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### Fatty Acids Profile of Trevally (*Selaroides* spp), Catfish (*Clarias* sp) and Tuna (*Thunnus* sp) Fish Oil, Microencapsulated Mixture of Fish Oil and Fortified in Ice Cream

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Abstract: In recent years there have been considerable efforts to rearrange fatty acids composition of dairy products to improve the long-term health of consumers. One of the efforts is to fortify essential fatty acids in ice cream. The objective of this study was to find out the fatty acids profile of either Selaroides spp, Clarias sp and Thunnus sp fish oil, microencapsulated fish oil and ice cream fortified with this fish oil mixture. Selaroides spp, *Clarias* sp and *Thunnus* sp used as raw material were obtained from Palu, Central Sulawesi. The study was caried out using Nested Block Design as the experimental design. The microencapsulated fish oil was prepared using freeze drying and spray drying method. The variables measured were fatty acids profile, microencapsulated fish oil and ice cream fortified with microencapsulated fish oil. The research results showed that SFA, MUFA and PUFA contents of fish oil mixture of *Selaroides* spp, *Clarias* sp, and *Thunnus* sp using freeze drying method were 53.74%, 32.20% and 1.91%, while using spray drying method were 61.30%, 38.70% and 0% (not detected), respectively. It can be concluded that freeze drying method from the point of view of total PUFA is the best method for mincroencapsulation process of this fish oil mixture. Fortification of 15 g (w/w) microencapsulated fish oil in ice cream could reduced SFA and increased the MUFA and PUFA.

Keywords: fish oil, microencapsulation, spray drying, freeze drying, ice cream.

#### Introduction

Ice cream is a dairy product made by the process of freezing and agitation on materials consisting of milk and dairy products, sweeteners, stabilizers, emulsifiers, as well as a flavor enhancer (flavor). Currently ice cream is a food product that is popular in the community and is usually consumed as a snack (dessert), but the ice cream fortified with essential fatty acids like omega 3, omega 6 and omega 9 are still rare. Essential fatty acids are fats that are needed by the body and have the function to support the cardiovascular system, reproductive, immune and nervous system. Another function of essential fatty acids also can produce prostaglandins that can regulate body functions such as heart rate, blood pressure, blood clotting, fertility, conception and plays a role in immune function by regulating inflammation and encouraging the body to fight infection. Essential fatty acids can not be synthesized by the body and must be obtained from food. Deficiency of essential fatty acid can affect the health conditions such as heart disease, cancer, insulin resistance, lupus, schizophrenia, depression, postpartum depression, premature aging, stroke, obesity, diabetes, *arthritis*, and *alzhemeir* diseases. One source of essential fatty acids is fish oil. Fish oil is the main source of long chain

polyunsaturated fatty acids (LC PUFA) omega-3, especially EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid) which important for health. The positive influence of omega-3 fatty acids on health can prevent heart disease and cancer, and can improve the function of the brain and retina of the eye<sup>1</sup>. The mixture between trevally fish oil and catfish can produce 9.7% omega-3, 0.06% omega 6 and 42.81% omega 9<sup>2</sup>. Fatty acids are highly susceptible to oxidation, so it takes a process before fatty acid fortified to food products, and alternative processes that can be used is microencapsulation. Milk fortified with fish oil at the level of 15 g/kg did not affect the smell of it<sup>3</sup>. Previous study found that 2% salmon oil microencapsulation which added to the strawberry yogurt before pasteurization and homogenization can improve eicosapentaenoic acid and docosahexaenoic acid<sup>4</sup>. Other study also showed that the addition of lemuru fish oil in yogurt of 0.5%, 1%, 1.5% and 2% can improve the nutritional quality of the product, especially omega 3 and omega 6 fatty acids<sup>5</sup>. The research aimed to study the fatty acid profile of ice cream that has been fortified with microencapsulated mixture between fish oil of Trevally (*Selaroides* spp) and catfish (*Clarias* sp) and Tuna (*Thunnus* sp).

#### Experimental

#### Sample

Three type of non-economical fish such as Trevally (*Selaroides* spp), Catfish (*Clarias* sp) and Tuna (*Thunnus* sp) were obtained from sea water of Palu, Central Sulawesi Province. The chemical agents used for the analysis were: hexane, acetone, ethanol, diethyl ether, acetic acid, formic acid, petroleum ether, KOH and  $Na_2SO_4$  anhydrous (Sigma – Aldrich).

#### **Experimental Design**

This research was design using Nested Block Design with two treatments of microencapsulation method, namely freeze drying method ( $F_1$ ) and spray drying method ( $F_2$ ), respectively. The microcapsules of fish oil were obtained from a mixture of trevally and catfish oil ( $M_1$ ) and tuna fish oil ( $M_2$ ). The omega 3, 6, and 9 from the microcapsules of fish oil was determined using Gas Chromatography (GC) (SHIMADZU-FID)<sup>6</sup>.

#### Fatty Acid, SFA, MUFA, and PUFA Profile

Trevally and catfish oil used in this study was extracted by wet rendering method, while tuna fish oil using solvent method<sup>7</sup>. Subsequently, the fatty acids profiles from extracted fish oil were analyzed using Gas Chromatography (GC) (SHIMADZU-FID)<sup>6</sup>. According to the fish oil analysis the content of PUFA and MUFA, a mixture of trevally and catfish oil with ratio 1:1 were adopted for the next step of this research.

### Microencapsulation of Fish Oils and Fatty Acid Profile Analysis: SFA, MUFA and PUFA of Microcapsules Fish Oil

One encapsulating material used in this research was sodium caseinate with ratio 6:1 of sodium caseinate and fish oil<sup>8</sup>. Freeze drying and spray drying (Buchi Mini Spray Drier B-290) method were obtained to encapsulate trevally fish oil mixed with catfish oil and tuna fish oil. Spray drying was achieved by preparation of emulsion material, homogenizing of the ingredient and spraying the emulsion into the chamber. The emulsion preparation, coatings is dissolved into the water, then coating materials and ingredients were mixed up into a homogeneous emulsion. The homogenized emulsions were spray dried at inlet and outlet temperature of 130 and 72°C, with the flow rate of 5 ml/sec, respectively. For microencapsulation by freeze drying method was employed using freezer dryer scanvac coolsave. Samples were closed with aluminium foil cover to protect samples against light and stored at freeze temperature for 24 hours, then were kept at freese dryer for 40 hours. Moreover, the fatty acid profile, SFA, MUFA, and PUFA in microcapsules was characterized using Gas Chromatography<sup>6</sup>.

### Analysis of Fatty Acid Profile (SFA, MUFA, and PUFA) of Ice Cream Fortified with Microencapsulated Fish Oil

The cow's milk for ice cream was obtained from Agricultural Training Center, Batu Malang. Further, ice cream was characterized for fatty acid profile, SFA, MUFA, and PUFA using GC<sup>6</sup>. Ice cream was then fortified with microencapsulated fish oil using three treatments, i.e 15 g/kg; 20 g/kg and 25 g/kg. The best

treatment was then selected using<sup>9</sup>. Best treatment from ice cream fortified was analyzed the fatty acids profile, SFA, MUFA and PUFA using  $GC^6$ , as well as organoleptic testing.

#### **Statistical Analysis**

The descriptive analysis was applied to the data obtained from the profile of fatty acids PUFA, MUFA, and SFA. Analysis of variance was performed using SPSS software to evaluate the effect of the parameters studied. Differences among mean values were examined using Test Honestly Significant Difference (HSD) at the p<0.05 significance level. The best treatment was determined using<sup>9</sup>. Mathematic model was used to analyze the effect of microencapsulation methods and parameters studied (omega 3, 6, and 9):

 $\mathbf{Y}_{ijk} = \boldsymbol{\mu} + \mathbf{t}_i + \boldsymbol{\beta}_{(ij)} + \mathbf{E}_{ijk}$ 

#### **Results and Discussion**

#### Fatty Acids Composition of the Trevally, Catfish, and Tuna Fish Oil

Table 1 shows the composition of fatty acids in trevally, catfish and tuna fish oil. According to Table 1, the fatty acids produced by these fish oil were saturated fatty acids (SFA), monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFAs). Further, result shows that the dominant polyunsaturated fatty acids found are eicosatrionic, linoleic and docosahecsanoic acid, while the predominant saturated fatty acid in trevally, catfish and tuna fish oil is palmitic acid of which 33.03, 24.99 and 26.53%, respectively. Results are in agreement with that reported study that palmitic and palmitoleic acids are the fatty acid dominant in *Clarias gariepinus, Tilapia zillii, Pentanemus quinquarius, Pseudotolithus typus* in the sea water of Lagos, Nigeria<sup>10</sup>. Several factors affecting of fatty acid composition are climate, temperature, rain fall, species, sex, weight, size and feed<sup>10,11</sup>.

Fatty Acid	<i>Selaroides</i> spp	<i>Clarias</i> sp	<i>Thunnus</i> sp
Caproic	$0.007 \pm 0.006$	0 0	0 0
Caprilic	$0.003 \pm 0.001$	$0.046 \pm 0.003$	$0.124 \pm 0.002$
Lauric	$0.106 \pm 0.035$	$1.963 \pm 0.047$	0 0
Tridecanoic	$0.093 \pm 0.014$	$0.009 \pm 0.002$	$0.080 \pm 0.010$
Myristoleic	$0.030 \pm 0.004$	$0.053 \pm 0.001$	0 0
Myristic	$5.916 \pm 0.943$	$1.999 \pm 0.038$	$4.483 \pm 0.072$
Pentadecanoic	$1.689 \pm 0.287$	$0.210 \pm 0.006$	$1.348 \pm 0.022$
Palmitoleic	$8.183 \pm 0.581$	$4.956 \pm 0.072$	$7.884 \pm 0.079$
Palmitic	$33.026 \pm 0.865$	$24.999 \pm 0.416$	$26.528 \pm 0.470$
SFA	48.259	49.953	38.426
Heptadecanoic	$0.150 \pm 0.020$	0 0	$0.888 \pm 0.010$
Cis-heptadecanoic	$2.361 \pm 0.419$	0 0	$1.447 \pm 0.027$
Oleic	$15.502 \pm 0.569$	$34.967 \pm 0.488$	$19.746 \pm 0.038$
Stearic	$3.013 \pm 0.528$	$22.955 \pm 1.351$	$2.844 \pm 0.039$
Linoleic	$10.241 \pm 0.499$	$6.294 \pm 0.102$	$6.756 \pm 0.158$
MUFA	23.685	39.923	27.630
Arakidat	$6.304 \pm 1.025$	0 0	$4.571 \pm 0.072$
Linolenic	$1.525 \pm 0.230$	$0.866 \pm 0.728$	$0.759 \pm 0.012$
Heneicosanoic	$0.316 \pm 0.047$	0 0	$21.771 \pm 0.095$
Erucic	$0.261 \pm 0.041$	$0.321 \pm 0.516$	$0 \pm 0$
Eicosatrienoic	$11.383 \pm 0.712$	$0.118 \pm 0.041$	$0.128 \pm 0.013$
Arachidonic	$1.530 \pm 0.257$	0 0	$0.500 \pm 0.011$
Trikosanoat	$0.584 \pm 0.096$	$0.002 \pm 0.002$	$0 \pm 0$
Eicopentanoic	$0.231 \pm 0.037$	$0.004 \pm 0.004$	$0.237 \pm 0.018$
Nervonic	$0.689 \pm 0.151$	$0.037 \pm 0.037$	$0 \pm 0$
Docohexanoic	$0.336 \pm 0.055$	$0.003 \pm 0.003$	$0 \pm 0$
PUFA	25.246	7.285	8.380

Table 1. Fatty Acids Composition of Trevally *(Selaroides* spp), Catfish *(Clarias* sp), and Tuna Fish Oil *(Thunnus* sp)

Furthermore, the omega 3, 6 and 9 of trevally, catfish and tuna fish oil are shown in Table 2. In all of the fishs oil, trevally fish produced omega 3, 6 and 9 of 13.48, 11.77 and 15.50%, respectively. For the later the mixture of travelly and catfish oil were chosen for further research study to increase the accumulation of omega 3, 6 and 9. Gobel revealed in his studies that the mixture of trevally and catfish at ratio 1 : 1, led to the omega 3, 6 and 9, approximately 5.25, 20.61 and 35.52%, respectively<sup>2</sup>.

Table 2. The Composition of omega 3, omega 6 and omega 9 from Trevally *(Selaroides spp)*, Catfish *(Clarias sp)*, and Tuna Fish Oil (*Thunnus sp)* 

Fish oil	Omega 3 (%)	Omega 6 (%)	Omega 9 (%)
Trevally (Selaroides spp)	$13.48 \pm 0.34$	$11.77 \pm 0.72$	$15.50\pm0.48$
Catfish (Clarias sp)	$0.99 \pm 0.17$	$6.29 \pm 0.10$	$34.96 \pm 0.49$
Tuna Fish Oil ( Thunnus sp)	$1.12 \pm 0.03$	$7.25 \pm 0.15$	$19.75 \pm 0.04$

#### Microencapsulation of Fish Oil on the Fatty Acids, Omega 3, 6 and 9 Composition

Results of polyunsaturated (PUFA), monounsaturated (MUFA), and saturated (SFA) fatty acids from microencapsulation of trevally mixed with catfish oil and tuna fish oil are presented in Table 3. The predominant SFA produced by microencapsulation of trevally mixed with catfish oil were palmitic and stearic acid of 41.05 and 13.90% using freeze drying method, respectively. Then a slower rate was noted when spray drying was achieved for microencapsulation method of 40.72 and 12.49%, respectively, whereas palmitic acid of 47.87 and 44.97%, respectively were achieved when tuna fish oil was microencapsulated using freeze drying and spray drying method. Therefore, the spray drying method could effectively be employed as a microencapsulation method and led to higher oleic acid of trevally mixed with catfish oil and tuna fish oil approximately 38.70 and 18.86%, respectively. The highest SFA production was obtained in tuna fish oil using freeze and spray drying microencapsulation method, while the highest MUFA occurred in trevally mixed with catfish oil using spray drying microencapsulation method. Therefore, it is could employed as a microencapsulation method for tuna fish oil since most of fatty acid present are monounsaturated fatty acid (MUFA).

Additionally, spray drying is one of the most commonly used for fish oil microencapsulation and drying technologies because the process is flexible and produces good quality powder. The disadvantage of this technology is the high temperature conditions necessary for drying and access to air<sup>12</sup>. Moreover, parts of the product during drying may adhere to the surface of the capsules, which presents potential for oxidation and changes in the flavor balance of the finished food products.

Otherwise microencapsulation using freeze drying method could effectively led to increase the concentration of PUFA i.e linoleic, linolenic, arachidonic and eikosatrionic acid in trevally mixed with catfish oil and tuna fish oil from undetectable to 1.19% and from 1.65% to 2.29%, respectively. Therefore, drying processes at low temperature such as freeze drying could be an alternative for microencapsulation of fish oil, since it is essential to protect fish oil against oxidation due to the high susceptibility to oxidation of the highly unsaturated PUFA. PUFA plays an important role in human health body and recognized as essential in the diet 13,14,15.

In Figure 1, 21 peaks were detected in trevally fish oil mixed with catfish oil. In comparison with chromatograms obtained using standard, it was found that these oil contained saturated fatty acid (SFA), monounsaturated fatty acid (MUFA) and polyunsaturated fatty acid (PUFA) with the concentrations were found to be 53.74, 32.20 and 1.19%, respectively. Additionally, results showed that PUFA component in these fish oil were linoleic, linolenic, and arachidic and eicosatrionic acids. The results are in good agreement with that reported by Adesola that the fatty acid detected in *Clarias gariepinus* fish oil was MUFA approximately 26%, respectively<sup>10</sup>. Other study also reported that the major component of fatty acid in menheden and salmon fish oil were MUFA and SFA, approximately 24-29% and 21-34%, respectively<sup>15</sup>.

Moreover, the fatty acids compositions in tuna fish oil using freeze drying method are shown in Figure 2. According to Figure 2, total 16 fatty acids compound were identified. It was observed that the major fatty acids produced by tuna fish oil were palmitic acid (47.87%), stearic acid (15.57%) and oleic acid (15.59%). It

was reported that monounsaturated fatty acids (MUFA) were found in rainbow trout fish oil, bream fish oil and tench fish oil of 35.9, 35.8 and 38.3%, respectively<sup>16</sup>. Monounsaturated fatty acids (MUFA) were also present in Malabar Red Snapper fish oil, trevally fish oil and Spain Mackarel at the concentrations of 141.8, 286.8, 70.6 mg/100 g, while for polyunsaturated fatty acids (PUFA) at the concentrations of 724.7, 869.6, and 322.8 mg/100 g, respectively<sup>17</sup>. The differences of fatty acids composition are greatly affected by species, season, and water condition<sup>18</sup>.

	Freeze Drying	Engago Duning Tuno	Spray Drying	Spray Drying		
Fatty Acid	<b>Trevally-Catfish</b>	Freeze Drying Tulla	<b>Trevally-Catfish</b>	Tuna		
-		% Total F				
Caproic	$0.001 \pm 0.004$	0 0	0 0	0 0		
Caprilic	$0.024 \pm 0.013$	0 0	0 0	$0.430 \pm 0.042$		
Capric	$0.008 \pm 0.001$	0 0	0 0	$0 \pm 0$		
Lauric	$0.238 \pm 0.048$	$0.070 \pm 0.001$	0 0	$0.411 \pm 0.194$		
Myristoleic	$0.037 \pm 0.006$	$0.032 \pm 0.006$	0 0	0 0		
Myristic	$4.565 \pm 0.124$	$6.079 \pm 0.182$	$3.958 \pm 0.401$	$6.350 \pm 0.155$		
Pentadecanoic	$1.362 \pm 0.018$	$2.084 \pm 0.069$	0 0	$1.588 \pm 0.063$		
Palmitoleic	$6.238 \pm 0.303$	$6.119 \pm 0.037$	$2.890 \pm 0.084$	$5.874 \pm 0.880$		
Palmitic	$41.052 \pm 0.484$	$47.874 \pm 1.032$	$40.724 \pm 1.065$	$44.972 \pm 1.163$		
Heptadecanoic	$1.836 \pm 0.014$	$2.966 \pm 0.023$	0 0	$2.145 \pm 0.088$		
Oleic	$25.965 \pm 0.711$	$15.585 \pm 0.990$	$38.701 \pm 0.383$	$18.863 \pm 0.870$		
Stearic	$13.900 \pm 0.240$	$15.566 \pm 0.002$	$12.492 \pm 0.451$	$15.475 \pm 0.346$		
Linoleic	$0.032 \pm 0.007$	$0.048 \pm 0.008$	0 0	0 0		
Arachidonic	$1.886 \pm 0.006$	$0.842 \pm 0.233$	$1.242 \pm 0.354$	$0.709 \pm 0.019$		
Linolenic	$0.554 \pm 0.010$	$1.037 \pm 0.006$	0 0	$0.826 \pm 0.031$		
Behenic	$0.021 \pm 0.001$	$0.022 \pm 0.001$	$0.610 \pm 0.030$	$0.012 \pm 0.001$		
Eicosatrienoic	$0.176 \pm 0.001$	$0.422 \pm 0.032$	0 0	$0.317 \pm 0.014$		
Euric	$0.176 \pm 0.001$	0 0	0 0	$2.887 \pm 0.207$		
Arachidonic	$0.429 \pm 0.003$	$0.787 \pm 0.025$	0 0	$0.509 \pm 0.010$		
Lignoceric	$0.165 \pm 0.001$	$0.342 \pm 0.008$	0 0	$0.013 \pm 0.013$		
Nervonic	$0.280 \pm 0.002$	$0.750 \pm 0.002$	0 0	$0.051 \pm 0.051$		
SFA	53.741	75.338	61.306	67.909		
MUFA	32.203	21.704	41.510	24.737		
PUFA	1.191	2.294	0	1.652		

Table 3.	The Com	position	of Fatty	Acids,	Omega 3	, 6 and	9 in T	<b>Frevally</b>	fish	(Selaroides	spp)	mixed	with
Catfish (	Clarias sp)	Oil and	Tuna Fis	h Oil (2	Thunnus	sp) (%	Total	Fatty A	cids)				

Freeze drying is proved to be the best drying process to produce microcapsules, since it contained the highest omega 3 and 6. It is also obvious that omega 3 and 6 in tuna fish oil were considered statistically significant (p<0.01) compared with travelly mixed with catfish oil using freeze drying and spray drying method. Typical fish oil microencapsulation is usually based on the formation of ordinary emulsion in which fish oil droplets are emulsified using combination of matrices and then spray dried ir freeze dried to produce microcapsules. Encapsulated materials are generally used for microencapsulation is sodium caseinate. Sodium caseinate could be employed as encapsulan to produce stable microcapsules<sup>8</sup>. Other also reported that sodium caseinate is a protein-based coating that is able to protect against oxidation reaction, extreme storage conditions, and has a fairly high efficiency of the microcapsules<sup>19,20</sup>.

Moreover, a study reported that the freeze drying method showed the best result for producing encapsulated fish oil in the form of microcapsules<sup>12</sup>. Whereas, the stability of omega 3 in encapsulated fish oil was influenced by the best combination of material and the type of encapsulan drying method in use<sup>21</sup>.



Fig 1. Chromatogram of fatty acids composition in microencapsulation of trevally fish oil mixed with catfish oil using freeze drying method



Fig 2. Chromatogram of fatty acids composition in microencapsulation of tuna fish oil using freeze drying method

### Organoleptic Test Results of Ice Cream that has been Fortified to Various Concentrations of Microcapsules Fish Oil

Organoleptic test results showed that the panelists's favorite average number for fortified ice cream flavor is ranged from 2.73 (25 g / kg) - 3.83 (15 g / kg); to fortified ice cream scents is ranged from 2.43 (25 g / kg) - 2.77 (15 g / kg); on the texture of fortified ice cream ranges from 2.97 (20 g / kg) - 3.20 (15 g / kg). If the number of the average ranking of preferences panel getting higher, means that the panelists preference level of the flavor, aroma and the texture is more preferable. According<sup>9</sup> showed that the fortification microcapsules mixture between trevally and catfish fish oil as much as 15 g / kg into the ice cream can be used to increase the value-added of ice cream and more useful for the consumers's health that showed with Nh index 0.62.

#### The Profile of Fatty Acid Ice Cream that Fortified with Microcapsules contains of Trevally and Catfish Oil

The results of this analysis can be used to determine the changes that occur in the fatty acid composition. The Profile of Polyunsaturated Fatty Acids (PUFAs), Monounsaturated Fatty Acids (MUFA) and Saturated Fatty Acids (SFA) of the ice cream that has been fortified with microcapsules contains of trevally with catfish fish oil are presented in Table 4.

Fatty Acid	Not fortified	ice cream	fortified ice cream			
Caproic	0.380 ±	0.008	0	±	0	
Caprilic	1.016 ±	= 0.103	0	±	0	
Capric	0.014 ±	= 0.003	0.029	±	0.001	
Lauric	2.164 ±	= 0.021	1.742	±	0.029	
Tridecanoic	0	0	0.041	±	0.001	
Myristoleic	0.789 ±	= 0.012	0.030	±	0.001	
Myristic	10.159 ±	= 0.133	3.941	±	0.050	
Pentadecanoic	1.214 ±	= 0.016	1.009	±	0.012	
Palmitoleic	1.295 ±	1.116	4.633	±	0.077	
Palmitic	36.293 ±	0.443	26.466	±	0.307	
Heptadecanoic	0.687 ±	0.009	1.332	±	0.015	
Oleic	27.228 ±	1.055	33,799	±	0.382	
Stearic	17.182 ±	0.186	9.660	±	0,111	
Linoleic	0.633 ±	0.019	0.153	±	0.002	
Arachidonic	0.251 ±	0.008	1.511	±	0.021	
Linolenic	0.189 ±	0.059	1.164	±	0.016	
Behenic	$0.020 \pm$	0.001	0		0	
Erucic	0.015 ±	0.001	10.546	±	0.122	
Eicosatrienoic	0.034 ±	0.002	1.620	±	0.017	
Arachidonic	$0.077 \pm$	0.001	0.313	±	0.003	
Lignoceric	0.030 ±	0.001	0	±	0	
Eikopentanoic	0	0	0.090	±	0.001	
Nervonic	0.032 ±	0.024	0.223	±	0.003	
Docohexanoic	0	0	0.007	±	0.001	
SFA	65	46.21				
MUFA	28 52 38.43					
PUFA	0.93	33	3.347			

Table 4. The profile of fatty acids of fortified ice cream (15 g / kg) with microcapsules mixture between trevally and catfish fish oil (% Total fatty acids)

The data in table 4 explained that the ice cream that has been fortified with microcapsules mixture between trevally and catfish fish oil, is dominated by Saturated Fatty Acids (SFA), Monounsaturated Fatty Acids (MUFA) and Polyunsaturated Fatty Acids (PUFAs). After it has been fortified, the Saturated Fatty Acids (SFA) concentration decreased. On the other hand, MUFA and PUFA concentration was increasing. Therefore, from the aspect of health, fortified ice cream using microcapsules mixture between trevally and catfish fish oil, could be consider to give good influence and potential as a functional ice cream. It was reported that reduce the amount of some specific saturated fatty acids, especially myristic acid (C14: 0) and palmitic acid (C16: 0) might be increasing the amount of oleic acid vasenat acid and rumenat acid is a particular target, which could improves the long-term health for consumers<sup>22</sup>.

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