Rabbitfish (*Siganus guttatus*) culture in floating net cage with different stocking densities

**Rachman Syah¹, Makmur¹, B R Tampangallo¹, M C Undu², A I J Asaad¹ and Asda Laining¹**

¹Research Institute for Coastal Aquaculture and Fisheries Extention, Jalan Makmur Dg. Sitakka No.129, Maros-90512, Indonesia
²Polytechnic of Marine and Fisheries of Jembrana, Village of Pengambengan, District of Negara, Regency of Jembrana, Bali-82218, Indonesia

Email: rachman22000@yahoo.com

**Abstract:** Rabbitfish (*Siganus guttatus*) is a schooling species which potential for being farmed in high density, however the information about stocking density of this species remain rare. This study was aimed to evaluate growth, survival rate, FCR, stress level and osmoregulation of Rabbitfish under different stocking densities. The tested fishes were the second generation (G2) of Rabbitfish that produced by hatchery outdoor of Research Institute of Coastal Aquaculture and Fisheries Extension, Maros, Indonesia. There were two stages of this study: the first stage was fingerling production. The seeds of Rabbitfish with average of length 6.2±0.8 cm and body weight 4.7±1.9 g/ind were reared in total of 12 units of 1 x 1 x 1 m³ floating net cage for 90 days. The stocking densities were 50, 100, 150 and 200 ind/m³. The second stage of this study was fish growing, where the tested fishes were cultivated with stocking density of 100, 150 and 200 ind/m³ in the same size of net as the first stage. The result of first stage showed that stocking density did not significantly affect growth rate of Rabbitfish fingerling. However, survival rate at stocking density of 50 (99.3±1.15%) and 100 ind/m³ (98.3±0.58%) were higher compared to stocking densities 150 and 200 ind/m³ (94.89±1.39 and 93.50±2.65%, respectively). The result of second stage showed that stocking density of 100 ind/m³ resulted significant growth, survival rate and FCR compared to that observed on 150 and 200 ind/m³. The fish stocked with density of 100 ind/m³ had length (18.6±0.3 cm), weigh (121.8±9.8 g/ind.), survival rate (92.0±2.6%) and FCR (4.41±0.43). Whereas, the result for fish stocked with 150 ind/m³ were 17.6±0.3 cm, 107.1±7.0 gram, 86.2±7.1 % and 5.15±0.59, respectively, and 200 ind/m³ were 16.9±0.2 cm, 96.5±5.9 gram, 82.4±2.3 % and 5.64±0.6, respectively. High stocking density might trigger stress on Rabbitfish and lower blood osmolality found on stocking density of 150 ind/m³ (490.00±59.77 mOsm/kg) and 200 ind/m³ (469.00±23.30 mOsm/kg) compared to that observed on density of 100 ind/m³ (501.67±23.50 mOsm/kg). During hypo-osmotic condition, the osmoregulation was not regulated by stocking density as indicated by blood osmotic performance levels <1, which was 0.37 mOsm/kg (100 ind/m³) and 0.33 mOsm/kg (for 150 and 200 ind/m³).

1. Introduction

Rabbitfish is one of the important economical fish with tasty white meat. This fish is easy to find in restaurants as a highly referenced menu. Rabbitfish has become a candidate species to cultivate [1-5] also supported the idea considering that Rabbitfish is an herbivore, responsive to artificial food, and easy to breed so that seeds stock demand can be fulfilled by hatchery [6-7]. Rabbitfish are able to...
survive in dense conditions with high stocking density, easy to adapt to salinity range between 5-40; further, the range of cultivation spread can become larger and stimulate high selling price to about 35,000-50,000 rupiah per kilogram. Among the number of restaurants at Makassar, a 300-gram Rabbitfish is offered Rp 35,000.

Several studies about Rabbitfish have been conducted, such as a genetic variety of Rabbitfish population, Siganus guttatus around Makassar Strait and Bone Bay in South Sulawesi [8], also in the waters of Barru, Lampung, and Sorong [9], in northern Mindanao [10], whereas the study of the morphometric and meristic characteristic of Rabbitfish was conducted around Makassar Strait and Bone Bay [11].

The seeding attempt of Rabbitfish species is also in progress, for example, Siganus rivulatus [12], S. guttatus [6-7,13-17], Siganus randali [1], there is also study to stadia embryo development of S. guttatus [18] and the influence of salinity, light intensity, and tank size to Siganus sutor’s larvae [19].

The fingerling seed to Rabbitfish as transition activity to hatchery and to rearing becomes a significant process to maintain; it is aimed to produce ready to spread seeds into the growing circumstance. Study of fingerling has also been conducted; they are seed fingerling of Siganus canaliculatus in floating net cage [20], S. guttatus with different initial length, [21], fingerling technique for S. guttatus [22], the effect of seed size grading to growth ability of S. rivulatus [23].

In order to support cultivation activity, study to fish feed nutrition was conducted to analyze the feed protein requirement for S. rivulatus [24], the protein-energy ratio of feed for S. canaliculatus [25] and S. guttatus [26], the lipids requirement for S. rivulatus [27], the substitution of macroalgae flour Ceratophyllum sp into Rabbitfish feed formulation [28], and the use of macroalgae Enteromorpha sp to S. canaliculatus’ feed [29], the supplementation of yeast into S. guttatus’ growing feed [30], the effect of squid heart flour to maturation feed of S. guttatus [31], the test of commercial and natural food [32], the profile of nutrition contained in Rabbitfish of Kepulauan Seribu, Jakarta [33]. The study of S. canaliculatus growing aspect in floating net cage [34,35,36], S. rivulatus in floating net cage [37], the stocking density for Siganus javus in fishpond [38], the polyculture of blue shrimp (Litopenaeus stylirostris) and Rabbitfish (Siganus lineatus) [39], the polyculture of Penaeus indicus and S. rivulatus [40], the polyculture of milkfish-Rabbitfish-mullet [41], the analysis of land suitability for the development of Rabbitfish cultivation in seagrass ecosystem [42]. Based on the mentioned researches above, so that the aspect of stocking density, whether in fingerling or grow-out, is considered remains rare. Therefore the study of stocking density becomes necessary to implement.

One of the production factors that influence the productivity of Rabbitfish is stocking density. The seed stocking density in cultivation system will determine the level of implemented cultivation technology, caused by the limited space, feedstock as a nutrition source for the fish, the need of dissolved oxygen, and capacity of leftover feed, feces, and fish metabolite can lower the quality of maintaining culture media. The stocking density also affects the stress level due to limited space for catching food and their competitiveness to absorb dissolved oxygen. Hence, providing information about density for fingerling activity of rearing is necessary. This research is aimed to evaluate the level of stocking density for the second generation (G2) of Rabbitfish S. guttatus in both stages: seed fingerling and grow-out period.

2. Methodology

2.1. Study Site
This research is implemented at the Experimental Fishpond Installation of Research Institute for Coastal Aquaculture and Fisheries Extention, Punaga Village, District of Mangarabombang, Takalar Regency, South Sulawesi

2.2. Experiment Cage
For the seed fingerling process, we use a cage made of 12 black net (# 1mm) sized 1x1x1,2 meters, whereas for the rearing stage, we use nine polyethylene (# 0,5 inch) cages sized 1x1x1,2m. The cages
were hanged on a wooden raft in the fishpond and equipped with root blower for the bottom aeration system.

2.3. Tested Fish
The specimens were seeds of Rabbitfish, *S. guttatus* generation 2 (G2) that produced from previous outdoor hatchery system activity located at Fish Hatchery of Siddo, Barru. There were approximately 3,000 individu of Rabbitfish seed *S. guttatus* G2 relocated using fiberglass tank volume 2 m³, equipped by aeration system, from Barru to Punaga.

Before they were functioned as test fish, we adapted the fish to maintenance media and feed for 30 days. During the adaptation process, seeds of Rabbitfish were being reared in hapa sized 3x3x1.5 m, in stocking density 3000 ind/hapa. We feed the seed with a crumbled pellet (CP 38%) three times per day using a satiation system.

2.4. Procedure of Experiment
This research consists of two stages. The first step was seed fingerling into a floating cage for 90 days, and the next was growing the seed in the floating cage for 120 days. Firstly, we fingered seeds of Rabbitfish into *hapa* (nylon fishnet), the size of each seed was 6,2±0,8 cm length and 4,7±1,9 gram in weight that we collected from the adaptation process. The research was designed using Complete Random Design. The stocking density was handled as A: 50; B: 100; C:150; and D:200 ind/m³. Each treatment was repeated three times.

As the second stage, the seed of Rabbitfish G2 from the previous stage sized 13,1±0,7 cm length and weigh 42,9±4,3 g/ind fingered into volume 1 m³ cage. The stocking density was handled as A: 100; B: 150; and C: 200 ind/m³. Each treatment was repeated three times.

During the fingerling and grow-out culture, the seeds were given commercial feed (contains raw protein 38,25%, raw fat 4,69%, raw fiber 4,04%, and ash 10,09%). The feeding was attempted 10-4% (fingerling process) and 3-2% (rearing process) of fish biomass per day. We feed the fish three times a day at 7-8 a.m, 1-2 p.m, and 5-6 in the evening.

2.5. Measured Parameters
The observation to water quality comprises temperature, salinity, pH, DO was conducted *in situ* every 7-8 a.m and 5-6 p.m utilizing DO meter YSI Profesional Pro, whereas parameters of TAN, Nitrite, Nitrate, Phosphate, TSS, TOM and alkalinity were measured every week in the laboratory. The growth in length and weight were measured once every two weeks. The survival rate, biomass production, and feed conversion ratio were measured at the end of the research. The indicator of stress level as a response to the change of stocking density was observed by hematocrit, blood Leucocrit, blood glucose, and osmotic plasma activity of fish blood to the test fish at the end of the second stage.

2.6. Data Analysis
The data of biological response covers growth, survival rate, and FCR were analyzed of variance to find the effect of stocking density, whilst the effect of stocking density to stress indicator was analyzed descriptively as well as the data of water quality to find out habitat viability for Rabbitfish.

3. Results

3.1. Fingerling Production of *S. guttatus*
The seeds of Rabbitfish grew relatively in stocking density between 50-200 ind/m³, including growth length pattern (Fig. 1) as well as their weight (Fig. 2) during 90 days rearing process inside the cage. The increase of seed weight was approximately 41.68±4.36—43.97±3.15 g/ind and the total length was varied between 6.78±0.59—7.07±0.36 cm. The variance analysis results demonstrate that the treatment of stocking density gave no significant difference (p>0.05), whether to the daily length growth or to the daily weight growth of Rabbitfish seeds (Table 1). The graphic of growth encountered
increase to 60 days. In the third month of rearing, the daily weight gain development dropped drastically due to the increase of salinity media following the coming of the dry season.

**Figure 1.** The length growth of seed (*Siganus guttatus*) during fingerling production

**Figure 2.** The weight growth of seed (*Siganus guttatus*) during fingerling production

The stocking density gave a significant difference (p<0.05) to the survival rate of Rabbitfish *S. guttatus* seed in the fingerling production. The survival rate hit the top level at treatment 50 ind/m$^3$, it was 99.33±1.15%, although it was not significantly different with 100 ind/m$^3$ treatment which was (98.33±0.58%), both of treatments demonstrated significant change to treatment 150 ind/m$^3$ and 200 ind/m$^3$, those were 94.89±1.39% dan 93.50±2.65 (Table 1). The feed conversion ratio (FCR) showed a reversed response that was increased along with the improvement of stocking density, and it was also showed a real impact to feed conversion ratio. FCR of stocking density 50 and 100 ind/m$^3$ had no
difference; moreover, both demonstrated real difference to stocking density 150 and 200 ind/m$^3$. The lowest FCR occurred at a stocking density of 100 ind/m$^3$.

### Table 1. The biological response of Rabbitfish seed in different stocking densities.

| Variables               | Stocking Density (ind/m$^3$) |
|-------------------------|-----------------------------|
|                         | 50  | 100 | 150 | 200 |
| Initial length (cm)     | 6.2±0.8 | 6.2±0.8 | 6.2±0.8 | 6.2±0.8 |
| Final length (cm)       | 13.3±0.4 | 13.2±0.1 | 13.0±0.4 | 13.0±0.6 |
| Initial weight (g/ind)  | 4.7±1.9 | 4.7±1.9 | 4.7±1.9 | 4.7±1.9 |
| Final weight (g/ind)    | 47.65±3.97$^a$ | 48.67±3.15$^a$ | 46.38±4.36$^a$ | 47.76±4.95$^a$ |
| Length gain (cm)        | 7.07±0.36 | 6.99±0.13 | 6.81±0.43 | 6.78±0.59 |
| Weight gain (g)         | 42.95±3.97 | 43.97±3.15 | 41.68±4.36 | 43.06±4.95 |
| Daily length gain (cm/day) | 0.08±0.04$^a$ | 0.08±0.04$^a$ | 0.08±0.04$^a$ | 0.08±0.04$^a$ |
| Daily weight gain (g/day)| 0.48±0.04$^a$ | 0.49±0.04$^a$ | 0.46±0.05$^a$ | 0.48±0.05$^a$ |
| Survival Rate (%)       | 99.33±1.15$^a$ | 98.33±0.58$^a$ | 94.89±1.39$^b$ | 93.50±2.65$^b$ |
| Production (kg)         | 2.368±0.223 | 4.785±0.286 | 6.602±0.656 | 8.933±1.003 |
| FCR                     | 1.57±0.02$^a$ | 1.51±0.02$^a$ | 1.87±0.12$^b$ | 2.01±0.08$^b$ |

$^a$ the same alphabet in the same row indicates that there was no significant difference 95% on the level of trust.

The water quality of rearing media for Rabbitfish seed demonstrated relatively stable patterns as a response to temperature, pH, and dissolved oxygen for 90 days. We took observation in temperature around 25.2-33.7 (29.3±1.6) °C and pH between 7.5-9.2 (8.5±0.3) and dissolved oxygen around 3.3-6.9 (4.8±0.8) ppm, while salinity increased between the rate of 26.9 to 37.2 ppt (Table 2). In the third month, salinity was rising following dry season. The parameters of water quality that covered TAN, Nitrite, Nitrate, Phosphate, Alkalinity, TSS, and BOT were considered reasonable for the life and growth of *Siganus guttatus*.

### Table 2. Water quality parameters in nursery culture

| Variable              | Min  | Max  | Average | ±sd  |
|-----------------------|------|------|---------|------|
| Temperature (°C)      | 25.2 | 33.7 | 29.3    | 1.6  |
| Salinity (ppt)        | 26.9 | 37.2 | 31.8    | 3.6  |
| pH                    | 7.5  | 9.2  | 8.5     | 0.3  |
| Dissolved Oxygen (ppm)| 3.3  | 6.9  | 4.8     | 0.8  |
| TAN (ppm)             | 0.0770 | 0.6753 | 0.3148 | 0.2054 |
| Nitrite (ppm)         | nd   | 0.2884 | 0.0822 | 0.1055 |
| Nitrate (ppm)         | 0.0526 | 3.2395 | 1.4052 | 1.4233 |
| Phosphate (ppm)       | 0.0250 | 0.7108 | 0.1660 | 0.2342 |
| Alkalinity (ppm)      | 109.62 | 154.28 | 130.70 | 13.93 |
| TSS (ppm)             | 30   | 174  | 73      | 47   |
| TOM (ppm)             | 10.12 | 111.93 | 48.65  | 32.99 |

3.2. *The grow-out culture of S. guttatus in floating net cage*

Thorough the rearing process for 120 days, seeds of Rabbitfish were growing relatively normal in the stocking density treatment. In the first month, tested fish grew similarly to the entire treatment, the difference started to occur at the month until the last period (Fig. 3 and 4). Low density (100 ind/m$^3$) demonstrated higher growth response, either to length parameter 18.6±0.3 cm or fish weight 121.8±9.8 g/ind compared to 150 ind/m$^3$ and 200 ind/m$^3$ treatment. There was a tendency that showed stocking
density affected in significant different (p<0.05) to the length where all three of them were veritable different. The increase of fish weight in stocking density 100 ind/m³ was obviously different in stocking density 200 ind/m³, while density 100 and 150 ind/m³ was not demonstrated distinct difference and density 150 ind/m³ was not quite different to 200 ind/m³ (Table 3).

![Figure 3](image1.png)  
**Figure 3.** The length growth of *S. guttatus* during grow-out culture

![Figure 4](image2.png)  
**Figure 4.** The weight growth of *S. guttatus* during grow-out culture

The survival rate of Rabbitfish at the rearing stage reached 82.2-92.0% (Table 3). The higher density was, the lower the survival rate became. The ANOVA result showed that stocking density significantly influenced to survival rate. The density of 100 ind/m³ resulted in the highest survival rate that was 92.0±2.6% and it resulted not much difference to 150 ind/m³. Meanwhile, it demonstrated a distinct difference for density 200 ind/m³. The other result showed that density 150 dan 200 ind/m³ with each survival rate hit 86.2±7.1% and 82.2±2.3% gained no significant difference.
The applied stocking density influenced significantly to FCR. There was an indication that the higher density was, the higher FCR score become. FCR value at density 100 and 200 ind./m$^3$ were distinctly different, but both results were not quite dissimilar to density 150 ind./m$^3$ (Table 3). FCR score of this research was classified high between 4.41-5.64 with a low-efficiency score between 17.7-22.6%. This indicated that the tested fish did not consume efficiently.

The entire parameters of water quality measured in 120 days occurred at a suitable range for the life and growth of *S. guttatus*. The salinity of rearing media encountered a quite extreme increase during the process with a range of 34.60—43.89 ppt (Table 4) following dry season along with July to October 2019.

The observation result of the osmolality of tested fish in a cage with stocking density between 100-200 ind./m$^3$ did not show different effects on every tested density. Level of osmolality for density 100 ind./m$^3$ was 501.67±23.50 mOsm/kg, and it was higher compared to density 150 and 200 ind./m$^3$, for each resulted 490±59.77 mOsm/kg and 469,00±23,30 mOsm/kg (Table 5), the level of osmotic plasma activity of fish blood was around 0.33—0.37 mOsm/kg (Table 5), while water osmolality of rearing media was about 1,127—1,252 (1,217±45) mOsm/kg.

### Table 3. The biological response of Rabbitfish seed to different stocking density.

| Variable                        | Stocking density (ind/m$^3$) |
|---------------------------------|------------------------------|
|                                 | 100             | 150             | 200             |
| Initial length (cm)             | 13.1±0.7        | 13.1±0.7        | 13.1±0.7        |
| Initial weight (g)              | 42.9±4.3        | 42.9±4.3        | 42.9±4.3        |
| Final length (cm)               | 18.6±0.3        | 17.6±0.3        | 16.9±0.2        |
| Final weight (g)                | 121.8±9.8       | 107.1±7.0       | 96.5±5.9        |
| Initial biomass weight (kg)     | 4.74±0.28       | 6.67±0.39       | 9.37±1.01       |
| Final biomass weight (kg)       | 11.20±0.70      | 13.84±1.27      | 16.40±1.39      |
| Length gain (cm)                | 5.5±0.3         | 4.6±0.3         | 3.8±0.2         |
| Weigh gain (g)                  | 78.9±9.8        | 64.2±7.0        | 53.5±5.9        |
| Daily growth in length (cm/day) | 0.4±0.0         | 0.3±0.0         | 0.3±0.0         |
| Daily growth in weight (g/day)  | 7.3±0.7         | 6.3±0.5         | 5.6±0.4         |
| Biomass gain (kg)               | 6.46±0.85       | 7.17±1.05       | 7.03±1.31       |
| Survival rate (%)               | 92.0±2.6        | 86.2±7.1        | 82.2±2.3        |
| FCR                             | 4.41±0.43       | 5.15±0.59       | 5.64±0.61       |

*a the same alphabet at the same row indicates that there was no significant different 95% on the level of trust.

### Table 4. The water quality of rearing media in pond culture.

| Variable        | Min  | Max  | Average | ±sd  |
|-----------------|------|------|---------|------|
| Temperature (°C)| 24.77| 30.33| 27.37   | 1.37 |
| Salinity (ppt)  | 34.60| 43.89| 38.54   | 2.34 |
| pH              | 5.68 | 9.02 | 8.26    | 0.36 |
| DO (ppm)        | 2.38 | 8.70 | 5.15    | 1.05 |
| TAN (ppm)       | 0.1047 | 0.3905 | 0.2591 | 0.1033 |
| Nitrite (ppm)   | 0.0745 | 0.9418 | 0.2790 | 0.3750 |
The smaller the seed length, the daily increase of weigh during thorough fingerling period was relatively similar with stocking density 50-200 ind/m³. However, in the rearing period, stocking treatment resulted in real response to growth, where stocking density 100 ind/m³ showed a high growth score compared to the other treatments. The production of biomass also increased proportionally as well as the increase of stocking treatment. Bukhari [37] reported that stocking treatment 80, 100, and 120 ind/m³ did not show a real effect on the absolute growth and survival rate of S. rivulatus, although there was a tendency that the higher stocking density was, final weigh and survival rate changed adversely. The research by Saoud et al. [43] which applied to the stock treatment of S. rivulatus seeds in 10, 20, 30, and 40 ind/52L, initial weigh 65 g/ind for 8 months resulted in more than 95% survival rate to all treatment with feed efficiency value 0.67—0.71. Lante et al. [21] reported that the initial length of S. guttatus’ seed in 60 days fingerling for stocking density 250 ind/m³ showed a real impact on the daily increase of weigh and did not affect the daily increase of length. The smaller the seed length, the daily increase of weighing became greater.

We found that tendency of survival rate became lower following the increase of stocking density. It indicates that the stocking density had a potential influence on wiggle competition, the need for oxygen, rivalry to earn feed, and litter production. Although the survival rate at the fingerling period
did not affect by stocking density, however, it resulted in different real response at the rearing period. The survival rate we noted from the fingerling process in this research (93.50-99.33%) was higher than the research conducted by Lante et al. [21] that was around 50.67-63.60% from the same species with stocking density 250 ind/m² and 3.0-5.0 cm initial length.

The three times per day feeding schedule with 10-20% dosage of biomass weigh per day we implemented in this research demonstrated a similar result from Barakats’s in Barakat et al. [44]. It explained that three times feeding per day for S. rivulatus stimulated growth, FCR score, ultra-structured muscle, and better meat quality than once or twice feeding per day. S. rivulatus was a species with a slow growth rate, which needed feed dosage about 7.5% of biomass weight per day. On the other hand, fish that was treated in a 10m³ floating net cage might produce better than treatment in 20 m³ media [37]. FCR value we found during rearing period was as high as expected and not efficient because the tested fish was treated inside high salinity media; it was up to 40 ppt.

There was a tendency for Osmolality value to decrease related to the increase of stocking density. It indicates that stocking density was influencing to stress level during the rearing period. Several research results mentioned that high stocking density became one of the chronic stress factors and might affect the fish welfare and growth rate [45], as well as affecting the growth of Catla catla dan Labeo rohita [46]. Montero et al. [47] reported that high stocking density resulted in crowding stress which changed physiological and biochemistry parameters to juvenile of gilthead seabream, Sparus aurata, one of the effects was a decrease of the hepatosomatic index, and it changed liver fatty acid composition. It assured that there was an effect of stocking density to lipid metabolism in order to support the fulfillment of energy demand. The relatively low growth level and FCR point during chronic stress condition as a response to stocking density was indicated by the change in metabolism system such as the escalation of basal cortisol value which was a response sign to chronic stress [48].

The osmoregulation ability can be used as a tool to evaluate the physiological condition of cultivated fish or endurance capacity to stress caused by the environment salinity [49]. Through this research, Rabbitfish was treated in hypo-osmotic conditions due to the water osmolality of culture media was higher than hemolymph osmolality, hence the level of osmotic performance of Rabbitfish reduced to <1. In imbalanced osmotic conditions, osmotic performance value will carry out regulation. In the hypo-osmotic condition, when it is in high salinity level, fish will throw water from hemolymph and take water as much as possible to survive. The level of osmotic performance was the ability of a cultivated organism to adapt on osmotic pressure in blood plasma and osmotic pressure of its life medium. The difference of osmotic value in blood plasma and culture media will influence the stress level of cultivated fish. Shreck and Tort [50] stated that stress response is divided into three levels, they are (1) primary stress which caused by hormonal reactions, (2) secondary stress as the change of physiological function due to primary stress, and (3) tertiary stress as change that can be observed from outside such as growth, activity, appetite, and etc. The osmotic performance level was illustrated as subtraction between pressure on blood plasma osmotic and pressure of water in the culture medium. Based on the data, it seems that the osmolality of the entire tested fish was in a hypo-osmotic condition, which also means that the osmotic pressure of blood plasma was lower than the osmotic pressure of water medium. The high level of osmotic pressure on the cultivation medium was caused by a high level of salinity that was 38 ppt. Physiological responses to osmotic performance levels can influence stress levels. We suggest that stocking densities treatment 150 and 200 ind/m³ tends to cause greater stress compared to stocking treatment 100 ind/m³.

Blood glucose is a response of secondary stress for fish, which triggered by a response to primary stress; it is cortisol. That trigger can be caused by the environment: density and salinity. The high level of salinity on the medium produced osmotic pressure that made fish experienced hypo-osmotic conditions and later triggered stress for Rabbitfish. The value of blood glucose is also influenced by treatment, where the value increases along with the increase of stocking density. An increase in metabolism is a consequence of energy use to keep the body in homeostasis condition. It also may affect fish growth. The further impact of this response is fish will experience glycogen reduction in liver, blood volume, and leucosis reduction [51].
S. guttatus has a euryhaline characteristic, but the daily growth rate in the third month decreased to 50% compared to the growth rate of the previous months (Fig. 4). Babikian et al. [52] reported that the standard metabolic rate of S. rivulatus in water temperature 27 °C and salinity 35 ppt was 0.57±0.02 mgO2/g/hour. Meanwhile, the respiration rate was relatively similar in salinity 30, 35, and 40 ppt, although it raised in salinity 25 ppt. It indicates that S. rivulatus had euryhaline characteristics with optimal salinity range between 30—40 ppt. Overall, most of the parameters for water quality were still at the viable state for the life and growth of Rabbitfish, S. guttatus.

Though the rearing period, tested fish was survived in salinity 34-43 ppt (Table 4). In high salinity conditions, fish allocated most of the energy they gained to control the osmoregulation system of body fluids. The average measurement results of S. guttatus osmolality in salinity 38 ppt was 487±37 mOsm/kg, whereas the osmolality level of seawater was about 1.286±102 mOsm/kg (Table 5). It means that fish osmolality was 37.89% of seawater. It shows that the increase of medium salinity during the cultivation process will affect the increase of energy allocation to control body fluids so that it reduces energy for growing. The slow growth of Rabbitfish was parallel with the increase of medium salinity and indicated to the biomass production as well as low feed efficiency value. Among the criteria to conclude the success of cultivation are high growth rate and feed efficiency [48]. The key information we note from this research is S. guttatus generation 2 is able to adapt on salinity 40 ppt for long exposure, so these species demonstrate the ability to live in cultivation medium with quite a large range of salinity.

5. Conclusion and Suggestion
The fingerling process for Rabbitfish can be implemented in stocking density up to 200 ind/m³, resulting in survival rate >90% with 13.1±0.1 cm in length and 47.61±0.94 g/ind in weighing. The size of Rabbitfish is viable to treat at the rearing process either in fishpond or cages.

Based on the growth data, survival rate dan FCR, S. guttatus is feasible to cultivate in floating net cage with stocking density 100 ind/m³.

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