Extraction of coconut oil by using Yan-Pang-Hom (*Paederia linearis*) extract

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ABSTRACT

Coconut oil contains the amount of medium chain fatty acids (MCFA) and nearly 48-53% lauric acid, which is benefit to various functional properties including digestibility. Yan-Pang-Hom (*Paederia linearis*: YPH) is a food plant and herb in Thailand. This research was to study the various YPH extracts concentration and different temperature for coconut oil extraction and determine this coconut oil qualities. Coconut milk and YPH extracts were mixed in various ratios (100:0, 100:5, 100:10, 100:15 and 100:20 (w/w)) and allowed to separate for 7-27 h. YPH extracts were able to separate the coconut oil from coconut milk within 7 h, which were shorter time than the fermentation (100:0) at 27 h. Oil yield (about 108-110 ml) were not difference (p>0.05) in various YPH extracts concentration. The coconut milk samples from ratio 100:5 were incubated at 20, 30 and 40°C and detected the extraction times of coconut oil. It showed that extraction times were 98, 7 and 4 h, respectively. After that, the extracted oil (40 °C, 4 h) was steamed at 80°C for 5 min. The qualities of oil with YPH extract (ratio 100:5, 40°C for 4 h) was moisture content (0.14 ± 0.03), total acidity (0.43 ± 0.01), iodine value (4.65 ± 0.29), saponification value (257.80 ± 1.49), peroxide value (2.59 ± 0.12), color (L* = 65.25 ± 0.38, a* = 2.52 ± 0.06, b* = -11.06 ± 0.30) and total viable counts were less than 10 CFU/ml, which was met the quality of the proposed International Standard by the Asian and Pacific Coconut Community (APCC). In conclusion, coconut oil from coconut milk with YPH extract concentration at the ratio of 100:5 (w/w), at 40°C for 4 h was a method that reduced extraction time when compared to traditional fermentation.

Keywords: Coconut oil, Yan-Pang-Hom, *Paederia linearis*, Coconut milk, Extraction, Fermentation
1. INTRODUCTION

Coconut oil contains the amount of medium chain fatty acids (MCFA) and nearly 48-53% lauric acid, which is benefit to various functional properties including digestibility [1]. It is extracted by various methods such as dry or wet processing. Dry processing is widely used for coconut oil extraction by pressing copra follow by refining, bleaching and deodorizing [1-3]. Coconut oil from wet processing is obtained by the extraction of the coconut milk and destabilizing emulsion without thermal treatment, is known as virgin coconut oil (VCO). Several methods for VCO extraction are chemical solvent extraction, fermentation and enzymatic extraction etc. These methods, which are wet processing, separate the coconut milk into two layers: upper coconut oil layer and lower aqueous layer since coconut milk is broken emulsion. VCO from these methods is higher quality than dry processing [3-4].

Yan-Pang-Hom (*Paederia linearis*: YPH) is a food plant and herb in Thailand. Its root is rich in amylase enzyme which is used to be an ingredient in traditional glutinous rice cracker in northeast of Thailand for increasing sweet. Some reports were indicated various enzymes (amylase, protease etc.) were able to separate the coconut oil from coconut milk [3]. Therefore, YPH is utilized as enzyme in order to degrade components of the structural cell wall of coconut milk for extracting coconut oil or VCO. YPH extracts are investigated optimum concentration and temperature for coconut oil extraction and the obtained coconut oil is determined the chemical, physical and microbiological properties.

2. MATERIALS AND METHODS

**Preparation of Materials**

Coconut milk was prepared from squeezing the grated coconut meat mixed with water (1:1 w/w) by using coconut milk squeezer machine. Coconut milk was used to extract the coconut oil.

Roots of Yan-Pang-Hom (*Paederia linearis*: YPH) were washed in filtered water and soaked in 70% ethanol for 5 min before peeling, and then were grinded in a mortar. Grounded YPH root was mixed with filtered water (1:1 w/w), extracted, and squeezed through a layer of cheeseclothes. The filtrate was YPH extract which was used to extract coconut oil from coconut milk.

**Extraction of coconut oil**

**Optimum concentration of YPH extracts**

Coconut milk and YPH extracts were mixed in various ratios (100:0, 100:5, 100:10, 100:15 and 100:20 w/w) at room temperature (30°C) and allowed to settle and separate into two layers: upper coconut oil layer and lower aqueous layer. The amount of all treatment of extracted coconut oil was observed every 30 min until steady. The obtained oils were centrifuged (5,000 rpm, 15 min) and oil layer was separated and then steamed at 80°C for 5 min.

**Optimum temperature for extraction**

Coconut milk and optimum condition of YPH extract was mixed and incubated at 20, 30 and 40°C and observed the yield of separated oil every 30 min until steady. The obtained oils were centrifuged (5,000 rpm, 15 min) and oil layer was separated and then steamed at 80°C for 5 min.

**Analysis of coconut oil properties**

Extracted coconut oil from the YPH extract treatment, which showed the shortest extraction time, was selected for determination and comparison of chemical and microbiological properties with coconut oil from traditional fermentation, heat treatment and commercial coconut oil according to the proposed International Standard by the Asian and Pacific Coconut Community (APCC).

**Determination of chemical and physical properties**

The moisture content, acid value and peroxide value of extracted coconut oil were determined by AOAC (2000) method. The iodine value was determined according to AOCS Official Method 1d – 92 (1997). The saponification value was determined according to Paquot (1979). Color was measured by Hunter color value (L*, a*, b*).

**Determination of microbiological properties**

Total viable count of extracted coconut oil was performed using a standard plate count agar (Hi-media, India) and incubated at 35°C for 24 h.

**Statistical analysis**

The statistical analysis was carried out using SPSS statistic program (Version 17) for Window (SPSS Inc. Chicago, IL). The condition of coconut oil extraction and chemical of coconut oil properties were evaluated using one-way analysis of variance (ANOVA) and mean comparison was performed by Duncan’s Multiple Range Test significant difference at a 5% level.
3. RESULTS

Optimum concentration of YPH extracts
YPH extracts were mixed into the coconut milk and stand to settle at room temperature. After that, coconut milk was separated to two layers: top coconut oil layer and lower aqueous layer. After 7 h extraction, the coconut oil was separated from the milk with all concentration of YPH extracts (100:5, 100:10, 100:15 and 100:20 w/w). They were shorter time than the fermentation (100:0) at 27 h. Oil contents (about 108-110 ml) were not difference (p>0.05) in all treatments (Table 1).

Table 1. Volume and extraction times of coconut oil from coconut milk with various concentration of Yan-Pang-Hom extract

<table>
<thead>
<tr>
<th>Ratio of coconut milk : YPH extracts</th>
<th>Extraction times (h)</th>
<th>Volume of extracted coconut oil (ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100:0</td>
<td>27</td>
<td>108.33 ± 5.77</td>
</tr>
<tr>
<td>100:5</td>
<td>7</td>
<td>110.00 ± 1.15</td>
</tr>
<tr>
<td>100:10</td>
<td>7</td>
<td>109.33 ± 5.00</td>
</tr>
<tr>
<td>100:15</td>
<td>7</td>
<td>109.33 ± 1.15</td>
</tr>
<tr>
<td>100:20</td>
<td>7</td>
<td>109.33 ± 1.15</td>
</tr>
</tbody>
</table>

NS in the same column indicate no significant differences between volume of extracted coconut oil (p >0.05)

Means ± SD (n=3)

Extraction time of all concentration of YPH extracts were not difference therefore ratio of coconut milk;YPH extract at 100:5 was selected to study the suitable incubation temperature.

Optimum temperature for extraction
YPH extract (100:5) was mixed into coconut milk and incubated at 20, 30 and 40°C. At 40°C, YPH extract showed high efficacy in oil extraction (Table 2), it may be due to this condition was suitable temperature for activities of enzymes in YPH extract. YPH extract contained the protease and amylase for hydrolyzing the starch and protein in the cell wall structure of the coconut milk [5]. Protease hydrolyzed peptide bonds in the interior of the polypeptide chain therefore coconut milk emulsion was destabilized and caused oil droplets aggregation. Protein fragments moved towards the aqueous phase leading to phase separation [3].

Table 2. Volume and extraction times of coconut oil from coconut milk with Yan-Pang-Hom extract (100:5) at various incubation temperature

<table>
<thead>
<tr>
<th>Incubation temperature (ºC)</th>
<th>Extraction times (h)</th>
<th>Volume of extracted coconut oil (ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>98</td>
<td>120±0.00</td>
</tr>
<tr>
<td>30</td>
<td>7</td>
<td>120±0.00</td>
</tr>
<tr>
<td>40</td>
<td>4</td>
<td>120±0.00</td>
</tr>
</tbody>
</table>

NS in the same column indicate no significant differences between volume of extracted coconut oil (p >0.05)

Means ± SD (n=3)

Analysis of coconut oil properties
Extracted coconut oil from the YPH extract treatment (100:5), which showed the shortest extraction time, was selected for determination and comparison of chemical and microbiological properties with coconut oil from traditional fermentation, heat treatment and commercial coconut oil according to the proposed International Standard by the Asian and Pacific Coconut Community (APCC) (Table 3-4).

Coconut oil from heat treatment had lower L* value (darker yellow) than other treatments because the oil was oxidized by heat [6]. Coconut oil from YPH extract had color values (L*, a*, b*) similar to commercial coconut oil (oil from dry processing) (Table 3).
Table 3. The \( L^* \), \( a^* \), \( b^* \) values of coconut oil from various extractions

<table>
<thead>
<tr>
<th>Coconut oil from various methods</th>
<th>( L^* )</th>
<th>( a^* )</th>
<th>( b^* )</th>
</tr>
</thead>
<tbody>
<tr>
<td>YPH extraction</td>
<td>67.05±0.49&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.06±0.06&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-13.72±0.07&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Traditional fermentation</td>
<td>66.48±0.25&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.91±0.06&lt;sup&gt;d&lt;/sup&gt;</td>
<td>-9.43±0.09&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Heat treatment</td>
<td>65.25±0.38&lt;sup&gt;c&lt;/sup&gt;</td>
<td>2.52±0.06&lt;sup&gt;c&lt;/sup&gt;</td>
<td>-11.06±0.30&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Commercial coconut oil</td>
<td>66.38±0.09&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.21±0.05&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-13.86±0.10&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Different superscripts in the same column indicate significant differences between samples \((p \leq 0.05)\), Means ± SD \((n=9)\)

\( L^* \) = Lightness (0 = black, 100 = white), \( a^* \) = (+ red, - green), \( b^* \) (+ yellow, - blue)

Table 4. Chemical properties of coconut oil from various extractions

<table>
<thead>
<tr>
<th>Coconut oil from various methods</th>
<th>Moisture content (%)</th>
<th>Acidity (%)</th>
<th>Iodine value (iodine/100 oil)</th>
<th>Saponification value&lt;sup&gt;mo&lt;/sup&gt; (mg KOH/g oil)</th>
<th>Peroxide value (meq peroxide oxygen/kg oil)</th>
</tr>
</thead>
<tbody>
<tr>
<td>YPH extraction</td>
<td>0.17±0.10&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.46±0.01&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.34±2.25&lt;sup&gt;a&lt;/sup&gt;</td>
<td>255.05±4.19</td>
<td>2.21±0.41&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Traditional fermentation</td>
<td>0.34±0.04&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.42±0.01&lt;sup&gt;b&lt;/sup&gt;</td>
<td>5.33±0.28&lt;sup&gt;b&lt;/sup&gt;</td>
<td>254.60±2.50</td>
<td>2.22±0.05&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Heat treatment</td>
<td>0.14±0.03&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.43±0.00&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.71±0.33&lt;sup&gt;b&lt;/sup&gt;</td>
<td>257.49±1.66</td>
<td>2.61±0.13&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Commercial coconut oil</td>
<td>0.21±0.05&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.32±0.01&lt;sup&gt;c&lt;/sup&gt;</td>
<td>4.29±0.13&lt;sup&gt;b&lt;/sup&gt;</td>
<td>254.13±4.34</td>
<td>1.55±0.02&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>mo</sup> in the same column indicate no significant differences between volume of extracted coconut oil \((p > 0.05)\)

Different superscripts in the same column indicate significant differences between samples \((p \leq 0.05)\), Means ± SD \((n=9)\)

The chemical properties of extracted coconut oil were showed in Table 4. The extracted coconut oil was heat at 80°C for reducing the microbial contamination therefore total viable count was less than 10 CFU/ml. Peroxide value of oil from heat treatment was higher than other treatments, indicating this oil had low stability against oxidation [3]. Iodine value indicates a degree of saturation and unsaturated lipid content. The extracted oil (YPH extraction) showed high value, which indicated high unsaturated lipid content leading to a high sensitive to oxidative rancidity [3, 7]. Chemical, physical and microbiological properties of the extracted coconut oil from YPH extract indicated that had values within the limits of Asian and Pacific Coconut Community (APCC) standards for VCO.

### 4. CONCLUSIONS

Coconut oil from coconut milk with YPH extract concentration at the ratio of 100:5 (w/w), at 40°C for 4 h was a method that reduced extraction time when compared to traditional fermentation. The obtained coconut oil from YPH extract had % moisture content, % acidity, iodine value, saponification value and peroxide value within the limits of International Standard by the APCC. YPH extract was able to one of choices for coconut oil extraction method.

### ACKNOWLEDGEMENTS

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REFERENCES