EVALUATION OF QUALITY OF THE VIRGIN COCONUT OIL EXTRACTED BY TRADITIONAL AND COLD CENTRIFUGATION METHODS

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ABSTRACT

The study was conducted in the year 2022 to assess the quality of VCO obtained using various extraction methods. VCO was extracted from fresh and mature kernels of the Kerasree coconut variety using traditional (TVCO) and cold centrifugation (CCVCO) methods. TVCO showed the highest mean score of 8.99 for overall acceptance based on the organoleptic evaluation. Physicochemical properties of VCOs were statistically analysed and compared to the guidelines for edible oils established by the Asian Pacific Coconut Community (APCC). The findings revealed that there was a significant difference (p<0.05) in oil recovery, content of tocopherol and total phenol, total antioxidant activity and fatty acid profile of TVCO and CCVCO. High oil recovery and low moisture content were observed in TVCO. CCVCO contained more lauric acid (46.15%), tocopherol (26.25 µg/g), total phenol content (8.87 GAE µg/g) and total antioxidant activity (25.95 µg/mg) than TVCO. The findings demonstrated that the quality of VCO was affected by extraction methods.

Keywords: Cold centrifugation, Organoleptic evaluation, Physico-chemical properties, Virgin coconut oil

INTRODUCTION

Coconut (Cocos nucifera) is one of the most valuable trees and all of its parts are beneficial to people. Because of its various functions, the coconut is referred to in Indian mythology as “kalpavriksha” or “Tree of heaven” (Kalimuthu and Dharani, 2020). Coconut belongs to the palm family (Palmae or Arecaceae) which has about 190 genera and over 2800 species. Around 12 million hectares of land are used to grow coconuts, with a potential yearly production of 70 billion nuts. It offers the people options for a sustainable way of life through farming, processing, marketing, and trade-related industries. Therefore, it significantly affects rural economies.

Virgin coconut oil (VCO) is a comparatively new, high-quality coconut product that is becoming more popular as a functional food throughout the world. It is the purest kind of
coconut oil with a fresh coconut aroma. VCO is naturally extracted using heat or without it, from fresh and mature coconut kernels. VCO differs from other vegetable oils because of its high content of lauric acid, vitamin E, polyphenols and antioxidants. VCO is high in medium-chain fatty acids (MCFAs) at about 63% and contains lauric, myristic, palmitic, capric, stearic, oleic, and linoleic acids. Monolaurin, a monoglyceride form of lauric acid, boosts the immune system and protects young children from bacterial, viral, and protozoal infections (Nasir et al., 2018). Lauric acid, which has antibacterial and antiviral characteristics, and the phenolic compounds included in VCO, which have anti-mutagenic, anti-proliferative, and anti-carcinogenic properties, are some of the health benefits of VCO.

VCO is extracted using a variety of methods, which are generally categorised into dry and wet methods. In the dry method, the coconut kernel is heated under particular conditions to eliminate the content of moisture in it to prevent scorching and microbial invasion, whereas, in the wet method, heat is not applied to the coconut kernel. The wet method can be further divided into chilling, thawing, fermentation, enzymatic, and pH methods, or any of these in combination as the main intention is to destabilise the coconut milk emulsion. In the dry technique, the kernel was mechanically pressed to extract the oil after being dried using controlled heating. The qualities of VCO can vary by applying various extraction techniques. Thus, the objective of the study was to evaluate the physicochemical composition and organoleptic quality of VCO extracted from traditional and cold centrifugation methods.

MATERIALS AND METHODS

Collection of ingredients

The study was conducted in the year 2022 at the Department of Community Science in the College of Agriculture, Kerala Agricultural University (KAU), Vellanikkara, Kerala. The matured coconuts of the variety ‘Kerasree’ were procured from the Instructional farm of KAU, Vellanikkara, Thrissur, and RARS, Pilicode, Kasaragode.

Extraction of VCO

Preparation of coconut milk

The matured coconuts (10-11 months old) were used for milk extraction. After being dehusked, the coconut kernel was grated using a coconut grater. The coconut milk was extracted using a white muslin towel from the grated coconut kernel.

VCO extracted by traditional Method (TVCO)

Coconut milk was heated at 100 – 120 °C for 60 min to completely evaporate the water. The proteins in coconut milk become denatured when heated, which causes the milk emulsion to become unstable. The coagulated protein was removed using a muslin filter and the remaining residue was boiled again to release additional oil.

VCO extracted by cold centrifugation method (CCVCO)

Coconut milk was centrifuged at 10000 rpm for 10 minutes a 4 °C and the upper cream layer was removed for chilling. The cream was chilled at 4 °C for 24 h before being gradually thawed at 50 °C in a water bath. Then oil was filtered using Whatman filter paper No. 1 and stored in glass bottles.
Organoleptic evaluation

A group of 15 judges were selected by a standard procedure for the organoleptic evaluation. A nine-point hedonic scale was used by the selected group of judges to evaluate the organoleptic qualities of VCO.

Physico-chemical analysis

Physico-chemical properties such as oil recovery, moisture content, tocopherol content, phenol content, total antioxidant activity and fatty acid profile of VCOs were analysed using standard procedure.

Statistical analysis

The data were recorded and analysed as a completely randomised design (CRD). The organoleptic scores were evaluated by Kendall’s coefficient of concordance (W). The physicochemical properties of TVCO and CCVCO were statistically compared by independent t-test.

RESULTS AND DISCUSSION

In this study, sensory characteristics and physicochemical properties of the VCOs were analysed. The findings were confirmed with suitable statistical analysis and discussed under the following subheadings.

Organoleptic evaluation

The sensory evaluation was carried out for the extracted VCOs by using nine point hedonic scale with a group of 15 judges considering the six sensory attributes (appearance, colour, flavour, taste, texture and overall acceptability). The organoleptic mean scores were calculated and are shown in Table 1. The mean scores for the sensory attributes of each treatment were statistically analysed using Kendall’s coefficient of concordance. In the study, the organoleptic evaluation scores revealed that acceptability was highest for the VCO extracted by the traditional method. TVCO had the highest mean score for flavour, taste and texture. CCVCO scored highly on the organoleptic mean score for appearance and colour when compared to traditional VCO.

Dumancas et al. (2016) reported that VCO had a water like appearance and fresh coconut aroma. Ndife et al. (2019) found that all samples of VCO were colourless except VCO extracted

Table 1. Mean scores for organoleptic qualities of VCOs

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Sensory attributes</th>
<th>TVCO</th>
<th>CCVCO</th>
<th>Kendall’s [W] value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Appearance</td>
<td>8.97(1.4)</td>
<td>9(1.6)</td>
<td>0.20**</td>
</tr>
<tr>
<td>2</td>
<td>Colour</td>
<td>8.97(1.4)</td>
<td>9(1.6)</td>
<td>0.20**</td>
</tr>
<tr>
<td>3</td>
<td>Flavour</td>
<td>9(1.80)</td>
<td>8.82(1.20)</td>
<td>0.60**</td>
</tr>
<tr>
<td>4</td>
<td>Texture</td>
<td>9(1.60)</td>
<td>8.85(1.40)</td>
<td>0.20**</td>
</tr>
<tr>
<td>5</td>
<td>Taste</td>
<td>9(1.75)</td>
<td>8.95(1.25)</td>
<td>0.50**</td>
</tr>
<tr>
<td>6</td>
<td>Over all acceptability</td>
<td>8.99(1.80)</td>
<td>8.92(1.20)</td>
<td>0.45**</td>
</tr>
<tr>
<td>7</td>
<td>Total score</td>
<td>53.93</td>
<td>53.54</td>
<td></td>
</tr>
</tbody>
</table>

Values in parenthesis are mean rank scores based on Kendall’s W. (**significant at 1% level); TVCO - VCO extracted by traditional method; CCVCO - VCO extracted by cold centrifugation method
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Table 2. Physicochemical properties of VCOs

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Parameter</th>
<th>TVCO</th>
<th>CCVCO</th>
<th>t value</th>
<th>APCC standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Oil recovery (%)</td>
<td>39.37</td>
<td>38.82</td>
<td>32.75*</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Moisture (%)</td>
<td>0.09</td>
<td>0.11</td>
<td>1.177NS</td>
<td>0.1 - 0.5</td>
</tr>
<tr>
<td>3</td>
<td>Tocopherol content (µg/g)</td>
<td>17.81</td>
<td>26.25</td>
<td>496.57*</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>Total phenol content (GAE µg/mg )</td>
<td>7.78</td>
<td>8.87</td>
<td>4.903*</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>Total antioxidant activity (µg/mg)</td>
<td>17.52</td>
<td>25.95</td>
<td>763.13*</td>
<td>-</td>
</tr>
</tbody>
</table>

NS – Non Significant, *Significant at 5%; TVCO- VCO extracted by traditional method; CCVCO- VCO extracted by cold centrifugation method

by dry method. In this study, the colour of TVCO was slightly yellow and CCVCO was colourless. This yellow colour could be a result of a continued heating process.

**Physico-chemical properties of VCOs**

**Oil recovery**

The quantity of oil recovered is dependent on a lot of factors, including the age of coconuts and copra and the time of coconut harvest. Oil recovery provides a quantitative measurement of the effect of different extraction techniques on the quantity of oil produced. Table 2 showed the percentage recovery of VCO extracted by traditional and cold centrifugation processes. From the Table, it is evident that oil recovery was higher in the TVCO. There was a significant difference (p<0.05) in the oil recovery of the two samples. Narayanankutty et al. (2018) reported that the use of heat can help increase the oil yield. Similarly, Ajogun et al. (2020) found that the hot process gave a significantly higher oil recovery of 58%, while the cold process gave 50% oil recovery.

**Moisture**

The quality of the VCO is significantly influenced by moisture. High moisture content encourages the hydrolytic rancidity of oils. Low moisture content will extend the shelf life by slowing the process of oxidation and rancidity. In this study, the moisture content of the samples revealed that TVCO had the lowest moisture level (Table 2). This might be the result of using a high temperature that significantly removes the water components from the VCO. Ajogun et al. (2020) also found that moisture content was low in hot processed VCO (0.05%) than in cold processed VCO (0.07%).

**Tocopherol content**

Tocopherols are lipid-soluble, natural antioxidants that are mostly present in vegetable oils. It has significant antioxidant activities that prevent lipid peroxidation and reactive oxygen species scavenging (Kumar and Krishna, 2015). According to Ndifa et al. (2019), VCO had 2.92 mg to 4.28 mg of tocopherol per 100 g. In this study, the tocopherol content of VCO extracted using traditional and cold centrifugation processes ranged from 17.81 to 26.25 µg/g. There was a significant difference (p<0.05) in the tocopherol contents of the two samples. High tocopherol content was obtained from CCVCO.
EVALUATION OF QUALITY OF THE EXTRACTED VIRGIN COCONUT OIL

Table 2. Fatty acids composition of VCOs

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Fatty acids</th>
<th>TVCO</th>
<th>CCVCO</th>
<th>t value</th>
<th>APCC standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Caprylic acid (C8 : 0)</td>
<td>7.00</td>
<td>6.58</td>
<td>14.27*</td>
<td>5.00 – 10.0</td>
</tr>
<tr>
<td>2</td>
<td>Capric acid (C10 : 0)</td>
<td>5.95</td>
<td>5.83</td>
<td>6.35*</td>
<td>4.50 – 8.00</td>
</tr>
<tr>
<td>3</td>
<td>Lauric acid (C12 : 0)</td>
<td>45.14</td>
<td>46.15</td>
<td>67.31*</td>
<td>43.0 – 53.0</td>
</tr>
<tr>
<td>4</td>
<td>Myristic acid (C14 : 0)</td>
<td>21.04</td>
<td>17.73</td>
<td>194.74*</td>
<td>16.0 – 21.0</td>
</tr>
<tr>
<td>5</td>
<td>Palmitic acid (C16 : 0)</td>
<td>9.20</td>
<td>7.71</td>
<td>111.50*</td>
<td>7.50 – 10.0</td>
</tr>
<tr>
<td>6</td>
<td>Stearic acid (C18 : 0)</td>
<td>1.23</td>
<td>ND</td>
<td>NS</td>
<td>2.00 – 4.00</td>
</tr>
<tr>
<td>7</td>
<td>Oleic acid (C18 : 1)</td>
<td>9.46</td>
<td>10.83</td>
<td>80.21*</td>
<td>5.00 – 10.00</td>
</tr>
<tr>
<td>8</td>
<td>Linoleic acid (C18 : 3)</td>
<td>0.98</td>
<td>ND</td>
<td>NS</td>
<td>1.00 – 2.50</td>
</tr>
</tbody>
</table>

ND- Not Detected; NS – Non Significant; *Significant at 5%; TVCO- VCO extracted by traditional method; CCVCO- VCO extracted by cold centrifugation method

According to Srivastava et al. (2016), VCO extracted using the cold method had a higher tocopherol content (27.65 μg/g) than VCO extracted using the hot method (17.87 μg/g).

**Total phenol content (TPC)**

VCO contains high concentrations of polyphenols. According to Ghani et al. (2018), the TPC of VCO extracted using various techniques ranged from 1.16 to 12.4 mg GAE/g. In this study, the TPC in VCOs was observed to be between 7.78 and 8.87 GAE μg/mg (Table 2). There was a significant difference (p<0.05) in the total phenol content of TVCO and CCVCO. The variation in phenolic concentration in VCO may be caused by the varied extraction methods. Mulyadi et al. (2018) also observed the total phenol concentration in VCOs extracted using various methods and found that the phenol content varied depending on the method used. In this study, the highest concentration of total phenols was found in CCVCO.

**Total antioxidant activity**

The primary factor affecting the antioxidant activity of VCO is the amount of polyphenols present in VCO. The total antioxidant activity of VCO samples ranged from 17.52 to 25.95 μg/mg (Table 2). There was a significant difference (p<0.05) in the total antioxidant activity of the two oil samples. The variation in antioxidant activity among the VCO samples could be the result of the various processing methods. CCVCO showed more antioxidant activity than TVCO. A similar result was noted by Mulyadi et al. (2018). They reported that VCO extracted from the dry method showed the lowest antioxidant activity than the wet method because of the destruction of the polyphenols by heat.

**Fatty acids**

The most predominant fatty acid in VCO is lauric acid, which is followed by myristic, palmitic, capric, stearic, and small amounts of unsaturated fatty acids including oleic and linoleic...
acids. This is seen in Table 3, where the total lauric acid in VCO obtained by various extraction techniques ranged from 45.14% to 46.15%. Mohammed et al. (2021) also reported that lauric acid was the predominant fatty acid present in VCO, ranging from 47.95% to 48.83%. A small percentage of stearic acid and linoleic acid were present in TVCO, but not detected in CCVCO. The overall saturated fatty acid (SFA) content of TVCO and CCVCO was 89.56% and 84% while the total unsaturated fatty acid (UFA) ranged from 10.44% to 10.83%. The findings demonstrated that fatty acid content might vary depending on the extraction method used, and cold centrifugation is the best method for obtaining high lauric acid composition. Ghani et al. (2018) also pointed out that fatty acid composition may change depending on the extraction methods. Ajogun et al. (2020) also found that the fatty acid profile was different in hot processed coconut oil (91.60% SFA and 8.4% UFA) and cold processed oil (90.95% SFA and 9.05% UFA).

CONCLUSIONS

The study intended to evaluate the quality of VCO obtained using traditional and cold centrifugation extraction methods. The findings showed that the quality of VCO was affected by extraction methods. VCO extracted from the traditional method (TVCO) secured the highest mean score in an organoleptic evaluation. There was a significant difference (p<0.05) in oil recovery, tocopherol content, total phenol content, total antioxidant activity and fatty acid profile of TVCO and CCVCO. In comparison to traditional and cold centrifugation methods, CCVCO had higher levels of lauric acid, tocopherol, total phenols, and antioxidant activity. The increased levels of lauric acid, tocopherol, polyphenols, and antioxidant activity provide the oil with a significant medical value. As a result, VCO has a great future as a functional oil. The nutritional value of a variety of food products can be improved using it.

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