The Effect of Saccharomyces Cerevisiae - Enriched Diet on Feed Usage Efficiency, Growth Performance and Survival Rate in Java Barb (Barbonymus gonionotus) Fingerlings

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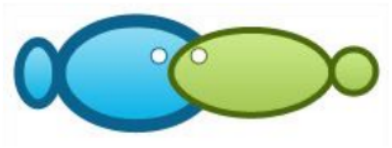

The effects of *Saccharomyces cerevisiae*-enriched diet on feed usage efficiency, growth performance and survival rate in Java barb (*Barbonymus gonionotus*) fingerlings

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Abstract. The study aimed to examine the effects of *Saccharomyces cerevisiae*-enriched diet on feed usage efficiency, growth performance and survival rate in Java barb (*Barbonymus gonionotus*) fingerlings. The Java barb fingerlings had an average weight of 2.53±0.58 g head^{-1}. They were collected from Muntilan, Central Java, Indonesia. Experimental method using Completely Randomized Design (CRD) was implemented. The experiment had 5 (five) treatments with four repetitions in each treatment. Those treatments were adding various doses of *S. cerevisiae* for every kilogram feed as follows: 0 g (treatment A), 1.5 g (treatment B), 3.0 g (treatment C), 4.5 g (treatment D) and 6.0 g (treatment E). The parameters studied were the efficiency of feed utilization (EFU), protein digestibility (ADCp), feed conversion ratio (FCR), protein efficiency (PER), relative growth rate (RGR), survival rate (SR), and water condition was also evaluated. The findings disclosed that *S. cerevisiae* supplemented diet has significant effect ($p < 0.05$) on EFU, ADCp, PER, FCR, RGR, otherwise it has insignificant effect ($p > 0.05$) on SR of Java barb fingerlings. The addition of *S. cerevisiae* 3 g kg^{-1} of feed was the best dose that produced EFU, ADCp, PER, FCR, RGR values of 72.09%, 75.42%, 3.89, 1.38, and 4.75% day^{-1} respectively. The parameters of water quality were still in the viable condition to cultivate Java barb.
Key Words: growth, supplementation, fingerlings, digestibility.

Introduction. Java barb fish (*Barbonymus gonionotus*) is an Indonesian native fish, which is highly preffered in Indonesian cuisines. They are easily cultivated and have high economic value (Budiharjo 2001). Java barb aquaculture depends on the availability of high quality diet. According to Tawwab et al (2010), high quality diet is an essential factor in intensive fish cultivation system and accounts for the most part of the total production cost.

One way to improve the quality of the fish feed is by incorporating *Saccharomyces cerevisiae* into feed. Tewary & Patra (2011) have described that the incorporating *S. cerevisiae* into feed has many benefits, such as 1). quickly, easily and cheaply produced, 2). very stable and recyclable from other industries; 3). a natural substance so that there are no adverse effects in fish and the environment.

Moreover, Rawung & Hengky (2014) disclosed that the S. *cerevisiae* addition into the feed could boost growth rate. Additionally, Tewary & Patra (2011) stated that the feed containing *S. cerevisiae* could increase enzyme activities in the digestive system of the fish. *S. cerevisiae* in the feed can also increase feed and protein digestibility, therefore it improved feed efficiency and growth (Manoppo & Kolopita 2015).

Several studies on the addition of *S. cerevisiae* into the feed showed that it can increase growth, feed conversion ratio, feed usage efficiency as reported by Tewary & Patra (2011) on *Labeo rohita*, Tawwab et al (2010) on *Sarotherodon galilaeus*, Manoppo & Kolopita (2016) and Razak et al (2017) on *Cyprinus carpio*, Manoppo & Kolopita (2015) on *Oreochromis niloticus*. However, there is still a lack of information about the

effectiveness of *S. cerevisiae* supplementation in the feed for Java barb, so the study on effects of *S. cerevisiae*-enriched diet on feed usage efficiency, growth performance and survival rate in Java barb is needed to be conducted. The objectives of the study were to examine the effects of *S. cerevisiae*-enriched diet on the feed usage efficiency, growth performance, and survival rate of Java barb.

Material and Method

Time and place of study. The study was conducted from April to May 2019 in the Laboratory for Fish Health and Environment Assessment, Muntilan, Jawa Tengah, Indonesia.

Preparation of test fish. The one hundred and eighty fingerlings of Java barb fish with the weight ranged from 1.95 to 3.11 g fingerling^{-1} were randomly assigned to four dietary treatments. The figerlings were procured from Muntilan, Central Java, Indonesia. Java barb fish were chosen based on healthiness, size uniformity, body organ completeness, activeness and disease free (Rachmawati et al 2017). Furthermore, the test fish was placed for one week to adjust to the new feed and the environment. Then the test fish fasted for one day before the study was conducted so that the previous feed metabolism did not affect the initial weight of the Java barb fingerling.

Feed preparation. The study used manufactured feed that had a 30% protein content. The treatments in the study were *S. cerevisiae* supplementation in feed. Those treatments were by adding various doses of *S. cerevisiae* for every kilogram feed, as follows: 0 g (treatment A), 1.5 g (treatment B), 3.0 g (treatment C), 4.5 g (treatment D) and 6.0 g (treatment E) (Tacon et al 2002). To examine protein digestibility, the 0.5% Cr_2O_3 was added into the diet (NRC 1993). Application of *S. cerevisiae* into the feed was by spraying as done by Vendrell et al (2008).

Cultivation preparation. The happas which were made from black net were utilized as tank experiment. Twenty happas with the size of 1x1x1 m^3 were placed randomly on the pond. Water used for Java barb cultivation came from spring water. The water was stored in the reservoir pond and deposited several days before it was used.

Implementation of research. This study was carried out at the Center for Fresh Water Hacthery in Muntilan, Central Java, Indonesia. The study was started by weighing the Java barb to measure the initial weight; then the Java barb fingerlings were stocked into happa with a density of 25 fish m^{-3}. The feed as much as 5% biomass weight day^{-1} was given using the fixed feeding rate method. The feeding frequency was three times a day, at 08.00; 14.00 and 18.00 Western Indonesian Time. The study had lasted for 60 days from April to May 2019 with the implementation of ten-day sampling to observe the weight gain of Java barb.

Parameters observed. The parameters observed in this study were the feed usage efficiency (EFU), feed conversion ratio (FCR) and protein efficiency ratio (PER), relative growth rate (RGR) and survival rate (SR), protein digestibility (ADCp) and water condition. The measurement of EFU, FCR, PER, RGR, and SR were based on the Tacon et al method (2002), while the measurement of ADCp was based on the Fenucci method (1981). The water parameters consisted of temperature, pH, dissolved oxygen and ammonia. The measurements of water condition were based on the APHA (1992) method. The parameter measurements followed the following formulas:

Feed usage efficiency (EFU) = 100 (end weight-beginning weight / diet weight consumed);

ADCp = 100 (% Cr_2O_3 in the feed / % Cr_2O_3 in the stool) x (% protein in the stool /% protein in the feed);

Specific growth rate (SGR) = 100 (ln W_2 – ln W_1) / T; where W_1= beginning weight, and W_2 = end weight, and T = the days in experiment;

Feed conversion ratio (FCR) = 100 (diet consumed (g) / weight increase (g));

Protein efficiency ratio (PER) = 100 (weight gain (g) / protein consumed (g));
Survival rate (SR) = 100 (beginning amount / end count)

Statistical analysis. The evaluation of the data used analysis of variance. If the results had a very significant effect ($p < 0.01$) or had a significant effect ($p < 0.05$), then the Duncan Multiple Area Test was conducted (Steel et al 1996). Descriptive analyses were used to compare the results of measurements of water condition on the study to requierd condition according to the literature.

Results. The results of observing parameters were presented in Table 1. Based on the table, it showed that *S. cerevisiae* supplementation in feed significantly affected EFU, ADCp, FCR, PER, RGR and did not considerably affect the SR.

Table 1

Data on parameter observations during the study

Experiment data	*Treatments*				
	A	*B*	*C*	*D*	*E*
EFU (%)	50.32 ± 0.15^{d}	58.25 ± 0.17^{c}	72.09 ± 0.15^{a}	65.15 ± 0.16^{b}	55.26 ± 0.17^{c}
ADCp (%)	52.31 ± 0.23^{d}	60.18 ± 0.29^{c}	75.42 ± 0.26^{a}	68.36 ± 0.28^{b}	58.36 ± 0.27^{c}
FCR	2.52 ± 0.26^{d}	2.20 ± 0.21^{c}	1.38 ± 0.23^{a}	1.98 ± 0.22^{b}	2.26 ± 0.24^{c}
PER	1.17 ± 0.25^{d}	2.60 ± 0.13^{b}	3.89 ± 0.26^{a}	2.84 ± 0.27^{b}	2.05 ± 0.26^{c}
RGR (% day^{-1})	2.08 ± 0.27^{d}	3.12 ± 0.14^{c}	4.75 ± 0.17^{a}	3.69 ± 0.26^{b}	2.54 ± 0.16^{d}
SR (%)	92.33 ± 1.77^{a}	90.33 ± 1.78^{a}	92.33 ± 1.27^{a}	88.33 ± 1.77^{a}	88.33 ± 1.26^{a}

Note: Mean values with different alphabets indicate a significant effect ($p < 0.05$).

Proxymate analysis in the Table 2 depicted the highest protein content that was found in the treatment C (3.0 g kg^{-1} diet); therefore, *S. cerevisiae*-enriched diet can support the fish growth.

Table 2

Proximate analysis of feeds

Parameters	*A*	*B*	*C*	*D*	*E*
Protein (%)	30.44	30.97	33.54	32.19	32.10
Lipid (%)	8.94	8.73	8.65	8.43	8.43
Energy (kcal)*	262.23	255.75	251.98	259.38	259.38
Ratio of E/P**	8.74	8.52	8.40	8.65	8.65

Sources: Laboratory of Feed and Nutrition, Faculty of Animal and Agriculture Diponegoro University (2019).
Note: *Based on Bomb Calorimetry (Tacon et al 2002); **E/P for optimal growth of fish range between 8-12 kcal g^{-1} (NRC 1993).

The results of polynomial orthogonal test and the regression of *S. cerevisiae*-enriched diet on EFU, ADCp, PER, and RGR were presented in Figures 1-5. The Figures 1-5 displayed that the relation between various doses of the *S. cerevisiae*-enriched diet and EFU, ADCp, FCR, PER, and RGR has quadratic relationship with the determination coefficients ranged from 73 to 91%.

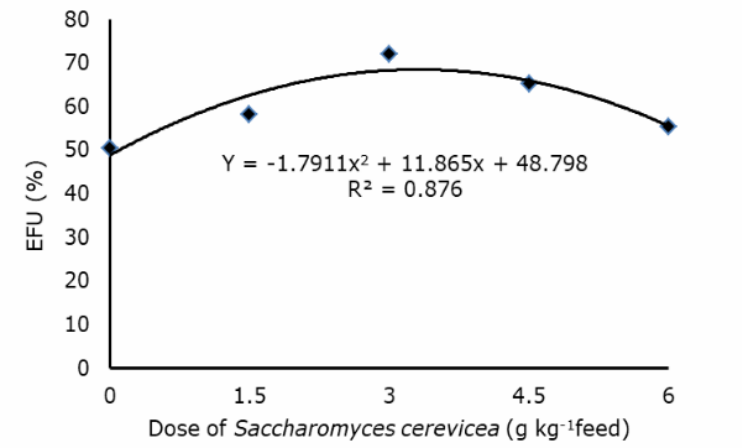

Figure 1. The relationship between the *S. cerevisiae*-enriched diet and EFU in Java barb.

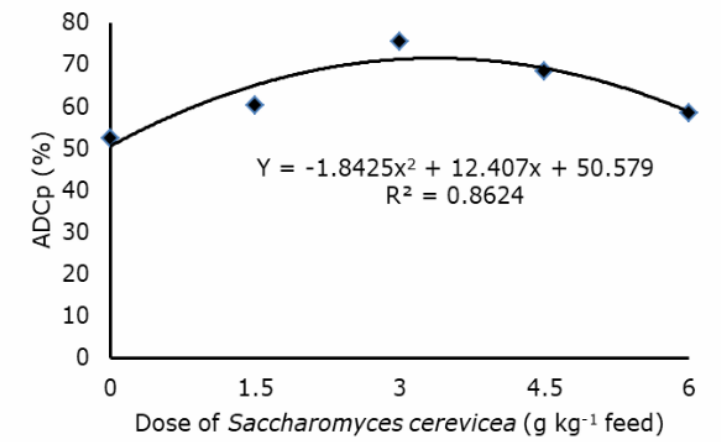

Figure 2. The relationship between the *S. cerevisiae*-enriched diet and ADCp in Java barb.

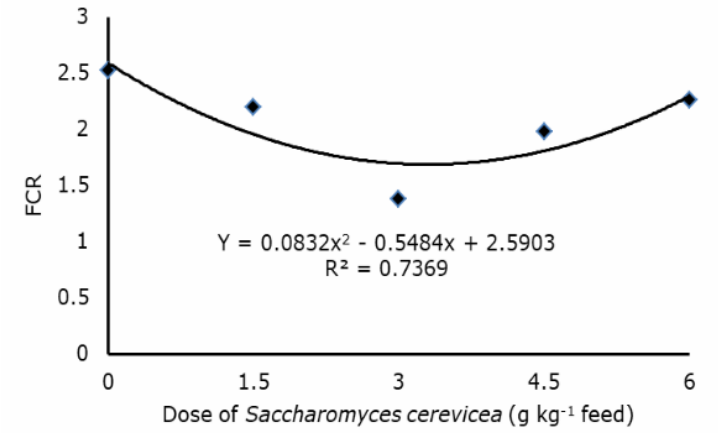

Figure 3. The relationship between the *S. cerevisiae*-enriched diet and FCR in Java barb.

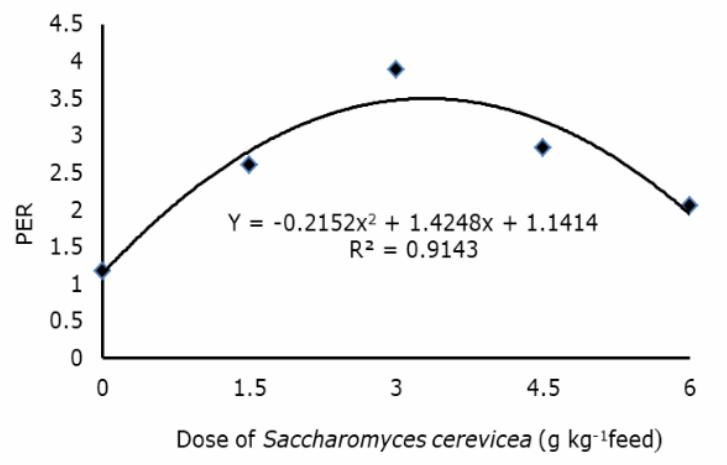

Figure 4. The relationship between the *S. cerevisiae*-enriched diet and PER in Java barb.

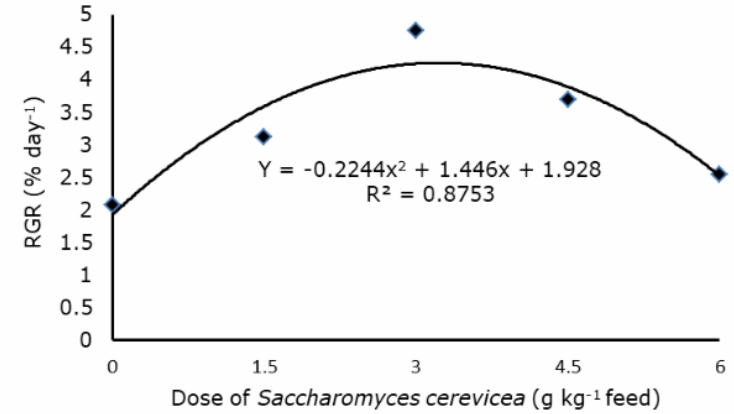

Figure 5. The relationship between the *S. cerevisiae*-enriched diet and RGR in Java barb.

The water condition during the study (Table 3) was in good condition according to the literature criteria; it indicated that water quality parameters were assumed feasible for Java barb fingerlings cultivation activities.

Table 3

Water condition parameters

Treatment	*Water condition*			
	Temperature (°C)	*pH*	*DO (mg L^{-1})*	*NH_3 (%)*
A	26-31	7.48-7.52	4.12-4.89	0.001-0.001
B	26-31	7.17-7.48	3.98-4.87	0.001-0.001
C	27-31	7.26-7.51	4.03-4.96	0.001-0.001
D	26-31	7.32-7.49	3.99-4.86	0.001-0.001
Feasibility	14-38*	6.50-8.5*	> 2*	< 0.1*

Note: *Boyd (2003).

Discussion. The Java barb fed with the *S. cerevisiae*-enriched diet (1.5-6 g kg^{-1} feed), i.e., B, C, D, and E treatments, had higher EFU values (58.25-72.09%) compared to the treatment without supplementation (0 g kg^{-1} feed), as in the treatment A (50.32%). The highest EFU value (72.09%) was obtained in Java barb fed with the dietary

supplementation of *S. cerevisiae* of 3.0 g kg^{-1} feed (treatment C) and followed by treatment D (65.15%), B (58.25%), E (55.26%) and A (50.32%). The high EFU value of Java barb fed the *S. cerevisiae*-enriched diet of 3 g kg^{-1} feed was thought to be an effective dose in increasing enzyme activities in the digestive system of fish so that protein digestibility increased and the feed usage efficiency maximized. The results indicated that treatment C brought about the highest ADCp value if it was compared to the other treatments (D, B, E, and A). This finding was supported by Razak et al (2017) who suggested that *S. cerevisiae* could increase enzyme activities in the digestive system, so that it increased the breakdown of nutrients into simpler form. The simpler nutrient form was easier to digest, in turn in increased the feed usage efficiency. Furthermore, Tewary & Patra (2011) also described that *S. cerevisiae* could stimulate digestion through increased digestive enzymes. Moreover, Razak et al (2017) and Manopo & Kolopita (2015) suggested that the addition of *S. cerevisiae* in the feed can improve the feed usage efficiency. The results of similar studies were reported by Tewary & Patra (2011) in *L. rohita* and Tawwab et al (2010) in *S. galilaeus*. The optimal dose of *S. cerevisiae* supplementation into the diet to obtain the highest value of EFU (68.42%) was 3.31 g kg^{-1} feed. The value of R^2 in the Figure 1A means that as much as 87.60% of EFU was influenced by the dietary supplementation of *S. cerevisiae,* while as much as 12.49% of EFU was influenced by other factors.

The *S. cerevisiae*-enriched diet had a significant effect ($p < 0.01$) on ADCp in Java barb fingerlings. Java barb fed with the *S. cerevisiae*-enriched diet with the doses of 1.5-6 g / kg feed, i.e., treatments B, C, D, and E, had higher ADCp values (58.36-75.42%) compared to without supplementation (0 g kg^{-1} feed), as in the treatment A (52.31%). The highest ADCp value (75.42%) was attained in Java barb in the treatment C (3.0 g kg^{-1} feed) and followed by treatment D (68.36%), B (60.18%), E (58.36%) and A (52.31%). The high ADCp value of Java barb as in the treatment C (3 g kg^{-1} feed) was expected to be an effective dose in increasing digestive enzyme activities, so that the ADCp process run optimally. Razak et al (2017) suggested that *S. cerevisiae* in the feed can increase the digestibility of feed and protein; therefore, it supports fish growth. The results of similar studies were reported by Manopo & Kolopita (2016), Azevedo et al (2016), Goda et al (2012), Razak et al (2017). The optimal dose of the *S. cerevisiae*-enriched diet can be found from Figure 2. The dose is 3.37 g kg^{-1} feed with the ADCp value of 71.44%. The value of R^2 in the Figure 2 was 86.20%. It means that as much as 86.20% of ADCp was influenced by the dietary supplementation of *S. cerevisiae,* while as much as 13.80% of EFU was influenced by other factors.

The *S. cerevisiae*-enriched diet caused a decrease in FCR value in Java barb fish fingerlings. The results of this study indicated that Java barb fed with *S. cerevisiae* supplementation (1.5-6 g kg^{-1} diet) had lower FCR values (1.38-2.26) compared to those without supplementation (0 g kg^{-1} diet) that has the FCR of 2.52. Java barb fed with *S. cerevisiae* supplementation of 3 g kg^{-1} diet had the lowest FCR value. It means that the feed usage efficiency was maximized; therefore, FCR decreased. Razak et al (2017) reported the addition of *S. cerevisiae* in the feed could increase protein digestibility, increase feed efficiency, increase growth and reduce FCR. *S. cerevisiae* supplementation in causing FCR decreased due to increased protein digestibility (Tovar et al 2002; Wache et al 2006). Furthermore, Abdel-Tawwab et al (2008) reported that *S. cerevisiae* supplementation in feed could reduce FCRs and improve the diet usage efficiency. The results of a similar study were reported by Manopo & Kolopita (2016) in *C. carpio*, Azevedo et al (2016); Goda et al (2012) in *O. niloticus*. The optimal dose of the *S. cerevisiae*-enriched diet can be found from Figure 3. The dose is 3.30 g kg^{-1} feed with the FCR value of 1.69. The value of R^2 in the Figure 3 was 73.60%. It means that as much as 73.60% of FCR was influenced by the dietary supplementation of *S. cerevisiae,* while as much as 26.40% of FCR was influenced by other factors.

The results of the variance analysis presented that the dietary supplementation of *S. cerevisiae* had a significant effect ($p < 0.05$) on PER in Java barb fingerlings. Java barb fed with *S. cerevisiae* supplementation (1.5-6 g kg^{-1} feed) had higher PER values (2.05-3.89) than those without supplementation (0 g kg^{-1} feed) of 1.17. Java barb fed with *S. cerevisiae* supplementation of 3 g kg^{-1} feed (treatment C) had the highest PER value

(3.75), otherwise the lowest PER value (1.17) was found in the treatment A (0 g kg^{-1} feed). The highest PER value in the treatment C (3 g kg^{-1} of feed) was thought to be effective in increasing digestibility and maximizing the feed usage efficiency so that the protein efficiency ratio increased. Tovar et al (2002) reported the addition of *S. cerevisiae* in feed could increase protein digestibility so that maximum feed usage efficiency increases protein efficiency ratio. Furthermore, Abdel-Tawwab et al (2008) expressed that supplementation of *S. cerevisiae* into feed could improve the feed usage efficiency and protein efficiency ratio. The results of a similar study were reported by Tovar et al (2002), Wache et al (2006) and Abdel-Tawwab et al (2008). The optimal dose of the *S. cerevisiae*-enriched diet can be found from Figure 1D. The dose is 3.31 g kg^{-1} feed with the PER value of 3.50. The value of R^2 in the Figure 4 was 91.40% It means that as much as 91.40% of PER was influenced by the dietary supplementation of *S. cerevisiae,* while as much as 8.60% of PER was influenced by other factors.

The results of the study (Table 1) showed that Java barb fed with *S. cerevisiae* supplementation (1.5-6 g kg^{-1} feed) had higher RGR values (2.54-4.75% day^{-1}) compared to those without supplementation (0 g kg^{-1} feed) amounting to 2.08% day^{-1}. Java barb fed with C (3 g kg^{-1} feed) had the highest RGR value which was thought to be effective at increasing the protein digestibility due to increased enzyme activity in the digestive tract so that the maximum feed usage efficiency supports increased fish growth. This opinion was supported by the results of this study which showed that Java barb fish fed C (3 g kg^{-1} feed) had the highest ADCp and EFU values, respectively (75.42%; 72.09%) when compared with other treatments D (68.36%; 65.15%), B (60.18%; 58.25%), E (58.36%; 55.26%), and A (52.31%; 50.32%). According to Manopo & Kolopita (2015) the addition of *S. cerevisiae* in feed can increase protein digestibility and feed usage efficiency resulting in increased fish growth. Furthermore, Rajagukguk et al (2017) reported that *S. cerevisiae* in the fish digestive system could increase the activity of digestive enzymes in the digestive system of fish so that there is an increase in protein digestibility, feed usage efficiency and ultimately increased fish growth. The results of a similar study were disclosed by Dhanaraj et al (2010), Essa et al (2010), Rawung & Manoppo (2014), Azevedo et al (2016), Manopo & Kolopita (2016), Mannopo & Kolopita (2015), Rajagukguk et al (2017), Sheikhzadeh et al (2012) and Razak et al (2017). Based on the Figure 5, the optimal dose of the dietary supplementation of *S. cerevisiae* can be found from Figure 5. The dose is 3.29 g kg^{-1} feed with the RGR value of 4.26% day^{-1}. The value of R^2 in the Figure 5 was 87.50%. It means that as much as 87.50% of RGR was influenced by the dietary supplementation of *S. cerevisiae,* while as much as 12.50% of RGR was influenced by other factors.

The dietary supplementation of *S. cerevisiae* insignificantly influenced ($p > 0.05$) on SR in Java barb fingerlings (Table 1). SR is not influenced by feed, but by initial treatment of fish and the quality of the cultivation condition (Yakuputiyage 2013). Hepher (1988) reported that SR is influenced by internal factors including age, reproduction, gender, and disease prone characteristic, also influenced by external factors such as water quality and amino acid types.

Conclusions. The study concluded that *S. cerevisiae* supplementation into feed could increase EFU, ADCp, PER, FCR, and RGR of Java barb fingerlings. Supplementation of *S. cerevisiae* at a dose of 3 g kg^{-1} diet was the best dose to produce the highest EFU value (72.09%), ADCp (75.42%), PER (3.89), FCR (1.38), RGR (4.75% day^{-1}) of Java barb fingerlings.

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References

Abdel-Tawwab M., Khattab Y. A. E., Ahmad M. H., Shalaby A. M. E., 2008 Compensatory growth, feed utilization, whole-body composition and hematological changes in starved juvenile Nile tilapia*, Oreochromis niloticus* (L.). Journal of Applied Aquaculture 18:17-36.

APHA, 1992 Standard methods for the examination of water and wastewater. American Public Health Association, Washington DC, 185 pp.

Azevedo R. V., Filho J. C. F., Pereira S. L., Cardoso L. D., Andrade D. R., Júnior M. V. V., 2016 Dietary mannan oligosaccharide and *Bacillus subtilis* in diets for Nile tilapia (*Oreochromis niloticus*). Acta Scientarium Animal Sciences 38(4):347-353.

Boyd C. E., 2003 Guidelines for aquaculture effluent management at the farm-level. Aquaculture 226(1-4):101-112.

Budiharjo A., 2001 Perubahan karakter morfologi ikan Tawes (*Barbodes gonionotus*) yang hidup di Andau Gua Serpeng, Gunungkidul. BIODIVERSITAS 2(1):104-109. [in Indonesian]

Dhanaraj M., Haniffaa M. A., Singh S. V. A., Arockiaraj A. J., Ramakrishanana C. M., Seetharaman S., Arthimanjua R., 2010 Effect of probiotics on growth performance of koi carp (*Cyprinus carpio*). Journal of Applied Aquaculture 22(3):202-209.

Essa M. A., El-Serafy S. S., El-Ezabi M. M., Daboor S. M., Esmael N. A., Lall S. P., 2010 Effect of different dietary probiotics on growth, feed utilization and digestive enzymes activities of Nile tilapia, *Oreochromis niloticus*. Journal of the Arabian Aquaculture Society 5(2):143-162

Fenucci J. L., 1981 Studies on the nutrition of marine shrimp of the *Penaeus*. PhD Thesis, Faculty of Department of Biology, University of Houston, Houston, Texas, USA, 185 pp.

Goda A. M. A., Mabrouk H. A. H. H., Wafa M. A. E., El-Afifi T. M., 2012 Effect of using baker's yeast and exogenous digestive enzymes as growth promoters on growth, feed utilization and hematological indices of Nile tilapia, *Oreochromis niloticus* fingerlings. Journal of Agricultural Science and Technology B(2):15-28.

Hepher B., 1988 Nutrition on pond fisheries. Cambridge University Press, Cambridge, USA, 388 pp.

Manoppo H., Kolopita M. E. F., 2015 Pengimbuhan ragi roti dalam pakan meningkatkan respons imun nonspesifik dan pertumbuhan ikan nila. Jurnal Veteriner 16(2):204-211. [in Indonesian]

Manoppo H., Kolopita M. E. F., 2016 Penggunaan ragi roti (*Saccharomyces cerevisiae*) sebagai imunostimulan untuk meningkatkan resistensi ikan mas (*Cyprinus carpio* L) terhadap infeksi bakteri *Aeromonas hydrophila*. Budidaya Perairan 4(3):37-47. [in Indonesian]

NRC, 1993 Nutrient requirements of fish. National Academy Press, Washington DC, 1248pp.

Rachmawati D., Istiyanto S., Maizirwan M., 2017 Effect of phytase on growth performance, diet utilization efficiency and nutrient digestibility in fingerlings of *Chanos chanos* (Forsskal 1775). Philippine Journal of Science 146(3):237-245.

Rajagukguk B. B., Lumenta C., Mokolensang J. F., 2017 Pemanfaatan ragi (*Saccharomyces cerevisiae*) pada formulasi pakan meningkatkan pertumbhan ikan nila (*Oreochromis niloticus*). Budidaya Perairan 5(3):44-49. [in Indonesian]

Rawung M. E., Manoppo H., 2014 Penggunaan ragi roti *(Saccharomyces cereviciae)* secara *in situ* untuk meningkatan respon kebal non-spesifik ikan nila (*Oreochromis niloticus*). Budidaya Perairan 2(2):7-14. [in Indonesian]

Razak A. P., Kreckhoff R. L., Watung J. C., 2017 Administrasi oral imunostimulan ragi roti (*Saccharomyces cerevisiae*) untuk meningkatkan pertumbuhan ikan mas (*Cyprinus carpio* L.). Budidaya Perairan 5(2):27-36. [in Indonesian]

Sheikhzadeh N., Heidarich M., Pashaki A. K., Nofouzi K., Farshabi M. A., Akbari M., 2012 Hilyses, fermented *Saccharomyces cerevisiae*, enhances the growth performance and skin non-specific immune parameters in rainbow trout (*Oncorhynchus mykiss*). Fish and Shellfish Immunology 32(6):1083-1087.

Steel R. G. D., Torrie J. H., Dickey D. A., 1997 Principles and procedures of statistics: a biometrical approach. 3rd edition, McGraw Hill International Book Company Inc., New York, 666 pp.
Tacon A. G. J., Cody J. J., Conquest L. D., Divakaran S., Forster I. P., Decamp O. E., 2002 Effect of culture system on the nutrition and growth performance of Pacific white shrimp *Litopenaeus vannamei* (Boone) fed different feeds. Aquaculture Nutrition 8(2):121-137.
Tawwab M. A., Mousa M. A. A., Mohammed M. A., 2010 Use of live baker's yeast, *Saccharomyces cerevisiae*, in practical diet to enhance the growth performance of Galilee tilapia, *Sarotherodon galilaeus* (L.), and its resistance to environmental copper toxicity. Jurnal of the World Aquaculture Society 41(2):214-223.
Tewary A., Patra B. C., 2011 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 2(1):1-7.
Tovar D., Zambonino J., Cahu C., Gatesoupe F. J., Vazquez-Juarez R., Lesel R., 2002 Effect of live yeast incorporation in compound diet on digestive enzyme activity in sea bass (*Dicentrarchus labrax*) larvae. Aquaculture 204(1-2):113-123.
Vendrell D., Balcazar J. L., de Blas I., Ruiz-Zarzuela I., Girones O., Muzquiz J. L., 2008 Protection of rainbow trout (*Oncorhynchus mykiss*) from lactococcosis by probiotic bacteria. Comparative Immunology, Microbiology and Infectious Diseases 31(4):337-345.
Wache Y., Auffray F., Gatesoupe F. J., Zambonino J., Gayet V., Labbé L., Quentel C., 2006 Cross effects of the strain of dietary *Saccharomyces cerevisiae* and rearing conditions on the onset of intestinal microbiota and digestive enzymes in rainbow trout, *Oncorhynchus mykiss*, fry. Aquaculture 258(1-4):470-478.
Yakuputiyage A., 2013 On-farm feeding and feed management strategies in tropical aquaculture. In: On-farm feeding and feed management in aquaculture. Hasan M. R., New M. B. (eds), FAO Fisheries and Aquaculture Technical Paper, 583:361-376.

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