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RESEARCH ARTICLE

AMINO ACID AND FATTY ACID PROFILE OF PRESTO INDIAN MACKERAL SCAD (*Decapterus russelli*) AND DARKBAR FLYINGFISH (*Cypselurus hexazona*)

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ABSTRACT

Fish is a prospectus source of protein, vitamins, and minerals. In compared to other food product, fish protein consist of amino acids that has a composition more complete and more digestible. The fish flesh also contains fatty acid, particularly Omega-3 which important for health. Research aimed to study the profile of amino acid and fatty acid of Indian Mackeral Scad and Darkbar Flyingfish which it applied to treatments: presto and presto by added 12% yeast. Research results showed that presto processed treatment applied to the fishes influenced the content of amino acid and fatty acid, where amino acid content of the two kind of fish treated increased after treatment, however, fatty acid content decreased except for some o fatty acids such as oleic acid, linoleic acid, and DHA. The changes of amino acid and fatty acid composition of Indian Mackeral Scad and Darkbar Flyingfish were closely linked to the treatments of which steaming and yeast addition applied, where they were significantly determining fish chemical compositions.

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INTRODUCTION

Indian Mackeral Scad (*Decapterus russelli*) and Darkbar Flyingfish (*Cypselurus hexazona*) have an important economic value, and also play an important role in fulfill people nutrition. The advantageous protein composition of these two fishes are more complete and digestible compare to the amino acid of protein from other animal. Fish also contains fatty acid, particularly Omega-3, which are important for the development of children's brain intelligentsia. Based on that explanation, fish can be identified as the best diet for people from all around the world, however, the right fish processing technology is still needed in order to have the high quality of fish product. The knowledge in processing fisheries products is not only fixated on one kind of processing technique but also many kind of fish processing techniques. It is important to note that inaccurate processing technique is able to damage fish nutrition particularly the amino acid and fatty acid which are the main components of fish body constituent. One of fish processed diversifications is pressed fish (called presto), while the tools used to make it called Pressure Cooker. *The way of Press Cooker work is using huge press system by heating water steam in the tight covered pan.* In this condition, the steam affects fish in the pan to be rapidly cooked without damaging the texture of fish, and also softens the spines and bones. In processing practicing, there is still meet the nutrition component damage, hence the accuracy of time and temperature must be noticed, beside that, the lack sanitation and hygiene standard processing implementation caused the products are unappropriate to be consumed. Research aimed to study the profile of amino acid and fatty acid of Indian Mackeral Scad and Darkbar Flyingfish which it applied to treatments: presto and presto by added 12% yeast.

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MATERIALS AND METHODS

Materials and Tools

Materials used in this research were *i.e.* fresh Indian Mackeral Scad and Darkbar Flyingfish, yeast, banana leaves, ingredients (sugar, salt, ginger, turmeric, garlic, lemongrass, bay leaves, galangal, and lime), and chemical materials such as aquadest, HCl, mercaptoethanol, Brij solution, borate buffer, Na-acetate, Na-EDTA, methanol, THF, NaOH, BF_3, NaCl, hexane, Na_2SO_4 anhydrate, millipore paper. While tools used in this

research were knife, basin, scales, presto pan (*Pressure Cooker*), stove, HPLC stationary, GC-MS stationary, and glasses kit.

Research Procedures

Fresh Indian Mackeral Scad and Darkbar Flyingfish were collected from fishermen at Ambon Bay. Head, fin, spine, scale, and offal of fish were gutted then fish were cleaned. The fish were immersed in 3% salt solution during 2 hours then drained. The whole fish were smeared with subtle ingredients. Banana leaves were placed in presto pan then placed the fish and banana leaf interchangeably in order to avoid the fish clung. The presto pan was covered tightly and cooked the fish about 40 minutes started when the pan was hissing. After 40 minutes, the fire was turned off then the fish were issued and drained. The presto fish were ready to pack and consume after the fish temperature were normal. The presto fish were analyzed to know the contents of water (Sudarmadji, 1997), ash (Sudarmadji,1997), protein (Sudarmadji,1997), lipid (Sudarmadji,1997), amino acid profile (AOAC, 2005), and fatty acid profile (AOAC,2005).

RESULT AND DISCUSSION

Chemical Composition

Proximate analysis of Indian Mackeral Scad (*Decapterus russelli*) and Darkbar Flyingfish (*Cypselurus hexazona*) were showed at Table 1.

Table 1. Proximate of Indian Mackeral Scad (*Decapterus russelli*) and Darkbar Flyingfish (*Cypselurus hexazona*)

Proximate	Indian Mackeral Scad (%)			Darkbar Flyingfish (%)		
	MM1	MM2	MM3	TT1	TT2	TT3
Water	59.45	67.60	62.32	60.95	60.30	60.64
Ash	1.38	1.73	2.78	1.21	1.70	1.28
Protein	25.55	24.68	25.94	25.52	26.95	27.42
Lipid	2.03	1.75	1.37	0.95	1.95	1.12

Note:
MM1 = TT1 = fresh fish
MM2 = TT2 = presto fish without yeast
MM3 = TT3 = presto fish with addition of yeast 12%

Water Content

Water content is an important characteristic of food because it could influence the appearance, texture and taste. The result of water content analysis of Indian Mackeral Scad (*Decapterus russelli*) and Darkbar Flyingfish (*Cypselurus hexazona*) was showed in Figure 1.

Figure 1 showed that water content of fresh Indian Mackeral Scad (*Decapterus russelli*) increased from 59,45% to 67,60% and 62,32% in fish of presto treatment and in fish of presto treatment with addition of yeast 12% respectively. While the water content of fresh Darkbar Flyingfish (*Cypselurus hexazona*) decreased insignificantly from 60,95% to 60,30% and 60,64, in fish of presto treatment and in fish of presto treatment with addition of yeast 12% respectively. In this research, the water content look so high it was naturally because of the water holding capacity of material tested - (Winarno, 1997). The water content of fish increased after presto treatment due to the water vapor from steaming process accommodated back to presto pan. The fish were moistened with water vapor so that the water content in fish was increasing.

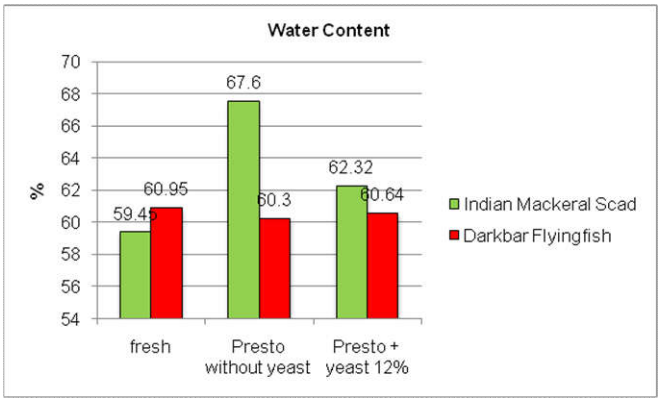

Figure 1. Water Content of Indian Mackerel Scad (*Decapterus russelli*) and Darkbar Flyingfish (*Cypselurus hexazona*)

Ash Content

Ash content could be used as an indicator of mineral presence in food. Food consist of 96% organic matter and water, while the remaining element were minerals which also known as inorganic material (ash content). In ashing process, organic materials were burnt out but not the inorganic matter, therefore its called ash (Winarno, 1997). The amount and composition of minerals in ash depended on the type of food and the ash analysis method used. Ash and mineral in foods were generally originated from the food itself or indigenous (Puspitasari, *et.al*, 1991).

The result of ash content analysis of Indian Mackeral Scad (*Decapterus russelli*) and Darkbar Flyingfish (*Cypselurus hexazona*) was shown in Figure 2.

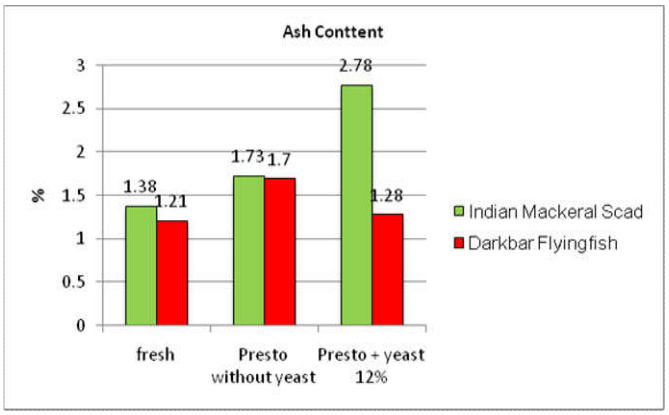

Figure 2. Ash Content of Indian Mackeral Scad (*Decapterus russelli*) and Darkbar Flyingfish (*Cypselurus hexazona*)

Figure 2 showed that ash content of fresh Indian Mackeral Scad (*Decapterus russelli*) was 1,38% increased to 1,73% and 2,78% in fish of presto treatment and in fish of presto treatment with addition of yeast 12% respectively. While in

fresh Darkbar Flyingfish (*Cypselurus hexazona*) the ash content was 1,21% increased to 1,70% and 1,28% in fish of presto treatment and in fish of presto treatment with addition of yeast 12% respectively. Ash content of Indian Mackeral Scad (*Decapterus russelli*) based on Chairita (2008) was 1,03%. Ash content level is caused by species differences and habitat. Every organism has an ability differences in regulating and absorbing iron which influenced the organism ash content.

Protein Content

Protein is an essential nutrient for the body, beside it can function as builder substance and new tissue regulator in the body, protein also can be used as source of energy in case of the energy of carbohydrate and lipid was depleted. The result of a protein content analysis of Indian Mackeral Scad (*Decapterus russelli*) and Darkbar Flyingfish (*Cypselurus hexazona*) was shown in Figure 3.

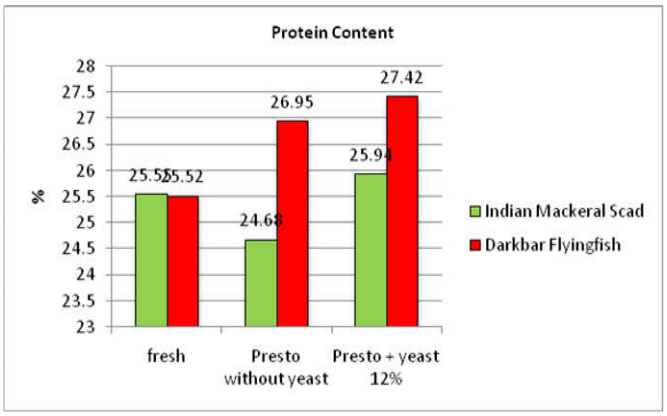

Figure 3. Protein Content of Indian Mackeral Scad (*Decapterus russelli*) and Darkbar Flyingfish (*Cypselurus hexazona*)

Figure 3 showed that protein content of fresh Indian Mackeral Scad (*Decapterus russelli*) was 25,55%, decreased into 24,68% in fish of presto treatment, and increased to 25,95% in fish of presto treatment with addition of yeast 12%. While protein content of fresh Darkbar Flyingfish (*Cypselurus hexazona*) was 25,52%, and increased to 26,95% in fish of presto treatment and 27,42% in fish of presto treatment with addition of yeast 12%. The protein content values were higher that of Chairita (2008), where the protein content was 18,13%. The variation of food chemical components was caused by some factors, *i.e.*, season, size, maturity stage, environment temperature, and the availability of food (Sudhakar *et al*., 2009). The increasing of protein content in presto fish was appropriate to the research result carried out by Taputubun *et al.* (2008), protein content increased because of the salting processed and temperature introduced during processing so that the water was vaporized which causing the protein in fish flesh became more concentrated. Suharjo (1998) reveal that main function of salt is stimulating natural flavor, incurring high osmotic pressure, and reducing water content which is causing the protein in fish flesh became more concentrated. The addition of yeast to presto processing could fasten the softening process. Protein content of Indian Mackeral Scad presto with yeast 12% addition was 1,26% while Darkbar Flyingfish presto was 1,90%. Yeast metabolism produced heat and raised the temperature which causing water evaporation hence the protein in fish flesh became more concentrated (Ratnasari, 2009).

Lipid Content

Biside carbohydrate and protein, lipid is also major component in food that has main role in determining the characteristic of food. Lipid is more effective as a source of energy than carbohydrate and protein. The result of lipid content analysis of Indian Mackeral Scad (*Decapterus russelli*) and Darkbar Flyingfish (*Cypselurus hexazona*) was shown in Figure 4.

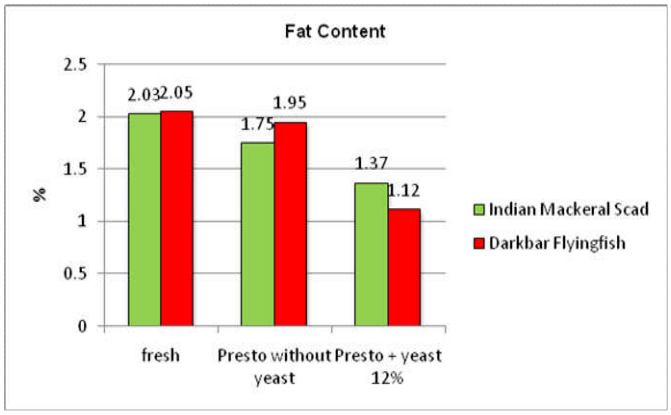

Figure 4. Lipid Content of Indian Mackeral Scad (*Decapterus russelli*) and Darkbar Flyingfish (*Cypselurus hexazona*)

Figure 4 showed that lipid content of fresh Indian Mackeral Scad (*Decapterus russelli*) was 2,03%, and decreased into 1,75% in fish of presto treatment and 1,37% in fish of presto treatment with addition of yeast 12%. The similar result also occurs to lipid content of Darkbar Flyingfish (*Cypselurus hexazona*) which was 2,05% in fresh condition and decreased to 1,95% in fish of presto treatment and 1,12% in fish of presto treatment with addition of yeast 12%.

Cooking process with extremely high temperature caused the lipid damage in food (Palupi *et al*., 2007). Level of damage varies depend on temperature and duration of steaming process. The higher temperature applied to the food, more damage the lipid will be. Due to process of press steaming, lipid will liquefy and evaporate caused the decreased of lipid content. It is caused by the outbreak of lipid components into volatile product such as aldehyde, ketone, alcohol, acids, and hydrocarbon which significantly influencing the flavor formation then increasing the palatability of the flesh (Deep, 2009). Suliantari (2001) reveal that heating causes lipid loss due to the formation of volatile carbonyl compounds, ketone acids, epoxy acids, and else.

Amino Acid Profile

The result of amino acids analysis of Indian Mackeral Scad (*Decapterus russelli*) and Darkbar Flyingfish (*Cypselurus hexazona*) was shown at Table 2. Protein quality is determined by a type and proportion of amino acids contained in that protein. The Qualitative protein is protein protein that can provide an essential amino acids as much as proportion needed

by body (Winarno, 1997). Amino acids analysis was conducted to know the types of amino acids and to determine the content of amino acids in protein of Indian Mackeral Scad and Darkbar Flyingfish either in fresh or presto condition. Method used was *High Performance Liquid Chromatography* (HPLC) method. The result showed that there were 15 amino acids that consisted of 9 essential amino acids and 6 non essential amino acids. Essential amino acids that contained in flesh of Indian Mackeral Scad and Darkbar Flyingfish were *i.e.* histidine, threonine, arginine, methionine, valine, phenylalanine, i-leucine, leucine dan lysine. While non essential amino acids were *i.e.* aspartic acid, glutamic acid, serine, glycine, alanine and tyrosine.

Table 2. Amino Acids Composition of Indian Mackeral Scad (*Decapterus russelli*) and Darkbar Flyingfish (*Cypselurus hexazona*)

Parameters	Result (%)					
	Indian Mackeral Scad			Darkbar Flyingfish		
	MM1	MM2	MM3	TT1	TT2	TT3
Amino Acid						
Aspartic acid	2.18	2.25	2.45	2.04	2.68	2.54
Glutamic acid	3.50	3.62	3.93	3.04	4.10	3.91
Serine	0.95	0.97	1.05	0.87	1.23	1.14
Histidine	1.10	0.91	0.87	1.48	1.54	1.30
Glycine	1.06	1.04	1.23	1.07	1.20	1.15
Threonine	1.06	1.06	1.17	1.09	1.26	1.26
Arginine	1.41	1.43	1.57	1.18	1.64	1.59
Alanine	1.31	1.31	1.41	1.30	1.62	1.57
Tyrosine	0.80	0.81	0.88	0.74	0.99	0.98
Methionine	0.70	0.72	0.79	0.69	0.87	0.84
Valine `	1.10	1.10	1.22	1.13	1.44	1.43
Phenylalanine	0.95	0.94	1.00	1.04	1.14	1.13
l-leucine	1.01	1.01	1.10	0.98	1.25	1.25
Leucine	1.81	1.83	1.97	1.70	2.20	2.15
Lysine	2.10	2.10	2.31	1.89	2.43	2.32
Amino Acid Total	21.05	21.11	22.94	20.25	25.57	24.57

Note :
MM1 = TT1 = fresh fish
MM2 = TT2 = presto fish without yeast
MM3 = TT3 = presto fish with addition of yeast 12%

Essential Amino Acid

The result showed that there were 9 types of essential amino acid *i.e.* histidine, threonine, arginine, methionine, valine, phenylalanine, i-leucine, leucine dan lysine. Histograms of essential amino acids content ratio in flesh of fresh and presto Indian Mackeral Scad (*Decapterus russelli*) and Darkbar Flyingfish (*Cypselurus hexazona*) were shown in Figure 5 and Figure 6.

Essential amino acid is non-synthesizable amino acid in body hence it have to be enriched from outside the body by food consumtion. Essential amino acid has important role in body balance. Figure 5 showed that the highest value of essential amino acids was lysine. Lysine in fresh and presto of Indian Mackeral Scad was 2,10%, while in presto with yeast addition it was 2,31%. Figure 6 showed the result of Darkbar Flyingfish of which lysine was also the highest value of essential amino acid with values of 1,89%, 2,,43%, and 2,32%, respectively to each treatment of fresh, presto, and presto with yeast addition.
In general, amino acids content in Indian Mackeral Scad (*Decapterus russelli*) and Darkbar Flyingfish (*Cypselurus hexazona*) increased after treated to presto with yeast condition. It was caused by yeast's activity that occurred during the fermentation. Fermentation is a metabolic process of organic compounds by microorganism yielding energy that generally occurred in an organism without presence of oxygen molecule and by utilizing organic compounds whether as an oxidator or as oxidized substrate (Buckle, *et al.*, 2004). Principally, preservation using fermentation method is activating the growth and metabolism of alcohol former microbe, and to press the growth of proteolytic bacteria and lipolytic bacteria (Winarno and Fardiaz, 1981). Winarno and Fardiaz (1981) also mentioned that fermented food commonly has higher nutrition compared to the origin.

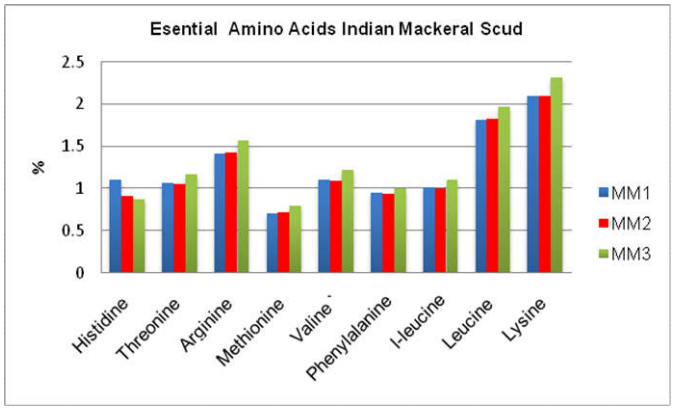

Figure 5. Content of Essential Amino Acids of Indian Mackeral Scad (*Decapterus russelli*)

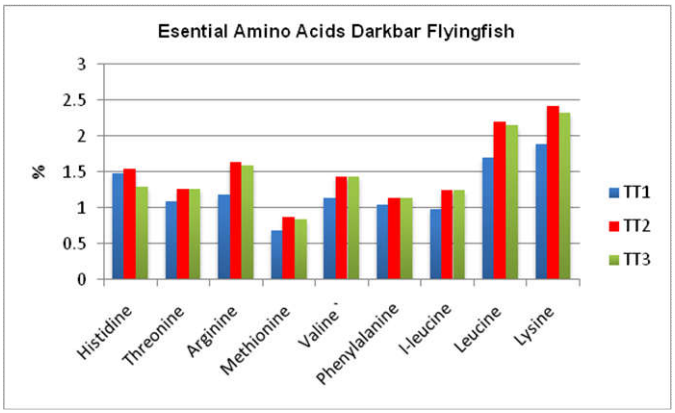

Figure 6. Content of Essential Amino Acids of Darkbar Flyingfish (*Cypselurus hexazona*)

Non Essential Amino Acid

Histograms of non essential amino acids content ratio in flesh of fresh and presto Indian Mackeral Scad (*Decapterus russelli*) and Darkbar Flyingfish (*Cypselurus hexazona*) were shown in Figure 7 and Figure 8.

Non essential amino acid is synthesizable amino acid by body. The analysis resulted 6 types of amino acids *i.e.* aspartic acid, glutamic acid, serine, glycine, alanine and tyrosine. Figure 7 showed that the highest value was glutamic acid which valued 3,50%, 3,62%, and 3,93%, respectively to treatments of fresh, presto, and presto with yeast addition of Indian Mackeral Scad

(*Decapterus russelli*). Figure 8 showed the result for Darkbar Flyingfish of which glutamic acid was also the highest value of essential amino acid with values of 3,04%, 4,10%, and 3,91%, respectively to each treatment of fresh, presto, and presto with yeast addition. Glutamic acid is natural compiler component in most of high protein food such as meat, fish, milk, and vegetables. Figure 8 and 9 showed that glutamic acid in either fish increased after the treatments of presto which it could be caused by ingredients addition in presto processing.

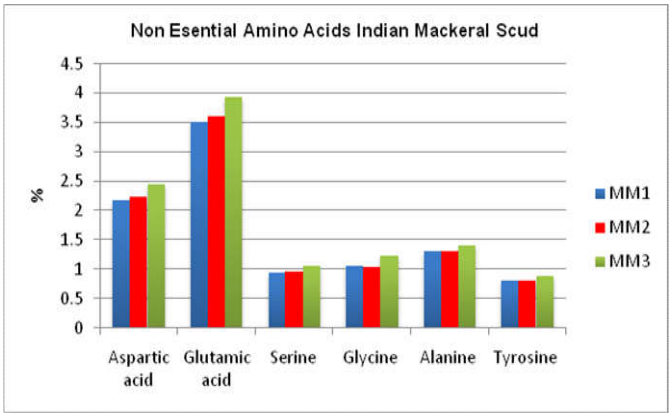

Figure 7. Content of Non Essential Amino Acids of Indian Mackeral Scad (*Decapterus russelli*)

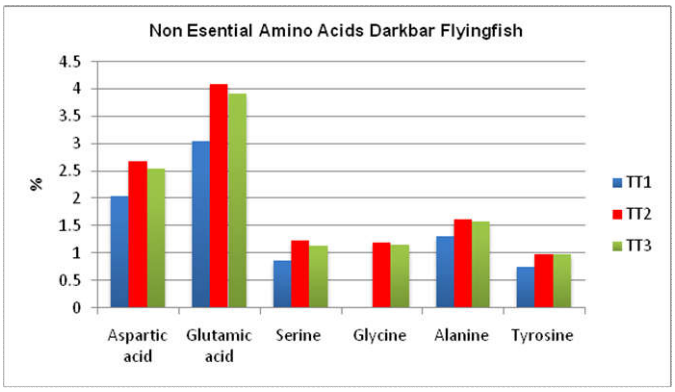

Figure 8. Content of Non Essential Amino Acids of Darkbar Flyingfish (*Cypselurus hexazona*)

The second highest value of non essential amino acids was aspartic acid which valued 2,18%, 2,25%, and 2,45%, respectively to treatments of fresh, presto and presto with yeast addition of Indian Mackeral Scad (*Decapterus russelli*). While in Darkbar Flyingfish (*Cypselurus hexazona*), the values were 2,04%, 2,64%, and 2,54% to each treatment. Serine, glycine, alanine and tyrosine are non essential amino acids of Indian Mackeral Scad and Darkbar Flyingfih in small amounts, and also being increased after the treatment of presto and presto with yeast addition. This condition was caused by yeast microbe activity during the fermentation process.

Fatty Acid Profile

The analysis result of fatty acids of Indian Mackeral Scad (*Decapterus russelli*) and Darkbar Flyingfish (*Cypselurus hexazona*) was shown at Table 3.

The result showed that Indian Mackeral Scad contained 21 types of fatty acid that consisted of 11 types of SFA, 4 types of MUFA, and 6 types of PUFA, while Darkbar Flyingfish contained 20 types of fatty acid that consisted of 11 types of SFA, 3 types of MUFA, and 6 types of PUFA,

Saturated Fatty acid/SFA

Saturated fatty acids are fatty acids that contain no double bonds between the carbon atoms. Based on Table 3, Indian Mackeral Scad has 11 types of SFA. SFA of fresh Indian Mackeral Scad was 26,71%, being decreased to 18,15% in presto fish, and being increased to 21,54% on treatment of presto with yeast addition. While result for Darkbar Flyingfish showed that SFA were continually decreased from 35,07% in fresh fish into 26,03% and 15,43% on treatment of presto and presto with yeast addition. Analysis results of either fish were shown in Figure 9 and 10.

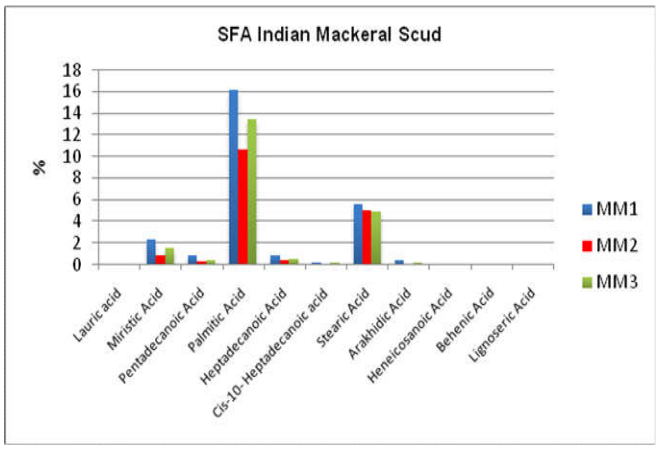

Figure 9. Saturated Fatty Acid Contents in Indian Mackeral Scad (*Decapterus russelli*)

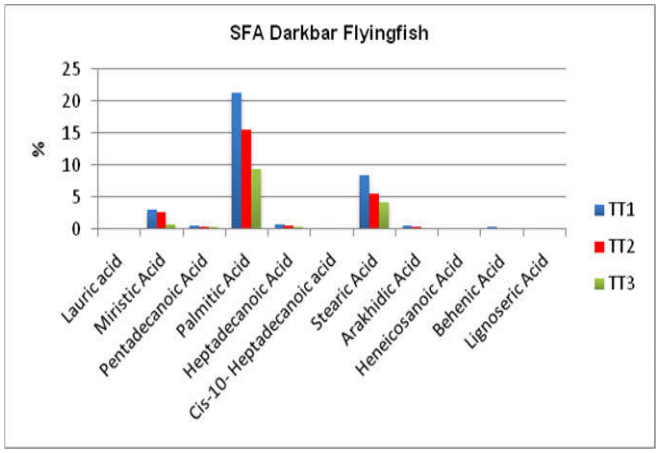

Figure 10. Saturated Fatty Acid Contents in Darkbar Flyingfish (*Cypselurus hexazona*)

Palmitic acid (C16:0) was SFA with the highest content in either fish (as shown in Figure 9 and 10). Fresh Indian Mackeral Scad (*Decapterus russelli*) contained palmitic acid 16,21%, 10,72% and 13,47% on treatments of presto and presto with yeast addition.

Table 3. Fatty Acids Composition of Indian Mackeral Scad (*Decapterus russelli*) and Darkbar Flyingfish (*Cypselurus hexazona*)

Parameters	Result (%)					
	Indian Mackeral Scad			Darkbar Flyingfish		
	MM1	MM2	MM3	TT1	TT2	TT3
Fatty Acid						
Lauric acid, C12:0	0.03	0.02	0.02	0.06	0.04	0.02
Myristic acid, C14:0	2.36	0.95	1.55	3.00	2.72	0.79
Pentadecanoic acid, C15:0	0.85	0.34	0.41	0.44	0.43	0.32
Palmitic acid, C16:0	16.21	10.72	13.47	21.23	15.66	9.36
Palmitoleic acid, C16:1	2.15	1.12	2.03	2.91	2.50	0.74
Heptadecanoic acid, C17:0	0.88	0.49	0.49	0.77	0.67	0.39
Cis-10- Heptadecanoic acid, C17:1	0.15	0.10	0.16	0.13	0.13	0.11
Stearic acid, C18:0	5.58	5.10	4.94	8.36	5.54	4.15
Oleic acid, C18:1n9c	5.51	9.17	9.74	11.28	9.98	12.51
Linoleic acid, C18:2n6c	1.08	6.26	6.45	1.84	4.45	12.63
Arachidic acid, C20:0	0.37	0.17	0.24	0.47	0.36	0.14
Cis-11-Eicosenoic acid, C20:1	0.88	n.d	n.d	n.d	n.d	n.d
Linolenic acid, C18:3n3	0.32	4.22	4.28	0.61	2.99	8.29
Heneicosanoic acid, C21:0	0.10	0.03	0.05	0.12	0.07	0.02
Cis-11,14-Eicosedienoic acid, C20:2	0.35	0.18	0.12	0.18	0.16	0.23
Behenic acid, C22:0	0.13	0.12	0.12	0.28	0.22	0.08
Erucic acid, C22:1n9	0.23	0.09	0.08	0.14	0.12	0.06
Arachidonic acid, C20:4n6	2.49	1.64	1.12	2.17	0.99	1.40
Lignoceric acid, C24:0	0.05	0.11	0.09	0.21	0.19	0.05
Cis-5,8,11,14,17-Eicosapentaenoic acid, C20:5n3	3.22	1.73	2.55	5.60	2.77	1.26
Cis-4,7,10,13,16,19-Docosahexaenoic acid, C22:6n3	16.16	13.13	19.66	19.60	9.58	10.09
SFA	26.71	18.15	21.54	35.07	26.03	15.43
MUFA	8.77	10.38	11.85	14.33	12.60	13.31
PUFA	23.62	27.16	34.18	30.00	20.94	33.90
Fatty Acid Total	59.08	55.68	67.55	79.38	59.56	62.63

Note :
MM1 = TT1 = fresh fish
MM2 = TT2 = presto fish without yeast
MM3 = TT3 = presto fish with addition of yeast 12%

While result for Darkbar Flyingfish showed that the fresh contained palmitic acid 21,23%, 15,66% and 9,36% on treatments of presto and presto with yeast addition. Decreases of palmitic acid content in either presto fish were rendered by heat. Other SFA contained in either fish were *i.e.* stearic acid (C18:0), myristic acid (C14:0), lauric acid (C12:0), pentadecanic acid (C15:0), heptadecanoic acid (C17:0), arachidic acid (C20:0), heneicosanoic acid (C21:0), behenic acid (C22:0) and lignoceric acid (C24:0). In general, the contents of SFA were being decreased after presto treatment due to the heating process was causing damage to SFA. Ningsih (2009) suggested that fried freshwater swan mussel was causing loss 2,7% of lipid. Over consumption of SFA produces and fastens process of arterioclerosis (Almatsier, 2002) hence none of SFA is needed for health.

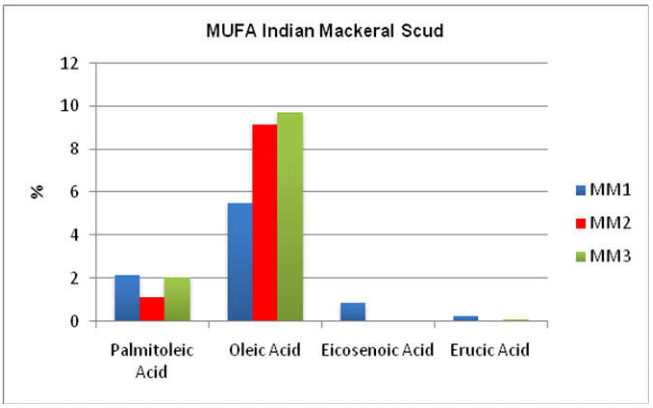

Figure 11. Monounsaturated Fatty Acids of Indian Mackeral Scad (*Decapterus russelli*)

Monounsaturated Fatty Acid/MUFA

Unsaturated fatty acids that contain of one double bond were defined as monounsaturated fatty acid (MUFA). Based on analysis result at Table 3, fresh Indian Mackeral Scad contained 4 types of MUFA (8,77%), and after treatment of presto and presto with yeast addition, MUFA reduced to 3 types however the contents were increasing to 10,38% and 11,85%. While Darkbar Flyingfish contained 3 types of MUFA with contents of 14,33%, 12,6%, and 13,31%, respectively to treatments of fresh, presto, and presto with yeast addition.

Analysis result of MUFA in Indian Mackeral Scad and Darkbar Flyingfish were shown in Figure 11 and 12.

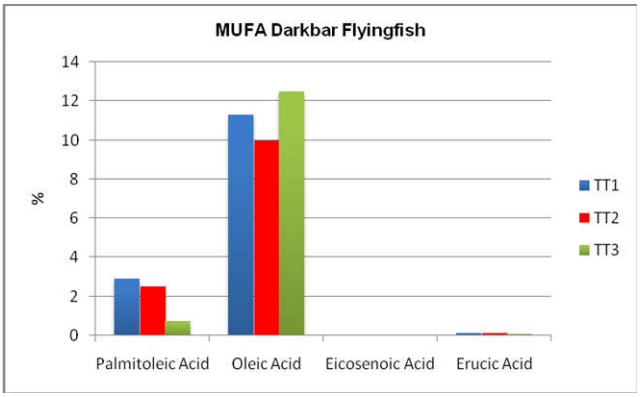

Figure 12. Monounsaturated Fatty Acids of Darkbar Flyingfish (*Cypselurus hexazona*)

Figure 11 showed that the highest of MUFA content in Indian Mackeral Scad was oleic acid (C18:1) of which valued 5,51%, 9,17%, and 9,74%, respectively to treatments of fresh, presto, and presto with yeast addition. Figure 12 showed the same result that oleic acid was the highest value of MUFA content in Darkbar Flyingfish with values of 11,28%, 9,98%, and 12,51%, respectively to treatments of fresh, presto, and presto with yeast addition. MUFA contents of either fish were increasing after the treatment of presto with yeast addition due to microbe activity during the fermentation process. Oleic acid is product of stearic acid de-saturation and produced by plants, animals, and bacteria. Sutiyoso (2009) suggested that other aquatic animal, such as sea cucumber, contains 2,21% of oleic acid. Oleic acid is unsaturated fatty acid with function to reduce cholesterol content in body and as precursor in forming PUFA (Farouk *et al*., 2007). Other fatty acids of Indian Mackeral Scad contained in small amounts were *i.e.* palmitoleic acid, eicosedienoic acid, and erucic acid, while Darkbar Flyingfish contained palmitoleic acid and erucic acid. Different to oleic acid content which became increased after treatments of presto and presto with yeast addition, contents of palmitoleic acid, eicosedienoic acid, and erucic acid were decreasing after either treatment.

Polyunsaturated Fatty Acid/PUFA

Unsaturated fatty acids that contain of two or more double bond were defined as polyunsaturated fatty acid (PUFA). Based on analysis result at Table 3, it showed that PUFA in Indian Mackeral Scad consisted of 6 types which valued 23,64%, 27,16%, and 34,18%, respectively to treatments of fresh, presto, and presto with yeast addition. Darkbar Flyingfish also had 6 types of PUFA which valued of 30,00%, 20,94%, and 33,90%, respectively to treatments of fresh, presto, and presto with yeast addition. The analysis results of PUFA in Indian Mackeral Scad and Darkbar Flyingfish were shown in Figure 13 and 14.

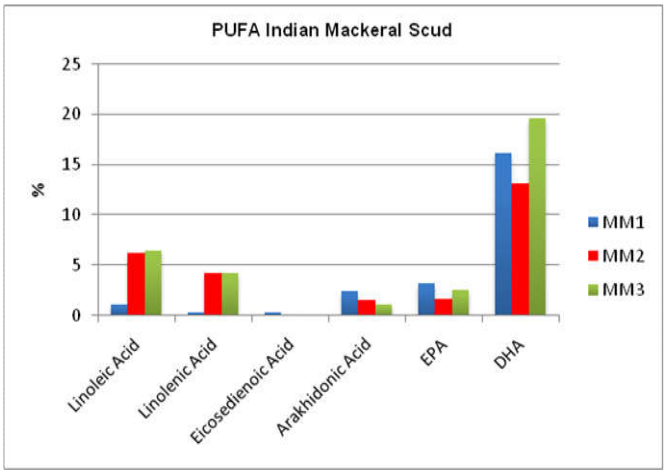

Figure 13. Polyunsaturated Fatty Acids of Indian Mackeral Scad (*Decapterus russelli*)

Figure 13 showed the highest PUFA content in Indian Mackeral Scad was DHA (C22:6n3) which valued of 16,66%, 13,13%, and 19,66%, respectively to treatments of fresh, presto, and presto with yeast addition. While Figure 14 showed that the DHA content in Darkbar Flyingfish were 19,60%, 9,58%, and 10,09%, respectively to treatments of fresh, presto, and presto with yeast addition.

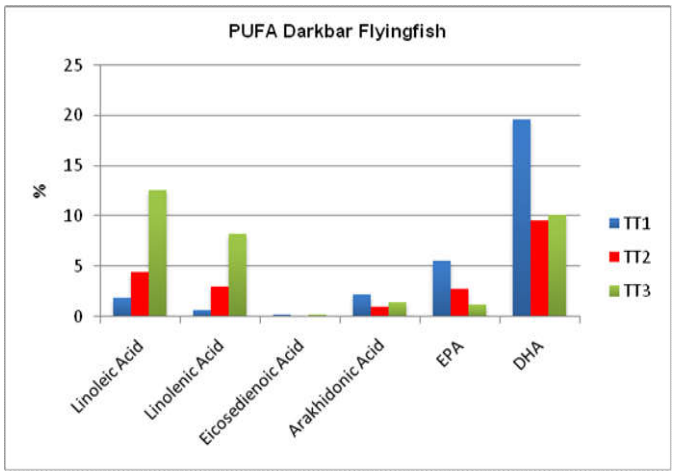

Figure 14. Polyunsaturated Fatty Acids of Darkbar Flyingfish (*Cypselurus hexazona*)

DHA content in Indian Mackeral Scad was increasing after the treatment of presto with yeast addition however it was decreasing in result of DHA content in Darkbar Flyingfish, which due to the microbe activity in added yeast beside of microbe metabolism rate which determined by fish shape and ligament. Adawiyah (2008) suggested that chemical content, size, and nutrition of fish are depended on species, age, sex, maturity rate, and habitat, of which fish with soft and moist texture has faster breakdown ability compared to hard texture fish. EPA content in Indian Mackeral Scad was decreasing from 3,22% in fresh condition into 1,73% and 2,55% after treatments of presto and presto with yeast addition. The same condition also occurred to Darkbar Flyingfish of which EPA content was decreasing from 5,60% in fresh condition into 2,77% and 1,26% after treatments of presto and presto with yeast addition. EPA content decreasing was due to the activity of microbe in yeast which the microbe needed food to its life process hence it degraded fatty acids as its food resource. Content of linoleic acid in fresh Indian Mackeral Scad was 1,08% and increased to 6,26% and 6,45% on treatments of presto and presto with yeast addition, while linolenic acid content was 0,32% on fresh condition and increased to 4,22% and 4,48% on treatments of presto and presto with yeast addition. Content of linoleic acid in fresh Darkbar Flyingfish was 1,84% and increased to 4,45% and 12,63% on treatments of presto and presto with yeast addition, while linolenic acid content was 0,61% and increased to 2,99% and 8,29% on treatments of presto and presto with yeast addition. The increasing of linoleic acid and linolenic acid of either fish was due to the yeast activity added to presto processing. Linoleic acid and linolenic acid are essential fatty acids needed by body however these two fatty acids can not be synthesized by humans. Essential fatty acids are utilized to preserve structural parts of cell membrane and to produce eicosanoids hormone. Essential fatty acids deficiency results malfunction of nerves and sight, and detaining growth (Almatsier, 2002). Indian Mackeral Scad and Darkbar Flyingfish contain omega-3 unsaturated fatty acids such as EPA, DHA, and linoleic acid

which are useful to prevent thrombocyte clotting then reducing the risk of arteriosclerosis and preventing coronary heart. EPA and DHA also have functions for developing most of brain cerebral cortex and for conducting normal growth of the organ hence important to maintain the content of EPA and DHA in food so not be damage. Consuming adequate number of omega-3 fatty acid competently reduces content of cholesterol in blood and decimating risks of heart disease, arteriosclerosis, and selective in killing cancer cells and healing symptoms of rheumatoid arthritis. Kinsella *et al.* (1990) alleged that clinical effect of omega-3 fatty acid in reducing blood cholesterol presumably contributed by its effect to mechanism of producing transport lipoprotein in liver of which then secreted into the blood. Arachidonic acid and eicosedienoic acid were also types of PUFA which contained in Indian Mackeral Scad and Darkbar Flyingfish in small amount. However, their roles are highly needed by body. Arachidonic acid is omega 6 fatty acid which highly needed for brain growth and keep the human's skin tight (Almatsier, 2002).

CONCLUSION

Based on the research done, steam pressing process (presto) subjected to Indian Mackeral Scad (*Decapterus russelli*) and Darkbar Flyingfish (*Cypselurus hexazona*) significantly influenced their amino acid and fatty acid content, where the content of amino acid of both Indian Mackeral Scad (*Decapterus russelli*) and Darkbar Flyingfish (*Cypselurus hexazona*) was increasing for both treatments; presto and presto by yeast addition; on the other hand fatty acid content tended to decrease, whereas some types of fatty acid were increasing such as oleic acid, linoleic acid, lonolenic acid, and DHA. The change of amino acid and fatty acid composition of both Indian Mackeral Scad (*Decapterus russelli*) and Darkbar Flyingfish (*Cypselurus hexazona*) was closely related to the treatments, where the steaming process and yeast addition were very affected the chemical composition of fish.

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