Nutrient content and endemic red fruit oil (*Pandanus austrosinensis*) fatty acid profile in Papua Indonesia

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Abstract. Pandanaceae clan red fruit of the in Papua and West Papua provinces, there are as many as 600 to 700 species. The research location was in the village of Bowi Subur (Settlement Unit VI/SP VI) Masni District Manokwari Regency. This study aims to determine the nutritional content and fatty acid profile found in the Menja cultivar red fruit oil (*Pandanus austrosinensis*), Edewewits and Mengkin. The nutritional levels of *Pandanus austrosinensis*, Edewewits, and Mengkin are as follows: the protein is the same at 0.04%, the highest fat in the Menja cultivar (*Pandanus austrosinensis*) is 99.35%; Mengkin cultivars 98.46%; and Edewewits 98.06%. Consecutive water levels of the Menja cultivars (*Pandanus austrosinensis*) by 0.71%, Edewewits by 0.46%, and Mengkin by 0.40%. The successive values of the Edewewits cultivar were 4.95 milliequivalents/1000 g, *Pandanus austrosinensis* were 4.91 mEq/kg, and the Mengkin cultivar was 2.96 milliequivalents/1000 g. The dominant fatty acid content; Menja cultivars (*Pandanus austrosinensis*): oleic acid 70.55%, palmitic acid 10.45%; Edewewits cultivar: oleic acid 72.00%; Mengkin buttvar: oleic acid 63.76% and palmitic acid 16.56%.

1. Introduction

The red fruit of the Pandanaceae clan is an endemic crop and agricultural commodity in the Land of Papua (Papua and West Papua) that has the potential to be developed on a large scale because it has high economic value. Pandanaceae red fruit extraction results in the form of oil called red fruit oil (MBM). It has the potential to be used as a local raw material for making fish feed (pellets). Pandanaceae red fruit oil is beneficial for human health because it contains nutrients such as protein, minerals (calcium), carotenoids (β carotene), tocopherol, omega-3 (eicosapentaenoic acid/EPA, C20: 5ω-3) and docosahexaenoic acid/DHA, C22: 6ω-3) and omega 9: docosatrienoic acid (C22: 3ω-9). In *Pandanus*
conoidesus. The highest content of fatty acids: oleic acid 69.0%, palmitic acid 19.2%, linoleic acid 7.8% and the lowest: myristic acid, palmitoleic acid, stearic acid, linolenic acid and eicosanoic acid [1].

The purpose of this study was to determine the nutritional content and fatty acid profile contained in Menja (Pandanus austrostinensis) red fruit oil, Edewewits and Mengkin. The location for taking the red fruit is Bowi Subur village (Settlement Unit VI/SP VI) Masni District, Manokwari Regency, West Papua. The area of Bowi Subur village is 42.64 km² or 2.99% of the area of Manokwari Regency. Masni District boundaries; the west is bordered by the Sidey District; North: Pacific Ocean; East: Prafi District; South: Testega District, Arfak Mountains Regency. Distance from the capital of the Masni District to the capital of Manokwari Regency 70 km [2].

Masni District is an alluvial lowland partly in the form of temporary swamps with flat slopes, valley areas, watershed with heights from 20 to 32 meters above sea level (asl). The river in the Masni District is Wariori River which is 96 km long. Dominant inceptisol soil. Consisting of 32 villages, seven villages that are coastal villages along the North coast of Manokwari Regency. The area of Masni District is 1,406.10 km² [3].

2. Methods

2.1. Sampling methods
The research sample of Pandanaceae red fruit was collected from the forest around Bowi Subur Village, Unit 6 Settlement Unit (SP 6) Masni and Experimental Gardens of the University of Papua, Manokwari Regency, West Papua Province. The location of the research location (Bowi Subur Village) is shown in Figure 1 below. The analysis was carried out at the Laboratory of Quality Testing and Food Safety of the Department of Agricultural Product Technology, Faculty of Agricultural Engineering, Malang University and PT Gelora Djaya Surabaya, East Java. Research sampling location map is as shown in Figure 1.
2.2. Analysis methods

The method of analyzing the nutrient content of Menja cultivars (*Pandanus austrosinensis*), Edewewits and Mengkin oil as follows: methods used for water content: Toluene, ash content: Gravimetry, fat content: Soxhlet extraction, protein content: Kjedhal, crude fiber: Gravimetry, Peroxide value: Volumetry, free fatty acids (FFA): Volumetry, calcium (Ca), iron (Fe) and sodium (Na): Atomic Absorbens Spectrophotometry (AAS). Red fruit oil fatty acid analysis method from the three cultivars uses Gas Chromatography - Spectrophotometry mass (GC - MS).

3. Result and Discussions

3.1. Species Identity

The result of this research identification refers to the long red fruit or its local name Menja was annual plant, aged 10 years, three to four months of harvest age, growing in groups with a density of 12-30 individuals per family. Plant height of 2 to 4 meters. Blunt-shaped three-siga fruit, the weight of whole fruit (*chepallum*) an average of 6.72 kg, the average fruit length is 57.30 cm, the average tip diameter of the fruit is 43.50 cm, the average diameter of the fruit is 41.20 cm, the weight of pulp and seeds on average 2.36 kg, pulp and seeds are called grains (*drupa*), and the weight of seeds (without pulp) an average of 2.10 kg. The average weight of the pith (*pedicel*) was 3.34 kg and the yield were 0.89%.

Morphology of the Red Fruit Menja cultivar plant, (A) in the garden near the house (area of 0.5 ha), (B) in the garden (area of 2 ha), (C) in the yard of the house (area of 346 square meters).

The long red fruit cultivar, by the Dani, is called Sait while the three large Arfak tribes in Manokwari call it Mongka memyeri (*Meyah tribe*), Ubmera goije (*Sough tribe*), and Hiba menaurena (*Hattam tribe*). *P. Austrosinensis* is grouped into groups of trees. The height of the tree is eight to 15 meters and the trunk diameter of 15 cm to 30 cm. The height of the first branch is five to eight meters above ground level. The length of the supporting roots is two meters up to 3.7 meters and the diameter of the roots is six inches up to 6.25 cm. Leaf length measures 88 cm to 102 cm and leaf width ranges from 5.7 cm to 9.5 cm. The tip of the leaf is tapered with a gnarled base, the edge of the thorny leaf is 1 mm long, and the main leaf bone is on the underside of the thorny leaf. Light brown stems. The length of the fruit stalk (*sinkarp*) is 7 cm to 17 cm, cylindrical in shape, the tip of the fruit (*sinkarp*) is blunt, and the base is hanging. *Sinkarp* length at 96 - 102 cm, diameter of 14.50 - 20.50 cm. The fruit (*sinkarp*) leaf protector is pointe with the main leaf bone spiked 8 to 10 parts from the tip. Fruit is easily brick red, after ripe it turns bright red. Fruit length 11-13.5 cm, width 4-6 cm, and thickness of 1.5 - 3 mm. Epicarp is square and the top of the shell which is tapered. Light brown stems [4].

Some long red fruit cultivars with long fruit size; among others others, the Mbarugum cultivar, the length of fruit 58-62 cm; Hibcau, fruit length 43-74 cm; Himbiak, fruit length 72-80 cm; Hityom, fruit length 61 - 79 cm; Monsrus, the length of the fruit is 50-62 cm; mameri, fruit length 54-65 cm; and Edewewits, fruit length 71-80 cm [5] (Picture of the long red fruit of the Menja cultivar (*P. austrosinensis*), as seen in Figure 2.

![Photo: Albert W. A. Renyaan (2016)](image)

**Figure 2.** Menja cultivar long red fruit
3.2. Nutrient content of Menja cultivars (Pandanus austrosinensis), Edewewits and Mengkin

The results of the analysis of the nutritional content of the Menja cultivar (Pandanus austrosinensis) red fruit oil, can be seen at Table 1.

**Table 1.** Analysis of the nutritional content of red fruit oil from Menja (pandanus austrosinensis), Edewewits, and Mengkin cultivars

| Parameters (%)       | Pandanus austrosinensis | Edewewits | Mengkin | Testing Method       |
|----------------------|--------------------------|-----------|---------|----------------------|
| Water                | 0.71                     | 0.46      | 0.40    | Toluene              |
| Ash                  | 0.18                     | 0.01      | 0.01    | Gravimetry           |
| Fat                  | 99.35                    | 98.06     | 98.46   | Sokhlet Extraction   |
| Protein              | 0.04                     | 0.04      | 0.04    | Kjedahl              |
| Crude Fiber          | Not Detected             | Not Detected | Not Detected | Gravimetry |
| Peroxide (mEq/kg)    | 4.91                     | 4.95      | 2.96    | Volumetry            |
| FFA                  | 33.04                    | 33.65     | 36.65   | Volumetry            |
| Ca (ppm)             | 57.86                    | 7.04      | 6.22    | AAS                  |
| Fe (ppm)             | 3.22                     | 1.54      | 1.58    | AAS                  |
| Sodium/ Na (ppm)     | 5.73                     | 4.31      | 4.70    | AAS                  |
| Total Carotene (µg/g)| 8223.15                  | 6888.35   | 6447.90 | Spectrophotometry    |

The protein content in the Menja cultivars (P. austrosinensis), Edewewits, and Mengkin were equal and the fat did not any differences. The highest water occurred in the Menja cultivar (P. austrosinensis) at 0.71%. The water content in oil is one of the parameters determining oil quality. The higher the water content in oil, the lower the oil quality because water is one of the catalysts for the hydrolysis reaction of the oil so that it produces free fatty acids. The water content in this study was categorized as low. When compared with rice bran oil content 0.87 ± 0.06% to 0.91 ± 0.02% [6]. The maximum water content in oil is 20% [7]. This shows that the three oils have a low water content means that the quality is very good. Furthermore, Peroxide in Menja and Edewewits had a value two times higher than Mengkin. Peroxide value testing in oil aims to see the amount of hydroperoxide content, the greater the value of peroxide indicates that the oil is damaged [8] and the value is the main parameter that influences the quality of fish oil [9], which means it will also affect the quality of vegetable oil.

The increase in the value of peroxide is an indicator and a warning that oil will soon become rancid that has been damaged [10]. Strong taste occurs in oil whose peroxide number is one to two meq O2/kg even in other oils will occur when the peroxide number is 100 meq O2/meg/kg [11]. [7] also says that the peroxide value in oil is 5 meq O2/kg. Compared to the peroxide value of Menja cultivar red fruit oil (P. austrosinensis) research results, proving that there is no real difference. This revealed the quality of Menja cultivar red oil (P. austrosinensis) is still very good, meaning that there hasn't been any rancidity yet. The FFA content in the Mengkin cultivars was 3% higher than others. When compared with the levels of palm oil that FFA levels which are less than 1% [8].

The levels of calcium (Ca), iron (Fe) and sodium (Na) in this study in Menja cultivar have a greater value. Calcium (Ca) and sodium (Na) are macro minerals needed by fish, both freshwater fish and seawater but in small amounts. Similarly, the need for micro minerals such as iron (Fe). The need for calcium (Ca) in some types of freshwater fish such as catfish (Clarias batrachus) 0.45%, Tilapia (Oreochromis spp) 0.70%, carp (Cyprinus carpio) 0.34%, eels (Anguilla anguilla) 0.34% and red sea bream (Colossosoma macropomum) 0.34% [12]. Some studies say that the administration of sodium chloride (NaCl) of 1 to 4% has not shown an increase in body weight and optimal use of feed for some freshwater fish [12]. Also, freshwater fish needs for micro minerals namely iron (Fe) are different in number such as the need for catfish (Clarias batrachus) at 30 mg/kg of feed, Atlantic salmon at 60 mg/kg of feed and eel (Anguilla anguilla) at 170 mg/kg feed [12]. If seen from the needs of freshwater...
fish for the minerals mentioned above, it can be said that to meet these needs can be obtained from the red fruit oil of the three cultivars as a source of minerals both macro minerals and micro minerals.

Total carotenoids in the Menja cultivar (*Pandanus austrosinensis*) were 75% higher than others. Carotene (α-carotene and β-carotene) or astaxanthin are the main ingredients of carotenoids as forming red pigment in fish and shrimp. Red fruit (*Pandanus conoideus* Lam.) contains carotene compounds at 12,000 mg/L, β-carotene at 700 mg/L, and tocopherol at 11,000 mg/L [13]. Total carotene in red fruit extract was 265.55 ppm and β-carotene were 102.71 ppm [14], β-carotene 123 to 4583 ppm [15], [16]. So that the oil from the three red fruit cultivars can be used as a source of carotenoids for GIFT tilapia and other freshwater fish. However, crude fiber levels were not detected in this study. Based on these descriptions, it can be said that the red fruit oil can be used as a fortification ingredient in the manufacture of fish feed, especially GIFT tilapia (*Oreochromis niloticus* Bleeker) and as a source of nutrients and minerals for fish growth tilapia GIFT (*O. niloticus* Bleeker) or other freshwater fish.

Characterization of saturated fatty acids and unsaturated fatty acids aims to determine the types and how much content of saturated fatty acids and unsaturated fatty acids contained in three different red fruit. The source of fat used for the needs of tilapia is usually derived from vegetable oil because it contains essential fatty acids such as linoleic acid (C18: 2ω-6) or omega-6 [17], [18]. Based on the identification carried out using GC-MS, a saturated fatty acid chromatogram (ALJ) and unsaturated fatty acids (essential fatty acids, ALE) MBM cultivars (*P. austrosinensis*), Edewewits and Mengkin which peak point show high intensity and retention time highest, as shown in Figure 3; 4 and 5.

The chitogram of Menja's cultivar red fruit oil (*P. austrosinensis*) in Figure 3, showed the fatty acid components identified with high intensity peaks as follows: (1) Lauric acid/Dodecanoic acid with a retention time of 11,906 minutes. (2) Myristic acid (Pentadecanoic acid).14-methyl-, methyl ester with a retention time of 18,227 minutes. (3) Palmitic acid or Palmitoleic acid (n-Hexadecanoic acid) with a retention time of 19,039; all of them are saturated fatty acids (SFA) and (4) oleic acid or omega-9 with retention time 24.308 minutes higher are unsaturated fatty acids (UFA) or essential fatty acids (EFA). The results are shown in table 2.

Table 2 showed the fatty acid content in Menja cultivars when compared with palm kernel oil containing lauric acid and myristic acid (Pentadecanoic acid) which ranged between 46-52% and 14-17% [8] can be said to be low. On the other hand, the content of palmitic acid (Hexadecanoic acid) and oleic acid of palm kernel oil is lower, ranging between 6.5 - 9.0 and 13.0 -19.0% [8] of the red fruit oil of Menja cultivars that is 10.45 and 70.55%. Also, when compared with the content of palmitic acid
(Hexadecanoic acid) and oleic acid in Pandanus conoideus Lamarck red fruit oils, respectively 0.6-1.36% and 37-79% [19], [20], [21] then palmitic acid (Hexadecanoic acid) and oleic acid in Menja cultivar red fruit oil are still good because the levels are 10.45 and 70.55%. When compared with the content of oleic acid 58% [22] and 31.83% [23] in Pandanus conoideus Lamarck red fruit oil, oleic acid in fruit oil red cultivar of Menja (Pandanus austrosinensis) by 70.55% better.

Table 2. Profile of saturated fatty acids and unsaturated fatty acids Menja cultivar red fruit oil

| No. | Compound Name                               | Molecular Formula | Retention Time (menit) | Area (%) | Relative content (%) | Similarity of Instrument/Quality min 85 (%) | Usability   |
|-----|--------------------------------------------|-------------------|------------------------|----------|----------------------|--------------------------------------------|-------------|
| 1   | Dodecanoic acid                             | C₁₂H₂₄O₂          | 11.906                 | 0.04     | 0.04                 | 91                                         | antioxidant|
| 2   | Pentadecanoic acid                          | C₁₅H₃₀O₂          | 15.581                 | 0.04     | 0.04                 | 89                                         | antioxidant|
| 3   | (n-Hexadecanoic acid/ Palmitoleic acid)     | C₁₆H₃₂O₂          | 19.039                 | 10.45    | 10.45                | 95                                         | antioxidant|
| 4   | Oleic acid                                 | C₁₈H₃₄O₂          | 24.308                 | 70.55    | 70.55                | 94                                         | antioxidant|

Edewewits cultivar red fruit oil chromatogram by GC-MS test can be seen in Figure 4. This chromatogram showed the fatty acid components identified with high intensity peak as follows: (1) Palmitic acid or Palmitoleic acid (n-Hexadecanoic acid) with retention time 19.010; (2) Oxacyclohexadecan-2-one with a retention time of 18.547. Both are saturated fatty acids (SFA).

Figure 4. Edewewits cultivar red fruit oil chromatogram

The results of profile of saturated fatty acids and unsaturated fatty acids Edewewits cultivar red fruit oil are shown in Table 3.
### Table 3. Profile of saturated fatty acids and unsaturated fatty acids Edewewits cultivar red fruit oil.

| No. | Peak | Compound Name                                      | Molecular formula | Retention Time (min) | Area (%) Relative content | Similarity of Instrument/Quality min 85 (%) | Usability     |
|-----|------|---------------------------------------------------|-------------------|-----------------------|---------------------------|--------------------------------------------|---------------|
| 1   | 1    | Oxacyclohexadecan-2-one acid                      | C_{16}H_{30}O_{2} | 18.547                | 1.78                      | 91                                         | antioxidant   |
| 2   | 2    | (n-Hexadecanoic acid/Palmitoleic acid)            | C_{16}H_{32}O_{2} | 19.010                | 72.00                     | 98                                         | antioxidant   |

Table 3 showed fatty acid content in Edewewits Cultivation: Acid Oxacyclohexadecan-2 was 1.78% and palmitic acid (Hexadecanoic acid) was 72.00%. When compared with palmitic acid (Hexadecanoic acid) content of palm kernel oil which is lower, ranging from 6.5 - 9.0 [8], the results of this study are 70.55%. Therefore, it is suitable for consumption and as a source of palmitic acid (Hexadecanoic acid).

![Figure 5. Mengkin cultivar red fruit oil chromatogram](image)

The Mengkin cultivar red fruit oil chromatogram in Figure 5, shows the fatty acid components identified with high intensity peaks as follows: (1) Palmitic acid or Palmitoleic acid (n-Hexadecanoic acid/Palmitoleic acid) with a retention time of 18.982; (2) oleic acid with a retention time of 14.924. Palmitic acid or Palmitoleic acid (n-Hexadecanoic acid/Palmitoleic acid) is a saturated fatty acid (SFA) and oleic acid is an essential fatty acid (EFA). The results are shown in Table 4.
Table 4. Profile of saturated fatty acids and unsaturated fatty acids (essential fatty acids) Mengkin cultivar red fruit oil.

| No. Peak | Compound Name                        | Molecular Formula | Retention Time (min) | Area (%) | Relative content | Similarity of instrument/quality min 85 (%) | Usability |
|----------|--------------------------------------|-------------------|----------------------|----------|------------------|---------------------------------------------|-----------|
| 1        | Oleic acid (n-Hexadecanoic acid)     | C_{18}H_{34}O_{2}  | 14.924               | 63.76    | 63.76            | 94                                          | antioxidant |
| 2        | Palmitoleic acid (n-Hexadecanoic acid) | C_{16}H_{32}O_{2}  | 18.982               | 16.56    | 16.56            | 99                                          | antioxidant |

Table 4. shows the fatty acid content in Edewewits Cultivation: Acid

Oleic (Oleic acid) was 63.76% and Palmitic acid (Hexadecanoic acid) was 16.56%. When compared with the content of palmitic acid (Hexadecanoic acid) and oleic acid palm kernel oil is lower, ranging between 6.5 - 9.0 and 13.0 - 19.0% [8], the results of this study which is 16.56% and 63.76%. So it is suitable for consumption and as a source of palmitic acid (Hexadecanoic acid).

4. Conclusion
Menja, Edewewits and Mengkin cultivars have high nutritional content. Profile of Menja cultivar fatty acids (*Pandanus austrosinensis*): Lauric acid (Dodecanoic acid), Miristic acid (Pentadecanoic acid). 14-methyl-, methyl ester, Palmitic acid or Palmitoleic acid (n-Hexadecanoic acid). Edewewits cultivar: Palmitic acid or Palmitoleic acid (n-Hexadecanoic acid) and Oxacyclohexadecan-2-one. Mengkin cultivar: Palmitic acid or Palmitoleic acid (n-Hexadecanoic acid) and oleic acid are also quite high. So that the red fruit oil from the Menja, Edewewits and Mengkin cultivars can be used for human and animal health and growth, both land animals and aquatic animals, specifically fish. And as a source of nutrients and fatty acids namely saturated fatty acids and unsaturated fatty acids.

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