goncalves P. Partial replacement of fishmeal by brewer's yeast *Saccharomyces cerevisiae*, in diets for sea bass *Dicentrachus labrax* juveniles. Aquaculture, 2001, 202: 269'278
39. Li P, Galtin III DM. Nucleotide nutrition in fish: Current knowledge and future application. Aquaculture, 2006, 251 : 141 – 152.
40. Lin, YH, Wang H, Shiau, SY. Dietary nucleotide supplementation enhance growth and immune response of grouper, *Epinephelus malabaricus*. Aquaculture Nutrition, 2009, 15: 117-122
41. Manoppo, H., Sukenda, Djokosetyanto, D., Fatuchri, M., Harris, E. Nukleotida meningkatkan respon imun dan performa pertumbuhan udang vaname, *Litopenaeus vannamei*. Jurnal Aquacultura Indonesiana, 2009, 10 (2): 85-92
42. Wache' Y, Auffray F, Gatesoupe FL, Zurrbonino J, Gayet V, Labbe' L, Quentel C. Cross effect of the strain dietary *Saccharomyces cerevisiae* and rearing condition on the onset of intestinal micro biota and digestive enzymes in rainbow trout, *Onchorhynchus mykiss* fry. Aquaculture, 2006, 258:470-478

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