Characteristics of Softgel Capsules Mixture of Patin Oil, Red Palm Oil, and Shark Liver Oil

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Abstract. Fish oil is a source of unsaturated fatty acids, especially the content of omega-3 fatty acids, omega-6 and omega-9. Freshwater fish oil omega-3 content is relatively low, but the high content of omega-9, is one of those derived from patin oil. Sea fish oil has a relatively high content of omega-3 fatty acids, one of which comes from shark liver. Oil is not only comes from fish but also from plants. One of the vegetable oils from palm oil that is beneficial for health is red palm oil which has a relatively high carotenoid content which is a source of vitamin A. These three types of oil have excess and deficiencies in the composition of fatty acids, so they can be combined to improve their functional properties in the form of softgel capsule. The mixture of these three oils in the form of capsule softgel is functional food. The research method of mixing the three oils with a certain ratio of F1 (45 patin oil, 25 red palm oil, and 30 shark liver oil), F2 (45 patin oil:30 red palm oil:25 shark liver oil), and F2 (45 patin oil:35 red palm oil:20 shark liver oil) was analyzed the composition of fatty acids. The selected F1 formulation is used as a softgel capsule. The analysis results show that the quality characteristics of the three oils are in accordance with IFOS standards (peroxide number and free fatty acids). The composition of softgel fatty acids produced with F1 formula, produced omega-3 (0.47%), Omega-6 (32.87%), and omega-9 (26.97%), Besides the high omega-3,6 and 9 content, the saturated fatty acid content is also low.

Keyword: carotenoid, fatty acid, omega-3, omega-6, omega-9

1. Introduction

Fish oil is rich in unsaturated fatty acid, especially docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA). Fatty acids play a role in preventing diseases including cardiovascular, diabetes, depression, skin problems and improve general health. At present the public is aware of the importance of consumption of fish oil containing omega-3 so that the demand for fish oil for food and pharmaceutical industry needs. The composition of patin oil contains low omega-3, to prevent deficiency of omega-3 fatty acids it is necessary to fortify with oils that are rich in omega 3.

Fish oil from freshwater has a lack of omega-3 and is rich in omega-9, while marine fish oil is rich in omega-3. Fish oil is easily oxidized, to prevent the oxidation process needed antioxidants. One source of natural antioxidants is red palm oil (MSM) also a source of vitamin A.

Red Palm Oil (MSM) is the result of processing oil from Crude palm oil (CPO) without bleaching and
deodorization because minor components such as carotenoids will be absorbed by bleaching earth and damaged by high temperatures (260 - 280 °C) and low vacuum pressure in the deodorization process (3). Red palm oil is without going through the process aims to keep the content of carotenoid. Red palm oil can be used as functional food, because red palm oil acts as a carrier for provitamin A and vitamin E for consumers (6) MSM carotene content is ranges from 524-542 mg / kg (20; 10), dominated by beta-carotene which in vivo can be converted into two vitamin A molecules (11).

Raising public awareness of the importance of natural resource utilization for health prevention. the results of research on fish oil from both freshwater fish and sea fish have been carried out. The results of these research including the characterization and modification of fish oil purification processes according to the standards have been widely reported among others fish oil from swangi fish (13); sardines (14), (7), (); Cone Fish (16); to processing byproducts (19; 17; 18; 4).

Research single of fish oil have been carried out, while the combination of freshwater and marine fish oil and red palm oil are still rare. Based on research that has been carried out before, it is necessary to do research on the characteristics of a mixture of patin oil, shark liver oil and red palm oil as one source of functional food and pharmaceutical. This research aims to determine the characteristics softgel of mixtures (red palm oil, oil patin and shark liver oil) by comparison mixing by sharing comparison formulations.

2.Materials and Method

2.1.Materials

The main ingredients were used consist of patin oil as a by-product of smoked fish processing in the form of abdomen fat which is extracted by dry rendering, red palm oil and commercial shark liver oil (Purchased at the Herbal Shop, Surakarta, Central Java). The chemicals used are glacial acetic acid, chloroform, saturated KI, NaS2O3, isooktan, n-hexane, aluminum foil, methylene chloride, nitrogen gas, and distillate water. The equipment used is a tool for oil extraction patin, tools for analysis such as glassware, gas chromatography, centrifugation, homogenizer and other equipment.

2.2. Methods

This research is an experiment by extracting fish oil, by rendering dry crude coarse fish oil is produced and then purified, red palm oil is made directly from CPO and commercial shark liver oil. The treatments used are mixing three different oil is then used in the form of softgel capsules performed comparison is presented in Table 1

| Raw material     | Composition (%) |
|------------------|-----------------|
| Red palm oil     | F1  | F2  | F3  |
| Fish oil         |     | 45  | 45  | 45  |
| Shark liver oil  | 30  | 25  | 20  |

The study consisted of several stages, namely extraction of patin oil, the process of making red palm oil. Analysis of the fisyc-chemical composition of patin oil, red palm oil and shark liver. Mixing patin oil, shark fish and red palm oil is then made into a soft gel capsule.

2.2.1. Patin Fish Oil Extraction. Extraction of patin oil using the Damongilala method (8). The abdominal fat of patin is washed using a blender, then weighed and put in a container and heated in an oven at 65 °C for 7 hours. The extracted oil is filtered and put in a dark glass bottle and stored in the refrigerator.
2.2.2. Purification of Patin Fish oils. The crude fish oil purification procedure was carried out based on Sari et al. (19). Crude patin oil weighed 100 g and put into Erlenmeyer tubes for degumming, by the way fish oil is heated at 65°C for one minute then the oil is added with 3 mL of 3% citric acid solution and heated at 65°C while stirring and allowed to stand at temperature room.

The degumming oil is neutralized by adding 9.5% NaOH solution by 50% of the sample weight and heated at 65°C for 20 minutes while stirring. d oil is allowed to stand at room temperature. The neutral oil is bleached by adding bentonite 1; 4; and 7% of the sample weight, heated at 65°C for 20 minutes while stirring, then filtered using a vacuum filter, obtained pure oil.

2.2.3. Analysis. The analysis of patin oil, red plam oils, and shark liver oil are free fatty acid numbers and peroxide (2; 1), and fatty acid composition (1).

2.2.4. Statistical analysis

3. Result and Discussion

3.1. Characteristic Physicochemical of fish patin oil, red palm oil, and shark liver

a. Fish Patin oil

Patin fish oil is the result of extraction from the abdominal fat processed by smoked fish. Fish oil is extracted by dry rendering produced crude oil. The sensory characteristics of crude patin have a dark yellow color, rather thick and fishy smell. purification is done resulting in pure fish oil with bright yellow physical characteristics and reduced fishy odor. The chemical characteristics of fish oil are presented in Table 2.

Table 2. Characteristic chemical of Patin fish oil

| Composition         | Crude oil | Refinned oil | Satuan | IFOS (2011) |
|---------------------|-----------|--------------|--------|-------------|
| Free fatty acid     | 0.30      | 0.12         | mgKOH/g| ≤ 2         |
| Acid number         | 1.26      | 0.06         | mgKOH/g| ≤ 1.5       |
| Peroxide value      | 4.62      | 3.86         | mEq/kg | ≤ 3.75      |
| Iodine number       | 23.35     | 6.85         | g/100 g|             |

Table 2, the crude and refined fish oil peroxide numbers are 1.26 and 0.06%. Purification of fish oil can reduce the peroxide number and free fatty acids. Refining oils and crude oil peroxide levels are below the IFOS standard, so these oils are suitable as food grade. Refining patin oil has a free fatty acid value of 0.06, which shows that the oil was produced is in accordance with the International Fish Oil Standard / IFOS (15) which is equal to 1. 50%. Purified patin oil peroxide number of 3.86 meq / kg, is in accordance with the requirements of the Indonesian pharmacopoeia standard for food grade fish oil (15) which is less than or equal to 5 meq / kg

b. Characteristics of red palm oil

Red palm oil is obtained from the extraction of crude palm oil (CPO) derived from palm oil mill (MCC) PTPN V Galuh River. CPO oil extraction into red palm oil is carried out in the Kampar Polytechnic laboratory. The yield of red palm oil produced is 30%. The processing of MSM have been conducted, including degumming, deasidifikasi, deodorization, and fractionation. Degumming and deasidifikasi MSM conducted following a pilot plant scale Widarta method (20). Red palm oil is produced further characterized physico-chemical properties.
Table 3. Characteristic of Reda palm oil and palm oil

| Parameter                              | Plam oil     | Red palm oil          |
|----------------------------------------|--------------|-----------------------|
| Carotenoid Total (ppm)                 | 573.88±1.80  | 556.93±0.24           |
| Tocopherol Total tokoferol (ppm)       | 1174,1925±29.58 | 935,8475±22.5        |
| Chlorofil total (ppm)                  | 10.01±0.05   | 4.36±0.03             |
| F enolik fenolik (ppm)                 | 40.21±0.03   | 23.38±0.01            |
| Free fatty acid (%)                    | 3.61±0.07    | 0.13±0.00             |
| Peroxsida Number (%)                   | 1.21±0.00    | 0.81±0.00             |

Tabel 3, MSM carotenoid levels are 556.93 ppm and act as vitamins, A, free fatty acids and peroxide numbers of 0.13 and 0.81%. Besides containing carotenoids MSM also contains tocopherol, chlorophyll, and phenolic. The results of the analysis of the composition of fatty acids by gas chromatography showed that the composition of MSM fatty acids was dominated by saturated fatty acids, mainly palmitic acid (35.62%), with total saturated fatty acids 44.37%. monounsaturated fat content of 43.47%, and polyunsaturated fatty acids of 11.44%. The composition of MSM fatty acids is presented in Table 4.

Table 4. The fatty acid composition of red palm oil.

| Fatty acid                      | Content (%) | MSM  |
|---------------------------------|-------------|------|
| C10:0 (Kaproic acid)            | 0.02        |      |
| C12:0 (lauric acid)             | 0.26        |      |
| C14:0 (myristit acid)           | 0.92        |      |
| C15:0 (pentadeconoit acid)      | 0.04        |      |
| C16:0 (palmitic acid)           | 35.62       |      |
| C18:0 (stearic acid)            | 3.90        |      |
| C20:0 (arachidic acid)          | 0.35        |      |
| C22:0 (behenic acid)            | 0.06        |      |
| C24:0 (lignocerid acid)         | 0.07        |      |
| **Saturated fatty acid (SAFA)** | 44.37       |      |
| C16:1 (palmitoleate acid)       | 0.18        |      |
| C17:1 (Cis-10-heptadecanoic acid)| 0.03     |      |
| C18:1 (oleic acid)              | 40.33       |      |
| C20:1 (eicosanoic acid)         | 0.15        |      |
| **Monounsaturated fatty acid,MUFA** | 43.47   |      |
| C18:2 (linolenic acid)          | 11.00       |      |
| C18:3 (linolenic acid)          | 0.39        |      |
| C20:2 (eikoseidienic acid)      | 0.05        |      |
| **Polyunsaturated fatty acid (PUFA)** | 11.44    |      |
| **Total fatty acids identified** | 99.28       |      |

c. Shark liver oil

The characteristics of shark liver oil have numbers of peroxide and free fatty acids of 1.54 and 0.31%. Peroxide numbers and free fatty acids in hu fish liver oil are in accordance with
pharmokopeae standards as food ingredients. The composition of fatty acids in shark liver oil is dominated by unsaturated fatty acids (63.81%) and low saturated fat asm (24.58%), and omega-3 content of 3.57% (Diharni et al, 2019).

The fatty acid profile of a mixture of patin oil, red palm oil and shark liver oil. Patin oil, red palm oil, and patin oil have different fatty acid characteristics. The results of the analysis show that a mixture of the three different oils of the formula is presented in Table 5.

Table 5. The fatty acid composition of mixture of patin fish oils, red palm oils and shark liver oil.

| Fatty acid                          | Composition |
|-------------------------------------|-------------|
|          | F1   | F2   | F3   |
| C12:0 (lauric acid)                 | 0.05 | 0.08 | 0.07 |
| C14:0 (myristic acid)               | 0.48 | 1.22 | 0.75 |
| C15:0 (pentadecanoit acid)          | 0.03 | 0.07 | 0.05 |
| C16:0 (palmitic acid)               | 16.13| 22.03| 18.76|
| C18:0 (stearic acid)                | 2.70 | 3.65 | 3.22 |
| C20:0 (arachidic acid)              | 0.22 | 0.27 | 0.27 |
| C22:0 (behenic acid)                | 0.16 | 0.12 | 0.16 |
| C23:0 (tricosanoic acid)            | 0.02 | 0.02 | 0.03 |
| C24:0 (lignocerid acid)             | 0.06 | 0.06 | 0.06 |
| **Saturated fatty acid (SAFA)**     | **19.85** | **27.49** | **23.37** |
| C14:1 (mristoleic acid)             | -    | -    | -    |
| C16:1 (palmitoleate acid)           | 0.22 | 0.41 | 0.31 |
| C17:1 (cis-10-heptadecanoic acid)   | -    | -    | -    |
| C18:1 (oleic acid)                  | 26.97| 32.71| 30.76|
| C24:1 (nervonic acid)               | 0.02 | 0.04 | 0.02 |
| **Monounsaturated fatty acid, MUFA**| **27.21** | **33.31** | **31.09** |
| C18:1 (elaidic acid)                | 0.08 | 0.1  | 0.09 |
| C18:2 (linolenic acid)              | 32.79| 31.84| 24.97|
| C18:3 (linolenic acid)              | 0.19 | 0.23 | 0.30 |
| C18:3 (gama-linolenic acid)         | 0.18 | 0.22 | 0.11 |
| C20:2 (eikoseidienic acid)          | 0.05 | 0.13 | 0.18 |
| C20:4 (arachidonic acid)            | 0.03 | 0.06 | 0.10 |
| C20:5 cis-5,8,11,14,17-eicosapentaenoic acid | 0.08 | 0.09 | 0.11 |
| C22:2 cis-4,7,10,13,16,19-docosahexaenoic acid | -    | -    | -    |
| C22:6 (docosahexaenoic acid)        | 0.10 | 0.13 | 0.19 |
| **Polyunsaturated fatty acids, PUFA**| **33.51** | **32.80** | **25.86** |
| **Omega-3**                         | **0.47** | **0.45** | **0.41** |
| **Omega-6**                         | **32.87** | **31.97** | **31.08** |
| **Omega-9**                         | **26.97** | **30.86** | **32.80** |
| **Total fatty acids identified**    | **83.71** | **90.06** | **88.62** |

Table 5. The third mixture of different oil formulations was showed that the formula F1, have be a less saturated fatty acids (27%) than the F2 and F3 (27.49 and 23:32%). Fatty acid content was monounsaturated fatty acids and double (MUFA and PUFA) The highest was F1 (27.21 and 33.51%)
of F2 and F3.). The content of saturated fatty acid (SAFA) in formulation oils (F1, F2 and F3) was detected 9 types, mono unsaturated fatty acid (MUFA) 6 types, and poly unsaturated fatty acid (PUFA) 10 types. The most saturated fatty acid (SAFA) type in all formulations was palmitate while in MUFA type was oleate and PUFA type was linoleic.

The highest levels of omega 3, omega 6 and omega 6 are also found in F1 oil mixture formulations. The oil mixture in the F1 formula is then made into a softgel capsule. The characteristics of each patin oil, red palm oil and shark liver oil and a mixture of the three oils are presented in Figure 3. The characteristics of each oil have a different color. Patin oil is bright yellow, orange red red palm oil, and packaged yellow shark liver oil

![Image of patin fish oil, red palm oil, and shark liver oil]

*Figure 1. a. Patin Fish oil, b. Red plam oil, and c. Shark liver oil*

The third mixture of F1 formulation oil is made in the form of capsule softgel, the third mixture of oil and the resulting capsules softgel is presented in Figure 2. Softgel was produced in the form of soft capsules contains omega-3 fatty acids, omega-6 and omega 9, which are needed by humans as a functional food source. The resulting softgel is also low in saturated fatty acid content (Table 7)

![Image of softgel capsules]

*Figure 2. a. The mixtire of patin fish oil, red plam oil, and shark liver oil  b. Softgel capsule.*

**Conclusion**

Patin fish oil, red palm oil and shark liver oil used have different characteristics, especially fatty acid composition and sensory characteristics, especially color. The quality characteristics of the three oils are according to IFOS standards and as food grade. The composition of the three fatty acids were varies, the highest is content of saturated fatty acids in red palm oil followed by patin oil. Shark liver oil contains the highest is omega-3, red palm oil contains carotenoids (Vitamin A). The third mixture of oil was produced low saturated fatty acids, high unsaturated fatty acids. Softgel was produced from a mixture of fish oil, red palm oil and shark liver oil with formulations (25 parts red palm oil, 45 parts fish oil, and 30 parts shark liver oil) have low saturated fatty acid content (19.85%), acid unsaturated fat (27.21 % MUFA and 35.51 % PUFA.) containing omega-3 (.0.47%), omega 6 (32.87%) and omega-9 (26.97%). The recommendations are for further research into the analysis of carotenoid content and shelf life of softgel.
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