

The Effect Of Giving Various Sources Natural β -Carotene To Increased Color Intensity On The Oranda Goldfish (*Carassius auratus*)

ABSTRACT

This research aims to examine the effect of adding various sources of natural beta-carotene obtained from sweet potato flour, carrot flour and pumpkin flour to the color brightness of Goldfish. The research was carried out from December 2021 to February 2022 at the Aquatic Animal Physiology Laboratory Building 2, Faculty of Fisheries and Marine Sciences, Padjadjaran University. This study used an experimental method and The experimental design used in this study was a completely randomized design (CRD) with five treatments and three replications. The treatments were negative control (A), positive control (B), 10% sweet potato flour (C), 10% carrot flour (D) and 10% pumpkin flour (E). Maintenance with treatment on the test fish was carried out for 60 days. Parameters observed included color brightness observed using Toca Color Finder (TCF), growth, life, and air quality (Temperature, pH, DO). The results showed that the addition of various sources of natural carotene in the feed had an effect on increasing the brightness of the color of the Oranda Goldfish (*Carassius auratus*). The highest value of increasing fish color brightness was found in treatment E with pumpkin flour as a natural source of betacarotene, namely 3.2 in the head, 3.3 in the body and 2.5 in the tail. Survival rate in this study is 100%. The water quality parameter values are in good condition for the growth and survival rate of goldfish. Based on observations of water quality the results of temperature ranged from 24.2 °C - 28 °C, pH ranged from 6.88 - 7.62 and DO ranged from 5.8 - 8.0 mg/L.

Keywords : Goldfish, Color Brightness, Toca Color Finder, Betacarotene, Sweet Potato Flour, Carrot Flour, Pumpkin Flour.

1. INTRODUCTION

The development of ornamental fish farming fisheries in Indonesia is increasing along with population growth and the development of human mindset, fish can be used as a means of recreation in the form of ornamental fish. Indonesia with a tropical climate has the potential of ornamental fish reaching 300 million heads / year and consists of 240 species of marine ornamental fish and 226 types of freshwater ornamental fish (Sumantri et al, 2017).

Goldfish is a dominating commodity in increasing ornamental fish production in Indonesia after koi and betta fish. The increase in goldfish production is known to have amounted to 66.823.000 heads in 2010 to 72.997.000 in 2014 (Sulistyo, 2015). According to the DJPB performance report, goldfish production in 2015 amounted to 28.731 heads in 2016, which doubled, which was 61.768 heads but in 2017 there was a decrease in production of 39.409 heads and again rose in 2018 by 81.284 heads with an average increase of 31.1% (DJPB, 2018).

Color is one of the reasons ornamental fish are in demand by the community, so cultivators need to maintain the color of ornamental fish by giving feed containing color pigments (Lesmana, 2002). These additives are the main source in the pigmentation process in tropical ornamental fish that are yellow, red and other colors, better known as carotenoids (Nasution, 1997 Solihah et al, 2015). Carotenoids can come from chemicals or natural materials whether they come from plants or animals.

38 Carotenoids derived from chemicals are relatively less safe for both fish and aquatic environments
39 whereas carotenoids from natural ingredients are safer (Dwijayanti, 2005 Solihah et al, 2015).

40
41 Natural sources of carotene substances contained in plants and fruits (Aulia, 2012). There are three
42 natural ingredients that can be used as a source of natural **betakarotin**, including carrots, sweet
43 potatoes and yellow pumpkin. The content of **betakaroten** at 100 grams of carrot powder is 20550 µg
44 (Marliyati et al, 2016). The content of betakaroten in 100 grams of purplish red sweet potatoes is 9900
45 µg (Yaeni et al, 2017). While the content of betakarotin levels in yellow pumpkin fruit is 180.00 SI
46 (Lestari, 2011). Because the content of betakarotin can be obtained from these three ingredients,
47 carrot flour, sweet potato flour and yellow pumpkin flour can be used as an alternative as an
48 additional ingredient in making fish feed.

51 52 **2. MATERIAL AND METHODS**

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54 This research was conducted from December 2021 to February 2022 at the Water Animal Physiology
55 Laboratory Building 2 of the Faculty of Fisheries and Marine Sciences, Padjadjaran University.
56 Oranda Goldfish are 3 months old with an average length of 5-8 cm as many as 60 heads obtained
57 from Parung Ornamental Fish Market, Bogor West Java. 15 aquariums with a size of 39.8 cm x 25.4
58 cm x 28 cm are used as maintenance containers. The study lasted for 60 days. During the feeding
59 frequency study 3 times a day at 08.00 WIB, 12.00 WIB and 16.00 WIB. The amount of feed will be
60 adjusted every 10 days based on the increase in fish weight after sampling. The color brightness
61 observation was done visually with three non-colorblind panelists using the standard value of the
62 Toca Colour Finder (Figure 1). The assessment starts from the smallest score of 1 to the largest score
63 of 7 with color gradations from orange to dark red. Observations of color, fish weight and water quality
64 were made once every 10 days during the research.

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66 The research method used is an experimental method and the experimental design used in this study
67 is a Complete Random Design (CRD). The study used five treatments with three repetitions. The
68 treatment tested was the difference in mixing natural **betakaroten** from sweet potato flour, carrot flour
69 and yellow pumpkin flour in commercial feed.

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71 The treatments tested in this study include :

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73 Treatment A = Negative Control (without mixture)
74 Treatment B = Positive Control (commercial ornamental fish feed brand Hikari Oranda Gold)
75 Treatment C = Commercial feed added 10% Sweet Potato Flour
76 Treatment D = Commercial feed added 10% Carrot Flour
77 Treatment E = Commercial feed added 10% Yellow Pumpkin

78 79 **2.1 Research Procedures**

80 81 **2.1.1 Test Fish Feed Preparation**

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83 The feed used during the study was in the form of commercial fish feed mixed with yam flour, carrot
84 flour and yellow pumpkin flour in accordance with the treatment. The three mixtures used are flour in
85 dry form. The feed used for control does not contain sweet potato flour, carrot flour or yellow pumpkin
86 flour. The three added flours are adjusted to the treatment dose. Mixing is done by adding
87 Carboxymethyl cellulose (CMC), which is a synthetic adhesive or binder added to the feed. According
88 to (Tarmizi et al, 2016) the dose of CMC commonly used as a binder in fish and shrimp feed is 2% -
89 3%.

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91 The stages of mixing sweet potato flour, carrot flour and yellow pumpkin flour in this feed refer to
92 Barus (2014) namely each flour such as sweet potato flour, carrot flour and yellow pumpkin flour with
93 a concentration of 10% put in a tray and mixed with commercial feed as much as 100 grams at each
94 concentration of treatment and stirred evenly, feed added with CMC as an adhesive by spraying on
95 the feed and stirred until it sticks and evenly, then continued with the drying process. After drying the
96 feed is wrapped in a zip lock according to the treatment and marked with label paper.

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2.1.2 Preparation Of Test Fish Maintenance Media

The preparation is to prepare an aquarium with a size of 39.8 cm x 25.4 cm x 28 cm as many as 15 pieces, then the aquarium is cleaned and rinsed with clean water and then dried for 24 hours. After drying the aquarium in the contents of the water up to a height of 16 cm with a volume of 15 liters of water and equipped with an aeration installation.

2.1.3 Maintenance Of Test Fish

Every day the test fish will remove dirt or leftover feed that causes the water to become dirty, therefore it is carried out daily. Water reception is done after the aerator is turned off, it is done so that dirt and fish food waste go down to the bottom of the maintenance container so that the call is easier to do. The amount of water volume that will be responded to ± 10% of the initial volume. Then, the wasted water will be replaced again with clean water as much as the amount of water volume wasted during the call-off process.

2.2 Data Analysis

Survival and growth data are analyzed with analysis of variance (ANOVA) test F with a confidence level of 95%, then if there is a difference between treatments followed by duncan double distance test. The color improvement data was analyzed using the Kruskal-Wallis analysis, then if there was a difference between treatments, the Z test was conducted with a confidence level of 95%. Water quality data is analyzed descriptively.

2.2.1 Color Brightness

How to calculate the intensity of color in fish is to compare the increase in color in each treatment and repeat by observing the color changes in sampling fish and seeing the increase in weight in M-TCF. Observations were made on the 0th, 10th, 20th, 30th, 40th, 50th and 60th days. Visual observations were made by three panelists who were not colorblind by comparing the original color of the fish on color measuring paper that had been given a weighting value. Ratings start from the smallest 1 to the largest score of 7 with color gradations from orange to dark red.








No.	Toca Colour Finder TCF	Description
1.		Score 1 TCF Code 0614
2.		Score 2 TCF Code 0814
3.		Score 3 TCF Code 0615
4.		Score 4 TCF Code 0815
5.		Score 5 TCF Code 0616
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7.		Score 7 TCF Code 0916

Fig 1. Toca Colour Finder (TCF)

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2.2.2 Heavy Growth

The weight growth formula used based on Effendie (2002) is as follows :

$$W = W_t - W_0$$

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Information :

W : Average weight growth of fish (grams)

W_t : Final fish weight growth (grams)

W_0 : Early fish weight growth (grams)

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2.2.3 Long Growth

150 The long growth formula used based on Effendie (1997) is as follows :
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$$W = P_t - P_0$$

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Information :

P_m : Average length growth (cm)

P_t : Final length growth (cm)

P_0 : Initial length growth (cm)

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2.2.4 Survival Rate (SR)

160 The survival rate formula used based on the Effendie formula (2002) is as follows :
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$$SR = \frac{N_t}{N_0} \times 100\%$$

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Information :

SR : Survival Rate (%)

N_t : Number of fish that live at the end time (tail)

N_0 : Number of fish that lived at the beginning (tail)

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2.2.5 Water Quality

169 The water quality observed at the time of the study for supporting materials was DO, pH and
170 Temperature. Observations were made on the 0th, 10th, 20th, 30th, 40th, 50th and 60th days.
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3. RESULT AND DISCUSSION

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3.1 The Brightness Level Of The Goldfish Color

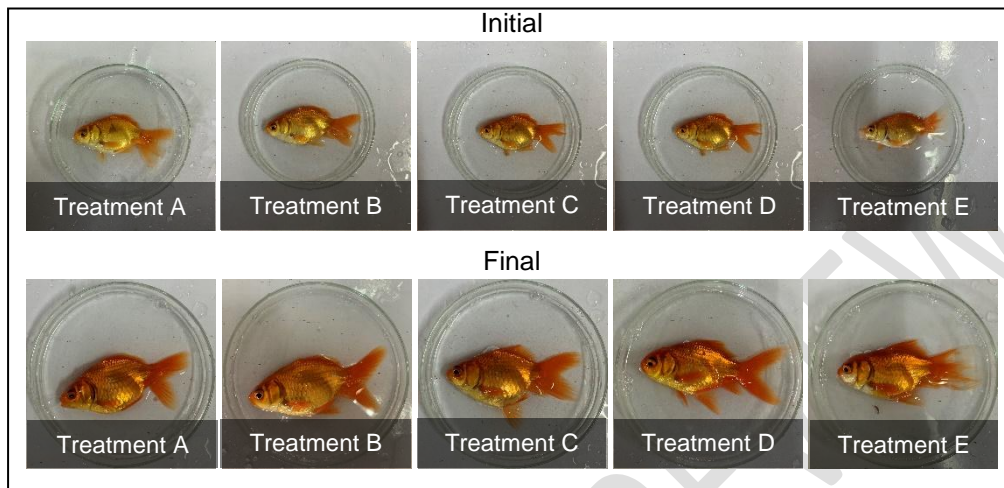
176 Research on discoloration in goldfish was observed in three different parts of the body, namely the
177 color on the fish head, fish body and goldfish tail. Color enhancement research on goldfish was done
178 visually by comparing the original color in fish with the Toca Color Finder (TCF) which was rated with
179 a value range of 1 to 7. The observations were made by three panelists with criteria not colorblind.
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Table 1. Average Increase in Goldfish TCF Score

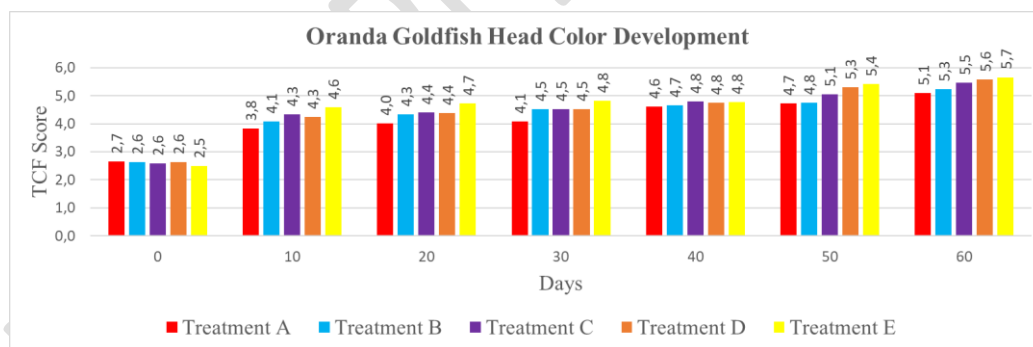
Treatment	Color TCF Score Improvement (60th-0th)		
	Head	Body	Tail
A (Negative Control)	2,4 ^a	2,6 ^a	1,9 ^a
B (Positive Control)	2,6 ^{abc}	2,7 ^{ab}	2,0 ^{ab}
C (Sweet Potato Flour)	2,9 ^{abc}	2,9 ^{ab}	2,1 ^{ab}
D (Carrot Flour)	2,9 ^{bc}	3,3 ^{ab}	2,1 ^{ab}
E (Pumpkin Flour)	3,2 ^c	3,3 ^b	2,5 ^b

183 Description : Different notations show a noticeable influence $P < 0.05$ (Double distance test Z)
 184 Based on observations made during 60 days of research with 5 treatments, the average color change
 185 was obtained in The Oranda Goldfish. The results of the count showed that all test fish experienced
 186 an increase in color brightness. Based on Table 1, it was found that the highest increased brightness
 187 value of fish color was found in treatment E giving yellow pumpkin flour as a natural source of
 188 betakaroten, namely 3.2 on the head, 3.3 on the body and 2.5 on the tail while for the lowest value
 189 found in treatment A or negative control, namely 2.4 on the head, 2.6 on the body and 1.9 on the tail.
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Fig 2. Observation of The Brightness Level of Goldfish Color

199 Based on the results of research shows that the addition of sweet potato flour, carrot flour and yellow
 200 pumpkin flour can affect the orange color on the head, body and tail of the goldfish. The increase in
 201 color score indicates the influence of the treatment of yam flour, carrot flour and yellow pumpkin flour
 202 on the orange color of goldfish. The development of the color of goldfish based on TCF from the
 203 beginning of the study to the end of the study can be seen in the following graph.
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Fig 3. Oranda Goldfish Head Color

209 Based on the graph above about the increase in color on the head of the oranda goldfish found that
 210 there was an increase in color scores. At the beginning of the research got a score with a range of 2.5
 211 - 2.7 and at the end of the research got a score of 5.1 - 5.7 with the best treatment on the E treatment
 212 with the addition of pumpkin flour.

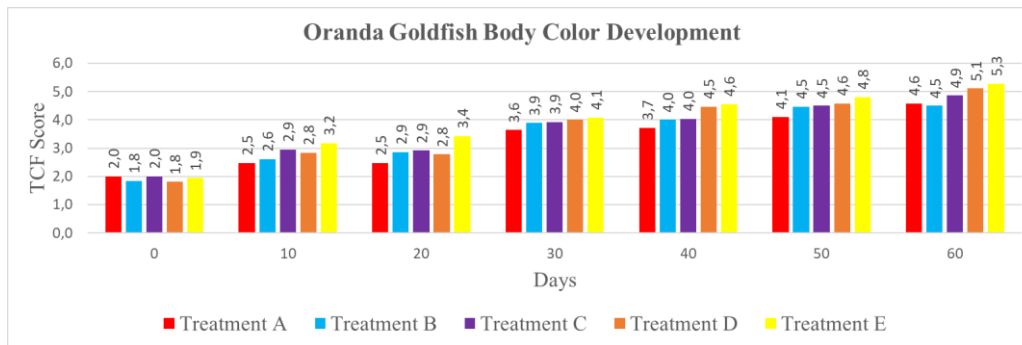


Fig 4. Oranda Goldfish Body Color Development

Based on the graph above about the increase in color on the body of the oranda goldfish, it was found that there was an increase in color scores. At the beginning of the research got a score with a range of 1.9 - 2.0 and at the end of the research got a score of 4.5 - 5.3 with the best treatment on treatment E with the addition of pumpkin flour.

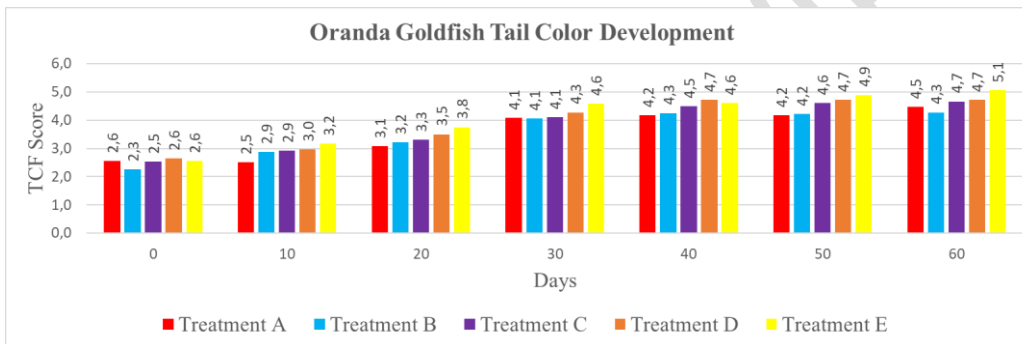


Fig 5. Oranda Goldfish Tail Color Development

Based on the graph above about the increase in color on the tail of the oranda goldfish found that there was an increase in color scores. At the beginning of the research got a score with a range of 2.3 - 2.6 and at the end of the research got a score of 4.3 - 5.1 with the best treatment on treatment E with the addition of pumpkin flour.

The highest color increase based on graph is occurring in Treatment E with the addition of pumpkin flour. This is suspected because the absorption ability of goldfish and the amount of betakaroten content contained in yellow pumpkin has been sufficient in the pigment absorption process so that the pigment absorption process takes place well and produces better color appearance (Lestari, 2011). This is supported by the statement (Fitriyani, 2005 Kurniawati, 2012) that fish take longer to break down carotenoid ingredients into color pigments if the amount of carotenoid content contained in the feed is more and more, and vice versa.

Lesmana and Sugito (1997) stated that the discoloration in fish depends on the amount of feed, especially the component of color ingredients in the composition of the feed which indicates that the greater the dose of carotenoids in the feed, the greater the value of croma. Nasution (1997) stated that the greater the content of carotenoids in the body of fish, the brighter the color in fish.

The process of overhauling carotenoids contained in feed ingredients into betakaroten enters the bloodstream after 24 hours, even in Brown Trout Fish carotenoids are still found in the blood after 72 hours (Storebakken and No, 1992). Carotenoids that enter the body will be synthesized into certain color pigments. Like other food substances, pigments will be carried along with the bloodstream and then the pigment is deposited in chromatophores contained in the dermis. According to Storebakken and No (1992) carotenoids that have been synthesized into pigments will be placed on xanthophores (yellow color) and eritophores (red or orange).

252 This is also reinforced by the statement of Kurniawati et al, (2012) that hormones have limits in the
253 ability to work. Giving excessive sources of pigment can decrease the work of hormones, added by
254 (Satyani, 1997 Kurniawati et al, 2012) that if the administration of excess carotenoids, at some point
255 will not give a better color change and may even lower the color value.

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257 **3.2 Goldfish Growth**

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259 Growth in living things can be defined as an increase in weight and length in a given time. As for one
260 of the factors that affect the growth of fish is good feed. Good feeding can increase the growth rate of
261 fish. The observations showed that the administration of various flours as a natural source of
262 betakaroten in feed showed varying results.

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264 The results of the fingerprint analysis of the variety of the **F ANOVA** (Analysis of Variance) test,
265 showed that the treatment of natural betakaroten sources for 60 days did not have a real influence
266 ($P>0.05$) on the growth of absolute length and absolute weight of oranda goldfish as stated in Table 2.

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268 **Table 2. Average Measurement Results of The Length and Weight of Goldfish**

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Treatment	Absolute Weight Growth (g)	Absolute Long Growth (cm)
A	2,3 ^a	1,5 ^a
B	3,2 ^a	1,5 ^a
C	3,6 ^a	1,7 ^a
D	3,7 ^a	1,4 ^a
E	3,7 ^a	1,7 ^a

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271 Growth data on the yellow pumpkin flour feeding treatment received the highest value including
272 absolute weight growth of 3.7 g and absolute length growth of 1.7 cm. The low growth value of oranda
273 goldfish on the treatment of the addition of various natural sources of betakaroten can be caused by
274 several factors. According to Soleha et al, (2022) the crude fiber content in feed is increasing in line
275 with the addition of the concentration of a mixture of sweet potato flour, carrot flour and yellow
276 pumpkin flour as a natural source of betakaroten. This is in line with the statement of Solihah et al.
277 2015 that the content of carotenoids in feed has no effect in the process of fish growth. According to
278 Azuri (2018) that carotenoids that have been added in the feed do not affect the growth process of
279 goldfish. Carotenoids given to ornamental fish will be more widely used for the process of improving
280 the quality of their color.

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282 **3.3 Survival Rate (SR)**

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284 Survival is a comparison between the number of organisms living at the end of the study with the
285 number of initial organisms at the time of distribution expressed in the form of percent, the greater the
286 percentage value indicates the more organisms that live during maintenance (Effendie, 1997).
287 Survival can be used as a benchmark to determine the tolerance and ability of cultivated organisms to
288 live. The survival rate of goldfish from observations for 60 days in each treatment can be seen in the
289 following graph (Fig. 6).

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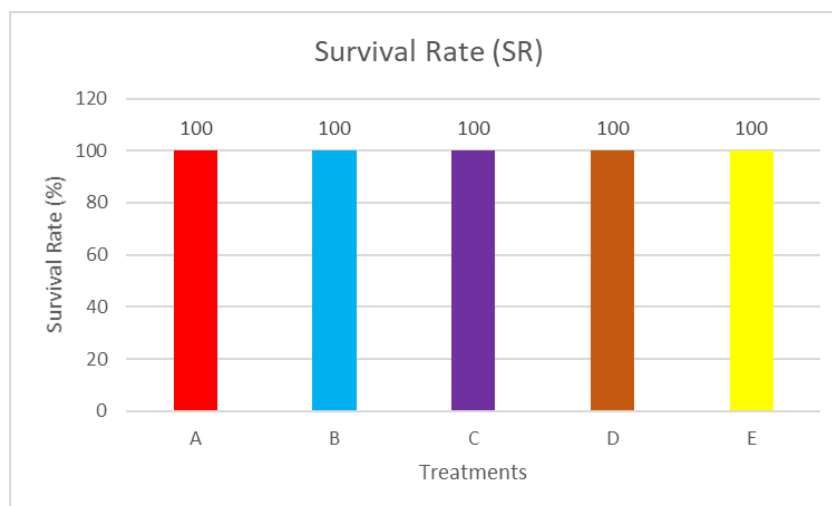


Fig 6. Goldfish Survival rate

3.4 Water Quality

Water quality is one of the things that need to be considered in aquaculture activities because it greatly affects the growth and development of fish. Good water sources in aquaculture activities should meet the criteria for water quality standards so that fish can grow and develop properly. The results of water quality measurements in maintenance containers during the study include Temperature, pH and DO presented in Table 3.

Table 3. Water Quality

Treatment	Water Quality Parameter Range		
	Temperature (°C)	pH	DO (mg/l)
A	24,4 – 27,5	6,89 – 7,62	5,8 – 7,2
B	24,3 – 28	6,89 – 7,44	5,8 – 8,0
C	24,4 – 27,3	6,88 – 7,62	5,8 – 8,0
D	24,4 – 27,3	6,92 – 7,62	5,8 – 7,3
E	24,2 – 27,5	6,91 – 7,61	5,9 – 7,9

Water quality observations in this study were conducted every ten days. Research on water quality in this study is still within the limits of eligibility. The results of temperature observations during the study ranged from 24.2 °C – 28 °C with optimum temperature values according to Manurung and Basuki (2017) ranging from 22 °C – 30 °C, the results of pH observations during the study ranged from 6.88 – 7.62 with the optimum value of pH according to Diansyah et al. 2019 which is 6 – 9 while for do observations during the study ranged from 5.8 – 8.0 mg / L with the optimum value of DO according to Solihah et al, (2015) which is >3 mg / L.

4. CONCLUSION

The results showed that giving yellow pumpkin flour as a natural source of **betakaroten** added to the feed can increase the brightness of the color of the goldfish with an increased score on the head of 3.2, on the body 3.3 and on the tail 3.5 but does not support optimal growth, namely with an absolute length growth of 1.7 cm and an absolute weight growth of 3.7 grams. The results of water quality observations during the study were temperatures ranging from 24.2 °C – 28 °C, pH ranging from 6.88 – 7.62 and DO ranging from 5.8 – 8.0 mg / L.

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