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**Research Article**

# Evaluation of Nutritional and Color on Indonesian and Imported Patin Fish (*Pangasius* sp.,) Fillets

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**Abstract:** Patin fish (*Pangasius* sp.,) is one of important freshwater fish in Indonesia. The demand of this fillet in Indonesia reached 700 tons/month. On the other hand, production of patin fish from Indonesia is in the range of 100-120 tons/month, others come from import. Therefore, the aim of this study was to evaluate the quality of Indonesian (Jambi and Karawang) and imported (Vietnam) patin fish fillets. This study determined and compared nutritional and color profiles including proximate composition, fatty acid analysis, amino acid profiles and hunter color and myoglobin concentration. The results show variation on location of farming resulted significant difference on proximate composition except for carbohydrate content. Palmitic, oleic and linoleic acids were dominant SFA, MUFA and PUFA, respectively in all examined patin fish fillets. However, Jambi and Karawang fillets had highest content of oleic acid while palmitic acid for imported fillet. Glutamic acid representing non essential amino acid and lysine for essential amino acid were found to be the highest in all fillets. Jambi fillet had highest on redness (*a*) and redeness index (*a*/*b*) as well as myoglobin concentration both white and dark muscles.

**Keywords:** Amino acid, color, fatty acid, myoglobin, *Pangasius* sp., proximate

## INTRODUCTION

Indonesia is a tropical country having a large biodiversity of marine and freshwater fish. Patin fish (*Pangasius* sp.,) from pangasiidae family, also known as catfish, is one of omnivorous freshwater fish that has become a leading farmed fish in Indonesia. This fish has more tender meat compare than other freshwater fish. The aquaculture of patin fish is rapidly increasing in some Asian countries such as Vietnam, Thailand, Philippine, Bangladesh and Indonesia. It is recognized that Vietnam is the largest producer of patin fish. It is called the same name "patin fish" in Indonesia, Malaysia, Thailand, Bangladesh and India (Abbas *et al*., 2006). In Vietnam, it is called "tra" and "basa" (Men *et al*., 2005). The Vietnamese production of patin fish is exported worldwide. More than 90% of world exports of *Pangasius* are supplied from Vietnam (ASC-aqua.org, 2012).

Culture of patin fish in Indonesia has been significantly increased. It showed fantastic growth rate during 2007-2009 as 92.5% (MMAF, 2010). The production of patin fish increased up to 651,000 tons/year from 2006 to 2012. Indonesian government through Ministry of Marine Affairs and Fisheries has been encouraged and promoted patin fish to be intensively cultured. They have predicted 1,107,000 tons of production in 2013. The center of this culture is located in 10 provinces. Some of them are Karawang (West Java Province, Java Island) and Jambi (Jambi Province, Sumatera Island) (DJBP (Direktorat Jendral Perikanan Budidaya), 2012).

It has been reported that the demand of fresh patin fish in Indonesia was 2,000 tons/month (Trobos, 2012). Patin fish is usually processed to be frozen fillets and demand for this fillet reached 700 tons/month in Indonesia. However, only 100-120 tons could be produced by themselves, the others were imported from countries such as Vietnam and Thailand (Nurhayat, 2013). Recent market study has indicated that consumers in Indonesia tend to choose imported patin fish fillet (Trobos, 2012). Thus, Indonesian fisheries industries directly compete with exporter.

Further research is needed to analyse the quality of these fillets. Some researchers reported the quality of

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*Pangasius* fish from Vietnam, Malaysia, India (Orban *et al*., 2008; Karl *et al*., 2010; Muhamad and Mohamad, 2012; Rathod and Pagarkar, 2013). However, there is no data reported so far for Indonesian patin (*Pangasius* sp.,) fillets in case from Jambi and Karawang. Therefore, the aim of this study was to evaluate the nutritional and color of Indonesian (Jambi and Karawang) and imported patin fish fillets. These findings would provide useful information especially for marketing of that fish.

## MATERIALS AND METHODS

**Sample preparation:** Three groups of frozen patin fish fillets used in this study based on the location of its farming. Two of them were from Indonesia, namely Jambi (name of city in Sumatera Island) and Karawang (name of city in Java Island). The other was imported from Vietnam. Patin fish fillets of Jambi and Karawang were kindly provided by Ministry of Marine Affairs and Fisheries, Jambi Province and Adib Global Co., Karawang, West Java, Indonesia, respectively while imported patin fish fillets from Vietnam were purchased from supermarket in Bogor, Indonesia. All samples were stored at -80$^{o}$C until used for experiment (for up 3 months).

**Chemicals:** Chemicals used in this study were of analytical grade, purchased through Wako Co. (Otsu, Japan) and Sigma-Aldrich (St. Louis, MO, USA).

**Proximate analysis:** Proximate analysis was carried out following AOAC methods (2005) including moisture, ash, crude protein and lipid content. The moisture content was determined by drying the sample in an oven at 105$^{o}$C until reaching constant of weight. Determination of ash content was conducted by incineration in a muffle furnace at 600$^{o}$C for 8 h. Lipid content was determined by Soxhlet extraction method with n-hexane as the solvent. Crude protein (N×6.25) was obtained by the Kjeldahl method. Carbohydrate content was calculated by difference according to the formula 100- (% moisture + %ash + %protein + %lipid).

**Fatty acid analysis:** Measurement of fatty acid was carried out according to AOAC (2005). Lipid was extracted from fish fillets by Soxhlet destruction then methylated to Fatty Acid Methyl Esters (FAMEs) by refluxing the fractions with addition of NaOH 0.5N in methanol at 80$^{o}$C for 20 min. The addition of internal standard was performed in order to identify FAMEs. The samples were cooled and converted to FAME by addition of 20% boron trifluoride in methanol. Gas chromatograph GC 2010 Plus (Shimadzu Co., Kyoto, Japan) equipped by a Flame Ionisation Detector (FID) was used to separate and quantify FAMEs.

**Amino acid analysis:** AOAC (2005) was used to determine amino acid composition in patin fish fillets using high performance liquid chromatography system (HPLC Shimadzu RF 20A, Kyoto, Japan). There were some steps in amino acid analysis: hydrolysis samples using 6N HCl in an oven at 110$^{o}$C for 24 h, drying step was carried out using rotary evaporator at 85$^{o}$C for 30 min, derivatization using Orthoptalaldehide (OPA), then the samples in final step were injected into HPLC. The results were reported as g amino acid per 100 g protein.

**Color attributes:**

**Hunter color of fillets:** The measurement of patin fish fillets was carried out according to Hutching (1999) using a calibrated Chromameter Minolta CR-310 (Konika Minolta, Tokyo, Japan). The hunter color values were obtained in terms of *L*, *a* and *b* values. *L* was the lightness factor indicating the degree of lightness or darkness of fish fillets; *a* and *b* represented the red (+) /green (-) and yellow (+) /blue (-), respectively. In addition, redness index (*a*/*b*) can be used to evaluate the color of patin fish fillets.

**Myoglobin concentration:** The determination of myoglobin was carried out following method of Nurilmala *et al*. (2013) with slight modifications. The white and dark meat of patin fish filets were homogenized in cold distilled water with ratio 1:7 for 1 min using a homogenizer. The centrifugation at 3000 g for 15 min was conducted using Himac CR 21G (Hitachi Koki Co. Ltd., Tokyo, Japan) at 4$^{o}$C in order to get the supernatant and subsequently filtered through Whatman filter paper. A 3 mL of supernatant was added 1.5 mL of 25 mM potassium buffer pH 7, then addition of 1.5 mL of $NaNO_3$ followed by 75 µL of 1% KCN. The absorbance was measured at 540 nm using UV-VIS 2500 spectrophotometer (LaboMed, California, USA) after 1 min of incubation in room temperature.

**Statistical analysis:** All measurements were performed in triplicate. Results were presented as mean values with standard deviations. The data were analyzed using one ways Analysis of Variance (ANOVA), followed by tukey test for significantly differences (Steel and Torrie, 1980) and statistical significance was determined at the $p<0.05$ level. Statistical Package for Social Sciences (SPSS Version 16 for Windows: SPSS Inc., Chicago, IL, USA) was used for all statistical analysis.

## RESULTS AND DISCUSSION

**Nutritional composition:**

**Proximate analysis:** Analysis of proximate was conducted to obtain content of moisture, ash, protein, lipid and carbohydrate as shown in Table 1. Generally, different location of farming showed significant

Table 1: Proximate composition of patin fish fillets

| Parameter | Jambi (%) | Karawang (%) | Imported (%) |
|---|---|---|---|
| Moisture | 77.45±0.06[a] | 83.07±0.33[b] | 84.99±0.22[c] |
| Ash | 0.83±0.04[a] | 0.61±0.03[a] | 0.26±0.13[b] |
| Lipid | 3.71±0.01[a] | 0.26±0.18[b] | 0.27±0.13[b] |
| Protein | 17.79±0.20[a] | 15.18±0.59[b] | 13.46±0.59[c] |
| Carbohydrate | 0.23±0.23[a] | 0.88±0.48[a] | 1.30±0.81[a] |

Mean±S.D. values in the same line followed by different letters of superscript are significantly different ($p<0.05$); n = 3

difference on proximate composition ($p<0.05$) excepting carbohydrate content.

The significant differences were found on moisture and protein content among all samples. The imported patin fish fillet had the highest ($p<0.05$) of moisture compared to that of Jambi and Karawang patin fish fillets. The addition of water binding additive during production of patin fillets in Vietnam caused higher moisture content (Karl *et al*., 2010). On the other hand, protein content of Jambi patin fish fillet was the highest ($p<0.05$). Imported patin fish fillet had 13.46% protein. This result is quite similar to the previous study reporting on the protein content of conventionally farmed fillets from Vietnam ranged between 13.3 and 15.7% (Karl *et al*., 2010). Protein is important for human nutrition. It is required for growth and maintenance of human body (Venugopal, 2009). As a result, patin fish fillet is a good source of protein. The protein content of patin fish fillet is the second highest after moisture content (Table 1). Moreover, Uhe *et al*. (1992) reported that protein from fish had greater satiety effect compared than that of beef and chicken.

Lipid has functions as a energy source as well as the carrier of fat-soluble vitamins (A, D, E and K) and contribute to the formation of cell and tissue membranes (Venugopal, 2009). No difference in lipid content was observed between Karawang and imported fillets. However, Jambi fillet had significantly different on lipid content (3.71%). Ghassem *et al*. (2009) reported that lipid content of Malaysian patin was 1.84%. The composition of their feed could effect to the lipid content of fish (Hossain, 2011).

Ash content was in the range of 0.26-0.86% for all examined fillets. Fennema (2004) stated that ash content could estimate total of mineral in its product. In addition, Hall (2010) reported that ash content in fish is considered a good source of mineral for human body. Carbohydrate content was counted by difference. There was no significantly different among examined patin fish fillets (0.23-1.3%). It has been known that fish meat is not a carbohydrate source. As a result, the differences in proximate composition among the samples could be caused by composition of their feed, age, the season of capture as well as body portion and physiological condition, (Yıldız *et al*., 2006; Leonarduzzi *et al*., 2014; Karl *et al*., 2010; Thammapat *et al*., 2010).

**Fatty acid composition of patin fish fillets:** Table 2 shows the detailed composition of fatty acid in all samples. It is known that there are three types of fatty acids: Saturated Fatty Acid (SFA), Mono Unsaturated Fatty Acid (MUFA) and Poly Unsaturated Fatty Acid (PUFA), respectively. Palmitic and stearic acid were found to be dominant in SAFA group for all examined

Table 2: Fatty acid composition of patin fish fillets

| Fatty acid | Jambi (%w/w) | Karawang (%w/w) | Imported (%w/w) |
|---|---|---|---|
| SFA | | | |
| Lauric acid, C12:0 | 0.82±0.04[a] | 0.10±0.01[b] | 0.08±0.06[b] |
| Tridecanoic acid, C13:0 | Nd | Nd | 0.06±0.05 |
| Myristic acid, C14:0 | 4.05±0.51[a] | 3.10±1.17[a] | 2.30±0.21[a] |
| Pentadecanoic acid, C15:0 | 0.14±0.02[a] | 0.21±0.02[a] | 0.37±0.13[a] |
| Palmitic acid, C16:0 | 24.05±1.28[a] | 20.97±4.29[a] | 16.74±2.53[a] |
| Heptadecanoic acid, C17:0 | 0.16±0.02[a] | 0.22±0.01[a] | 0.44±0.17[a] |
| Stearic acid, C18:0 | 6.48±0.33[a] | 5.87±0.89[b] | 4.11±0.82[b] |
| Arachidic acid, C20:0 | 0.18±0.01[a] | 0.16±0.01[a] | 0.20±0.02[a] |
| Heneicosanoic acid, C21:0 | 0.02±0.00[a] | 0.04±0.01[a] | 0.05±0.01[b] |
| Behenic acid, C22:0 | 0.08±0.01[a] | 0.17±0.13[a] | 0.18±0.07[a] |
| Lignoceric acid, C24:0 | 0.07±0.01[a] | 0.15±0.11[a] | 0.17±0.08[a] |
| MUFA | | | |
| Myristoleic acid, C14:1 | 0.03±0.01 | Nd | 0.06±0.05 |
| Palmitoleic acid, C16:1 | 0.85±0.06[a] | 1.03±0.17[a] | 2.01±1.00[a] |
| Elaidic acid, C18:1n9t | 0.15±0.01 | 0.12±0.05 | Nd |
| Oleic, C18:1n9c | 27.55±0.40[a] | 20.83±4.62[b] | 15.23±0.30[b] |
| Cis-11-eicosenoic acid, C20:1 | 0.80±0.05[a] | 0.76±0.19[a] | 0.56±0.01[a] |
| PUFA | | | |
| Linoleic acid, C18:2n6c | 7.63±0.34[a] | 9.31±2.14[a] | 10.71±0.03[a] |
| Linolenic acid, C18:3n3 | 0.41±0.02[a] | 0.87±0.10[a] | 1.44±0.37[b] |
| Linolenic acid, C18:3n6 | 0.24±0.01 | 0.14±0.04 | Nd |
| Cis-11,14-eicosadienoic acid, C20:2 | 0.37±0.03[a] | 0.53±0.06[b] | 0.66±0.04[b] |
| Cis-8,11,14-eicosatrienoic acid, C20:3n6 | 0.64±0.04[a] | 0.65±0.09[a] | 0.49±0.37[a] |
| Arachidonic acid, C20:4n6 | 0.46±0.07[a] | 0.59±0.13[a] | 0.59±0.08[a] |
| EPA (C20:5n3) | 0.25±0.00[a] | 0.54±0.01[a] | 0.95±0.47[a] |
| DHA (C22:6n3) | 0.76±0.11[a] | 1.55±0.00[ab] | 2.72±0.71[b] |

Mean±S.D. values in the same line followed by different letters of superscript are significantly different ($p<0.05$); n = 3; SFA: Saturated fatty acids; PUFA: Polyunsaturated fatty acids; MUFA: Monounsaturated fatty acids; EPA: Eicosapentaenoic acid; DHA: Docosahexaenoic acid

fillet samples. These results were similar in studies on *Pangasius* fish and other fish as reported by Karl *et al*. (2010), Orban *et al*. (2008), Mısır *et al*. (2013) and Kaya and Turan (2010). No significant difference was found for palmitic acid. However, there was a significant difference on stearic acid which Jambi fillet (6.48%) was the highest on this fatty acid ($p<0.05$).

MUFA group was dominant by oleic acid in all fish fillets. The significant difference between Jambi fillet and others was found on oleic acid ($p<0.05$). Jambi fillet was the highest (27.55%) followed by Karawang (20.83%) and imported (15.23%) patin fish fillet. As a result, Jambi fillet had highest on oleic acid among other investigated fatty acids. However, there was no significant difference between Karawang and imported fillets on oleic acid was observed. It is consistent report for study on fatty acid freshwater fish mainly on *Pangasius* that oleic acid was dominant in MUFA group (Ho and Paul, 2009; Karl *et al*., 2010; Muhamad and Mohamad, 2012). Total of MUFA was higher than PUFA in patin fish fillets. Muhamad and Mohamad (2012) previously reported that Malaysian patin fish was lower in PUFA.

Linoleic acid was the major PUFA in all examined patin fish fillets. No significant difference among patin fish fillets was found for content of linoleic acid and EPA content. DHA content was highest in Karawang patin fish fillet although there was no significant difference with imported patin fish fillet. The sum of n-3 PUFA of examined patin fish fillets was found in the range of 1.42-5.11% of total fatty acid. Previous study reported that PUFA content on *Pangasius* fish ranged 4-6% of total fatt acid (Karl *et al*., 2010). It has been known that PUFA is good for human health and prevention of diseases. Fish is a good source of PUFA (Hossain, 2011). Generally, freshwater fish had lower content on PUFA compared to marine fish. The differences on PUFA content can be caused by marine fish feed more zooplankton which rich in PUFA whereas freshwater feed largely on vegetation and plant materials (Muhamad and Mohamad, 2012). In addition, proportion of n-3 PUFAs and DHA/EPA ratios in majority of wild fish were higher than farmed fish. However, it could be adjusted by dietary intake of their feed (Hossain, 2011).

**Amino acid analysis:** Amino acid composition in fillet samples was conducted by following AOAC method (2005). It has been known that amino acid is classified to the Essential Amino Acid (EAA) and Non Essential Amino Acid (NEAA). The human body cannot produce EAA. It means EAA must come from their food. Fish is one of food source containing high amount of EAA. In this study, fifteen amino acids were detected in patin fish fillets as shown in Table 3. The fillets contained 9 EAA and 6 NEAA. The different location on farming indicated significant difference in some amino acids ($p<0.05$). Glutamic acid was found to be the highest among all amino acids in examined patin fish fillets. In addition, Jambi fillet was the highest followed by imported and Karawang fillets on this amino acid content. Glutamic acid or glutamate is important as flavor enhancer and involve in kreb cycle (Wu, 2009). Previous study reported that carps and catfishes were rich in glutamic acid and glysine (Mohanty *et al*., 2014).

The highest content in EAA group of all examined fillets was found in lysine. No significant difference was observed among the fillets. However, the second highest of EAA was found in leusine with Jambi fillet had the significant difference ($p<0.05$) among other fillets, namely Karawang and imported fillets.

Total amino acid of EAA and NEAA in examined fish fillets was in the range of 52.52-54.85% and 45.15-47.48% (data not shown), respectively. Amino acids have many functions of in the human body. They serve as precursors for nucleic acids, hormones, vitamins and other important molecules. Generally, no significant difference in the amino acid composition of freshwater and marine fish exception for histidine in mackerel and tuna (Venugopal, 2009).

Table 3: Amino acid composition of patin fish fillets

| | (g/100 g) | | |
|---|---|---|---|
| Amino acid | Jambi | Karawang | Imported |
| Non essential amino acid | | | |
| Aspartic acid | 1.95±0.35$^{a}$ | 1.62±0.43$^{b}$ | 1.95±0.33$^{ab}$ |
| Glutamic acid | 3.33±0.65$^{a}$ | 2.83±0.71$^{b}$ | 3.27±0.66$^{ab}$ |
| Serine | 0.68±0.23$^{a}$ | 0.50±0.12$^{b}$ | 0.62±0.06$^{ab}$ |
| Arginine | 1.24±0.17$^{a}$ | 1.08±0.31$^{a}$ | 1.25±0.34$^{a}$ |
| Glysine | 0.81±0.02$^{a}$ | 0.73±0.22$^{a}$ | 0.93±0.28$^{a}$ |
| Alanine | 1.06±0.16$^{a}$ | 0.92±0.25$^{b}$ | 1.12±0.25$^{ab}$ |
| Essential amino acid | | | |
| Histidine | 0.43±0.02$^{a}$ | 0.37±0.14$^{a}$ | 0.32±0.34$^{a}$ |
| Threonine | 0.88±0.20$^{a}$ | 0.70±0.22$^{a}$ | 0.64±0.45$^{a}$ |
| Tyrosine | 0.68±0.16$^{a}$ | 0.57±0.14$^{b}$ | 0.68±0.11$^{ab}$ |
| Methionine | 0.62±0.06$^{a}$ | 0.54±0.22$^{a}$ | 0.59±0.27$^{a}$ |
| Valine | 1.00±0.16$^{a}$ | 0.88±0.21$^{a}$ | 0.97±0.29$^{a}$ |
| Phenylalanine | 0.81±0.10$^{a}$ | 0.70±0.18$^{a}$ | 0.83±0.21$^{a}$ |
| Isoleusine | 1.02±0.16$^{a}$ | 0.89±0.20$^{a}$ | 0.99±0.26$^{a}$ |
| Leusine | 1.56±0.28$^{a}$ | 1.34±0.30$^{b}$ | 1.54±0.35$^{ab}$ |
| Lysine | 1.82±0.22$^{a}$ | 1.50±0.29$^{a}$ | 1.74±0.55$^{a}$ |

Mean±S.D. values in the same line followed by different letters of superscript are significantly different ($p<0.05$); n = 3

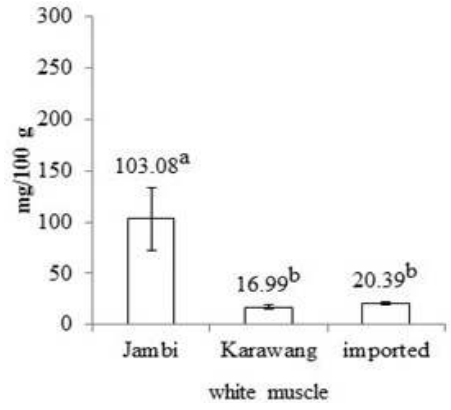
Table 4: Hunter color of patin fish fillets

| Fillet | L | a | b | a/b |
|---|---|---|---|---|
| Jambi | 49.62±0.68[a] | 12.65±0.13[a] | 17.24±0.01[a] | 0.73±0.01[a] |
| Karawang | 62.43±0.01[b] | 7.71±0.01[b] | 18.22±0.14[b] | 0.42±0.00[b] |
| Imported | 55.02±0.26[c] | 9.79±0.06[c] | 26.52±0.17[c] | 0.37±0.00[c] |

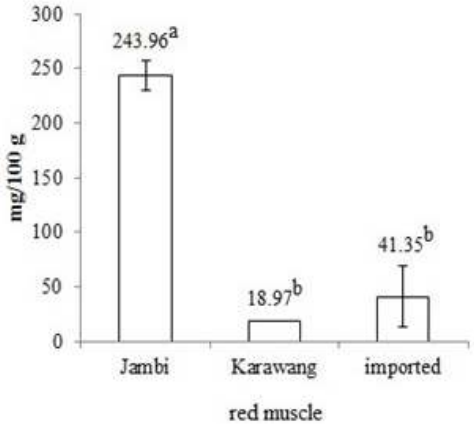
Mean±S.D. values in the same line followed by different letters of superscript are significantly different; ($p<0.05$); n = 3; L: Lightness; a: Redness; b: Yellowness; a/b: Redness index

(a) (b) (c)

Fig. 1: Patin fish fillet, (a) Jambi, (b) Karawang, (c) imported




(a)




(b)

Fig. 2: Myoglobin concentration, (a) white muscle, (b) dark muscle

**Color profiles of patin fish fillets:** Color is an important attribute on consumer's perception affecting decision to purchase not only in fish but also in beef, chicken and fruit such as tomato (Aksu and Alp, 2012; Tigist *et al*., 2013). Color profiles on this study were investigated based on measurements of hunter color and concentration of myoglobin. The hunter colors in Table 4 shows similar trend that *L* and *b* values on Karawang patin fish fillets were the highest ($p<0.05$) followed by imported and Jambi fillets. However, *a* value on Jambi patin fish fillet was found to be the highest. The *a* value represented redness of patin fish fillets. This result was supported by Fig. 1, color of Jambi fillet is more redness followed by imported and Karawang fillets, respectively. Moreover, the calculation of redness index (*a*/*b*) of Jambi patin fish fillet shows the highest value among others ($p<0.05$). As the results, the variation of farming location showed the significant difference on hunter color values.

Myoglobin concentration (mg/100 g) was observed on white and dark muscles of all samples (Fig. 2). Both white and dark muscles of Jambi fillets had the highest myoglobin concentration ($p<0.05$). Myoglobin concentrations on white and dark muscles of Jambi fillets were 103.8 and 243.96 mg/100 g, respectively. There was no significant difference between Karawang and imported fillets. In this study shows that there was a close relationship between redness value (*a*) and myoglobin concentration as well as rednes indeks (*a*/*b*) as previously reported (Nurilmala *et al*., 2013).

Myoglobin is a water-soluble protein having the responsibility on red color. It could be a quality parameter on tuna meat grade where the excellent grade meat had highest on myoglobin concentration (Nurilmala *et al*., 2013). In addition, myoglobin is primarily responsipble for beef color (Aksu and Alp, 2012). Myoglobin concentration also incresead significantly in response to environmental hypoxia in zebra fish and weddel seal (Jaspers *et al*., 2014; De Miranda *et al*., 2012). In case of Jambi fillet, the higher concentration of myoglobin is due to the possibility of hypoxia in environmental farming location. Generally, there was no water circulation system on patin fish farmimg in Jambi Province (KKP (Kementrian Kelautan Perikanan), 2013). This condition might be causing the hypoxia on its environment inducing myoglobin gen expression in the muscle.

## CONCLUSION

Generally, variation on farming location showed different significance on proximate composition. Jambi fillet had highest on protein, lipid and ash content. In addition, oleic acid classified in MUFA group was

identified to be dominant fatty acids in Jambi fillet. DHA of imported patin fish fillet was the highest compared to Jambi and Karawang fillets. There was no significant difference among all fillets for EPA content. Similar pattern was found for amino acid composition which EAA was higher than NEAA in all examined patin fish fillets. Karawang fillet was more lightness and less redness. In contrast, Jambi fillet was less lightness and more redness as well as highest concentration of myoglobin.

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