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Analysis on Nutrient Contents & Food Safety of Local Gatul Fish (*Xiphophorus hellerii*) as Potential Food Resources

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ABSTRACT

Gatul fish is one abundance of freshwater introduced fish that can be found in all tropical and subtropical area. One species of Gatul fish has been found in Telaga Sari, Pasuruan Regency is Xiphophorus hellerii. This fish are live bearers, dimorphism sexual, modification of anal fish called gonopodium and pregnant & birthing female. Until now, its potential as a food resource is not known. This research aimed to analyze nutrient contents of Gatul fish as food resources based on the protein and fat content and to evaluate the food safety based on the content of plumbum, cadmium, and mercury. The sample of Gatul fish was collected from Telaga Sari based on four Xiphophorus helleri (female and male). The protein content was analyzed using Kjeldahl method, while the content of fat was analyzed using soxhlet method. In addition, the level of plumbum, cadmium, and mercury in the flesh Gatul fish were tested using atomic adsorption spectroscopy (AAS). The results showed that both of the flesh Gatul fish (male and female) contained high protein for orange male (20.389±0.238); orange female (20.256±0.07); gray male (21.3557±0.25), and gray female (20.5687±0.10) respectively. The fat of flash Gatul Fish both male and female content in Gatul fish ranged from 2.966%-3.934%. It seems that the nutrient content outweighs the content of others commercial consumed fish. The content of plumbum in the flesh fish were 0.712±0.0116 ppm; chadmium were 0.128±0.129, Meanwhile, the content of mercury in the flesh fish were 0.0039±0.0017. These numbers are considerably lower that the level permitted. Hence, it can be concluded that Gatul fish has potency as a cheap, safe, and nutritious of food resource

Keywords: *gatul fish, protein, fat, potency, food safety*

Introduction

Indonesia is one of the megabiodiversity country after Brazil (Muchlisin & Azizah, 2010). Fish is one of the biological resources with high diversity and abundance. Muchlisin & Azizah (2010) was estimate that there are 4000 species of fish in Indonesian waters and at least 900 species of freshwater fish can be found in southern Indonesia and Borneo. Meanwhile, there are 1000 species of freshwater fish found in Indonesian waters, but not all of these fish species have been identified. The diversity of Indonesian freshwater fish species is very

high compared to the diversity of freshwater fish in various countries (Haryono & Tjakrawidjaja, 2006). One of the abundant fish found in Telaga Sari Pasuruan is gatul fish.

Gatul fish is a freshwater fish were found in Indonesian waters, one of which is in Telaga Sari which is located on the border between Purwodadi and Lawang, Pasuruan Regency. This fish belongs to the Poeciliidae family. In our previous study, based on the *16S mitochondrial ribosomal RNA* gene, Gatul fish is related to *Xiphophorus hellerii* from the United States. There are two types of Gatul fish that live in Telaga Sari, namely gray and orange Gatul fish. This Gatul fish has unique morphological characters, including the elongation of the tail fin like a sword, the presence of a sub-distal of the male gonopodium, the female is pregnant and birthing to 40-120 tail (Rahayu et al., 2010). While based on morphological characters, these fishes were included *Xiphophorus helleri* with unique characters in *sword tail* and gonopodium as modification of anal fish, that the function is to transfer sperm in to female gonophore (Rahayu et al., 2013 & Rahayu et al., 2019b). While, to strengthen identify up to the species level, Rahayu et al. (2019a) successfully identified Gatul fish in Telaga Sari are *Xiphophorus helleri*.

An abundance of introduced fish in Telaga Sari Purwodadi, Pasuruan Regency makes this fish interesting to study. This is because in one lake only were found Poeciliidae family while not found other species. The abundance of these fish not supported by the introduction of the community about the potential of these fish. Nurviana et al. (2017); Izwardy D et al. (2017) stated that as a food ingredient, fish is a very good and prospective source of protein, fat, vitamins and minerals. The main advantage of fish protein compared to other products is the completeness of the amino acid composition and its ease of digestion. Fishery resources are an important source of both macro- and micro-nutrients for humans (Thilsted et al., 2014). Fish protein contains have many essential amino acids and the content of these amino acids varies greatly depending on the species (Samsundari, 2007). The protein content of fish is closely related to the fat and water content (Hafiludin, 2015).

While, Fat is also one of the important nutritional components in fish. Fish fat content ranges from 1-20% that is easily digested and can be used directly by body tissues, most of which are unsaturated fatty acids needed for growth and can lower blood cholesterol (Hafiludin, 2011, 2015). Previous reports are mostly working on the potential of commercial fishes as food resources, especially *Chanos chanos* (Hafiludin, 2015); *Ompok eugeneiatus* from Riau (Nurviana et al., 2017); *Paraplotosus albilabris* (Mardiana et al., 2014); *Rasbora* sp. (Dika et al., 2017), and others.

Nutrition with good nutritional content is a very vital requirement for the body. Many people were assuming that sufficient nutritional needs can only be obtained at relatively high prices. In fact, if

people are more careful, adequate sources of nutrition can be obtained by consuming balanced nutrition by utilizing existing natural resources without incurring costs, one of which is by exploring the abundant potential of Gatul fish.

Besides nutrient content is very important for human, as well as the food safety related to the heavy metal's contamination as Heavy metals accumulated in the fish and other aquatic (Ambarwati et al., 2019; Yousif et al., 2021). Baki et al. (2018) & Rajeshkumar & Li. (2018) findings that heavy metals accumulation of organism organs indicate their levels contaminate in their surrounding environment. In previous research Yousif et al. (2021); Baki et al. (2018); (Rashed, 2001) and Rajeshkumar & Li. (2018b) have reported that heavy metals such as zinc, chromium, mercury, lead, copper, cadmium, and arsenic contaminate freshwater and marine environments and there are harmful to aquatic organisms. Rahman et al. (2012), Yousif et al. (2016), and Rajeshkumar and Li (2018), have reported that heavy metals such as zinc, chromium, mercury, lead, copper, cadmium, and arsenic contaminate freshwater and marine environments and are harmful to aquatic organisms.

There have been no scientific publications on the use of Gatul fish as a food resource in Telaga Sari, Pasuruan Regency. However, in fact, this fish is usually fished by the surrounding community, but the benefits have not been reported. The coastal communities refer to this animal as the name ikan ekor pedang.

The primary goals of this study were to evaluate the potency of Gatul fish (*Xiphophorus helleri*) as a food resource based on protein and fat content, as well as to evaluate food safety based on plumbum, mercury and cadmium content.

METHODS

Gatul fish (*Xiphophorus helleri*) samples were collected from the Telaga Sari, which is located from bordered between Lawang and Purwosari, Pasuruan (Figure 1 & 2) with coordinate at 7°11'02" S 112°54'51"E. This research is descriptive qualitative. In this study, two variants of Gatul fish were used, namely *Xiphophorus hellerii* orange and *Xiphophorus hellerii* gray, male and female respectively (Figure 3). Fresh specimens were kept in a cool box for analyzed protein & fat contents and heavy metals. Laboratory research was carried out at the Chemical Laboratory, Muhammadiyah University Malang.

The protein content was measured using the Kjeldahl method, while the fat content was determined using the Soxhlet method. For all analyses, three repetitions were required. The fat and protein content of Gatul fish was compared in the List of Food Ingredients to fish that were widely consumed by the public, namely: Mujair fish (*Oreochromis mossambicus*), Mas fish (*Cyprinus carpio*); Lele Fish (*Clarias sp.*);

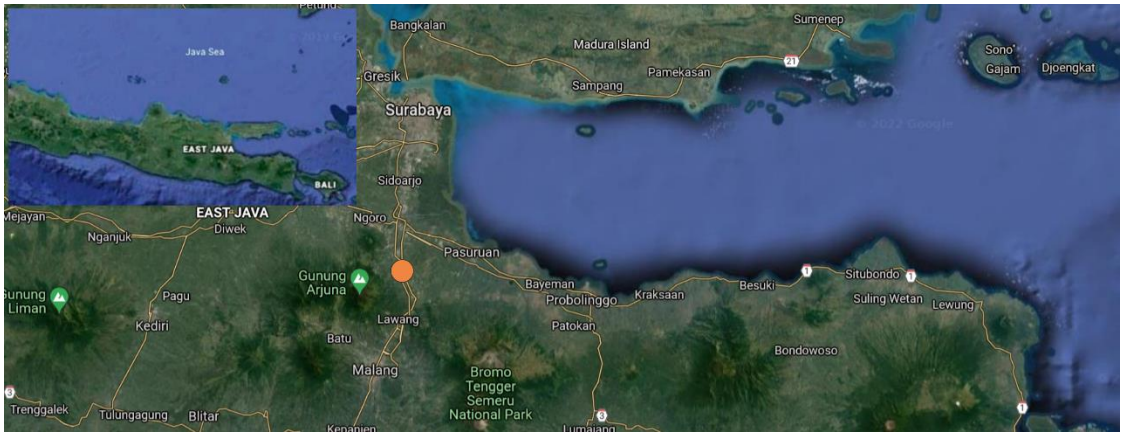

Figure 1. Sampling site of Gatul fish in Telaga Sari, Pasuruan Regency (Source: Google Earth). Note: orange circle: location

Figure 2. Telaga Sari Locality in Pasuruan Regency

Kakap Fish (*Lutjanus Campechanus*), and Bandeng Fish (*Chanos chanos*) (Mahmud, 2005; Izwardy D et al., 2017).

Data on protein and fat content were analyzed descriptive quantitatively and presented in table and histogram. The calculated water physicochemical parameters were included temperature, pH, salinity, DO, and BOD which were analysed descriptive quantitively.

The heavy metal content of fish meat observed was lead (Pb), cadmium (Cd), and mercury. Heavy metal analysis of fish samples in the laboratory using the *Atomic Absorption Spectrophotometer technique* (AAS). The method used in the analysis of heavy metal content in fish meat is based on quality standards Data analysis was done by comparing the heavy metal content in water

with sea water quality standard according to SK MNLH No. 51 year 2004. For heavy metal content in fish body organs were compared with maximum content of heavy metals based on SNI 7387: 2009 on the maximum limit of heavy metal of food contamination. This data presented in histogram and presentation.

RESULTS AND DISSCUSION

The gatul fish in Telaga Sari Pasuruan is *Xiphophorus helleri* with the main characteristics of male fish have elongated tail fin and modified anal fin, while female fish has rounded tail fin without elongated and pregnant. The existence of this fish is very abundant in one lake without the presence of other species of fish, this is because the female fish are pregnant and the embryonic development is in the female.

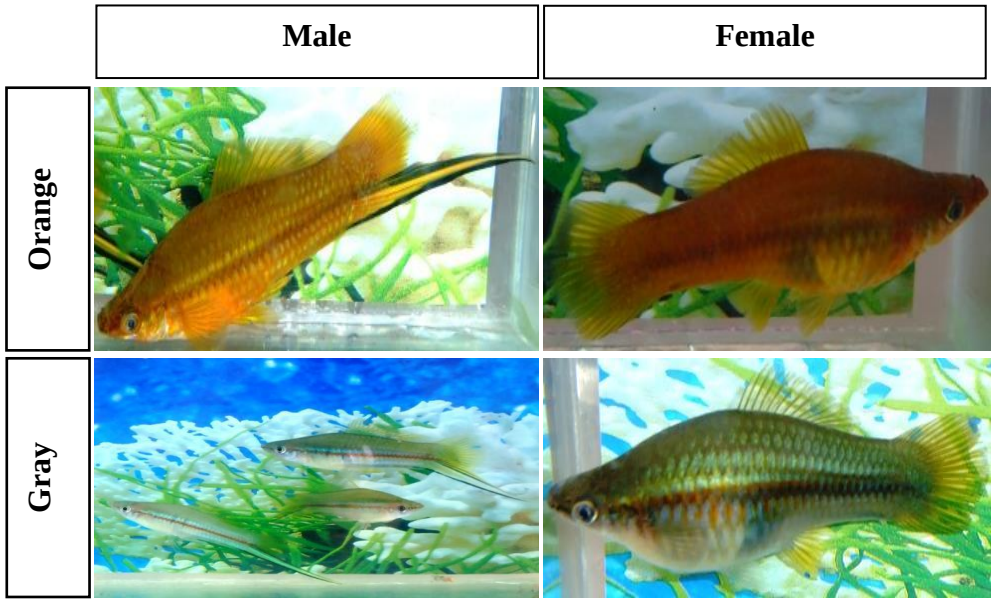

Figure 3. Gatul fish (*Xiphophorus helleri*) in Telaga Sari, Pasuruan Regency

Table 1. Nutrient content of Gatul Fish (*Xiphophorus helleri*) compared with others consumed commercial fish

Species	Nutrient Content (%)	
	Protein	Fat
Orange Male Gatul Fish (*Xiphoporus hellerii*)	20.389±0.238	2.862±0.10
Orange Female Gatul Fish (*Xiphoporus hellerii*)	20.256±0.07	3.233±0.10
Gray Male Gatul Fish (*Xiphoporus hellerii*)	21.356±0.25	3.036±0.04
Gray Female Gatul Fish (*Xiphoporus hellerii*.)	20.569±0.10	4.284±0.05
Mujair fish (*Oreochromis mossambicus*)*	18.7	1
Mas fish (*Cyprinus carpio*)*	16	2
Lele Fish (Clarias sp.)*	16.2	2.82
Kakap Fish (*Lutjanus campechanus*)*	20	0.7
Bandeng Fish (*Chanos chanos*)*	20	4.8

*References: (Mahmud, 2005) & (Izwardy D et al., 2017)

The protein content of Gatul fish

The results showed that protein content of male and female orange Gatul fish and male and female gray Gatul fish were classified as high. The protein levels of Gatul fish from the highest to the lowest were gray male Gatul fish (21.356±0.25%), gray female Gatul fish (20.569±0.10%); orange male Gatul fish (20.389±0.238%), and orange female Gatul fish (20.256±0.07%) respectively (Table 1, Figure 4). The protein content of Gatul fish did not show a significant difference. The high protein fish category includes protein content of 15-20% (Hafiludin, 2015; Izwardy D et al., 2017; (Munthe et al., 2016).

The protein content of Gatul fish was higher than that of Mujahir fish (18.7%), Mas fish (16.0%), and Lele fish (16,2%), and did not differ much from Kakap fish (20%) and Bandeng fish (20%) (Table 1). The slight difference protein content in gatul fish can be caused by many factors, especially the size, sex and sexuality of the fish (Munthe et al., 2016). This is in line with the results of Hafiludin's research (2015) that the difference in the size of Bandeng fish causes the amount of protein, it contains is different.

The human body requires adequate protein intake for metabolism in the body can run smoothly. Fish is a source of animal protein which has advantages such as being a of essential amino acids that the body needs (Nurviana et al., 2017; Ramlah. et al., 2016)). Our findings showed that Gatul fish had high protein content compared to other consumptive fish, it was easy to digest, easily absorbed by the body, and was not damaged during heating (Samsundari, 2007). The human body's need for more essential amino acids can be fulfilled by consuming Gatul fish.

Sediaoetama (2000) also reported that humans need one gram of protein per kg body weight per day and 30% is recommended to be supplied from animal protein sources. If the contribution of protein for someone who has a body weight of 60 kg, it is necessary to consume 60 grams of protein per day. Gatul fish has a protein content of ± 20%. Recommendation for this person's can be fulfilled by consuming 300 grams of Gatul fish per day.

The fat content of Gatul Fish

The results showed that the fat content of the orange male gatul fish was 2.862±0.10%, Gray male gatul fish was 3.036±0.04%, orange female gatul fish was 3.233±0.10%, and the gray female gatul fish was 4.284±0.05% (Table 1, Figure 5). Samsundari (2007) stated that fish with fat content of more than 15% were included high fat content, 5-15% moderate fat content and less than 5% including low fat content. Our findings showed that Gatul fish from Telaga Sari is a low-fat fish (3.934% < 5%).

Hafiludin (2015) & Mardiana et al., (2014) was reported that the fat content of fish ranges from 1-20%. The fat content of Gatul fish is higher than other consumptive fish (Table 1). Based on recommendations from the U.S. Department of Agriculture

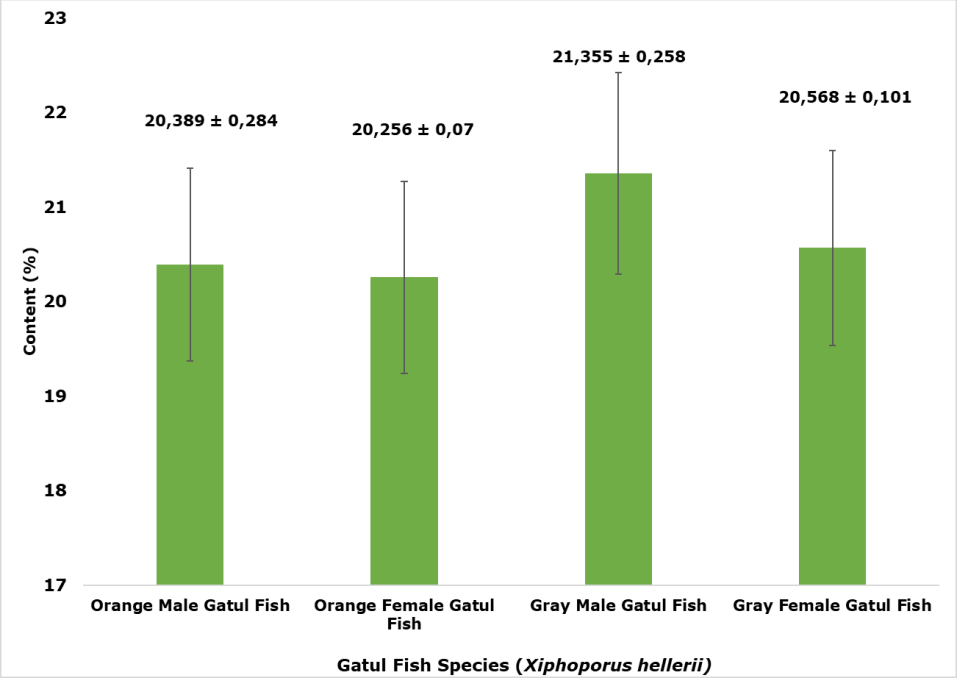

Figure 4. The content of protein of Gatul Fish from Telaga Sari, Pasuruan

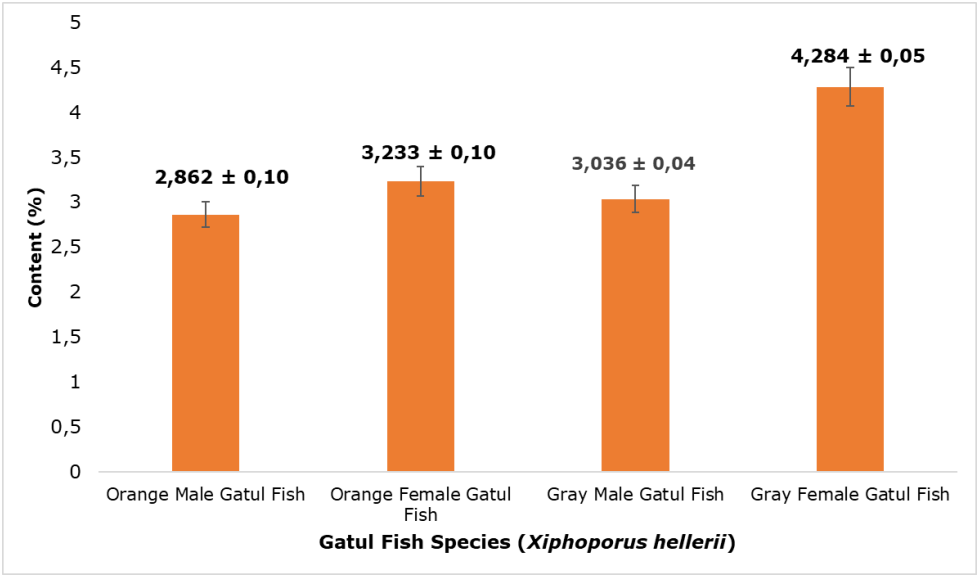

Figure 5. The content of fat of Gatul Fish from Telaga Sari, Pasuruan

(USDA) and the Department of Health and Human Services (HHS), fat intake should not exceed 35% of the total daily calories of each individual. That is, if you follow a diet of 1800 calories a day, your fat intake should not exceed 630 calories. One gram of fat is equivalent to 9 calories, so the maximum limit for fat consumption is 70 grams / day. Gatul fish contains 3.934 grams of fat per 100 grams,

so the maximum consumption of Gatul fish per day is 1779 grams.

Hafiludin (2015) were classified fish into several classes based on their fat and protein contents, one of which is fish with low fat content and high protein content, if it contains <5% fat content and >20% protein content. Based on Figures 4 and 5 findings that gatul fish in Telaga Sari, Pasuruan Regency are classified as fish with low fat and high protein content.

Gatul fish in Telaga Sari has potential as a food ingredient that has many advantages, namely nutrient contents because of its high protein content and low in fat, cheap and easy to obtain because of its abundance in Telaga Sari.

Food safety of Gatul Fish

One parameter of food safety was based on the content of heavy metal in the food (SNI, 2009). Heavy metals accumulation of organism organs indicates their levels contaminate in their surrounding environment. The content of heavy metal lead, cadmium and mercury of Gatul fish were very low. The content of lead (plumbum) in the flesh gatul fish were 0,712±0,0116 ppm; cadmium 0,128±0,129 ppm, and mercury 0,0039±0,0017 respectively (Table 2). This heavy metal content was comparatively lower than the maximum limit contamination in food for consume.

Heavy metal levels in flesh of Gatul fish certainly indicate levels of these metals in fish habitat waters. Heavy metals enter the body tissues of living things through several processes, which involve the respiratory tract, digestion, and penetration through the skin (Rochyatun & Rozak, 2007; Sagita et al., 2017) and can become bioaccumulation (Adam et al., 2018); (Argota et al., 2012).

Table 2. Heavy metal value of Gatul Fish

Parameters	Rata-rata ± Standar Deviasi (mg/kg)	SNI (mg/kg)	BPOM (mg/kg)
Pb	0,712±0,0116	1	0,25
Cd	0,128±0,129	1	0,2
Hg	0,0039±0,0017	1	0,03

Table 3. The Content of Heavy Metal in Telaga Sari Pasuruan Regency

Parameters	Sari Lake	Quality Standart (KepMen LH No.51 tahun 2004))
pH	7	7-8,5
DO (ppm)	3,96	>5
BOD (mg/L)	0,07	20
Temperature (˚C)	31	28 - 32
Salinity ‰	33	33-34
Conductivity (mS/cm)	22	0-200

Telaga Sari ecological conditions are pH 7 (neutral), temperature 31°C, DO 3.96 mg/L and conductivity 22 mS/cm (Table 3). In 2010, the Minister of State for Research and Technology recommended aquaculture of live bearer fish with the right method, namely with a temperature condition of 15-32°C, pH ranging from 7-8, and clear water with sufficient oxygen. This conditions very suitable for Gatul fish cultivation.

Environmental factors that can affect the distribution of heavy metal levels in waters are salinity, pH, water velocity and hydrodynamic conditions (Arifiyanto et al., 2017; Yousif et al., 2021)). pH and DO can affect the concentration of heavy metals in the waters, the higher the pH and DO values in the waters, the toxicity of heavy metals in these waters is low (Eshmat, 2014)).

Recommendation of Gatul Fish

The analysis that has been presented shows that the Gatul fish in Telaga Sari has the potential as a food ingredient that have many advantages, because of high and low protein content fat, cheap and easy to get because of its abundance in Telaga Sari, safe for consumption because heavy metal content is low from the maximum standart. The existence of this potential has been socialized to the community around Telaga Sari by showing the processed Gatul fish. People are very enthusiastic after knowing that the Gatul fish around them has the potential as highly nutritious food. Results Processed Gatul Fish has a good appearance, good taste and is not inferior to other fish, as evidenced by positive response of the community at the time of socialization.

Conclusion

Both of the flesh Gatul fish (male and female) contained high protein for orange male (20.389±0.238); orange female (20.256±0.07); gray male (21.3557±0.25), and gray female (20.5687±0.10) respectively. The fat of flash Gatul Fish both male and female content in Gatul fish ranged from 2.966%-3.934%. Meanwhile, the content of mercury in the flesh fish were 0.0039±0.0017. These numbers are considerably lower that the level permitted

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