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by Joshua Ronal

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SENSORY PROPERTIES OF VIRGIN COCONUT OIL CONTAINING ASCORBIC ACID MICROEMULSION

Ambar Rukmini[1,*], Sri Raharjo[2,*], Pudji Hastuti[2], and Supriyadi[2]

[1] *Department of Food Technology and Nutrition, Faculty of Agricultural Technology, Widya Mataram University, nDalem Mangkubumen KT III/237, Yogyakarta 55132, Indonesia.*

e-mail: ambar_rukmini@yahoo.co.uk (A. Rukmini)

[2] *Department of Food and Agricultural Product Technology, Faculty of Agricultural Technology, Gadjah Mada University, Bulaksumur, Yogyakarta 55281, Indonesia*

e-mail: sraharjo_ugm@yahoo.com (S. Raharjo)

ABSTRACT

As a functional food, virgin coconut oil (VCO) has been claimed to have numerous beneficial health effects. Thus, VCO production has shown dramatic growth in the market. During prolonged storage or display at retail outlets, VCO is susceptible to quality deterioration due to photooxidation which lead to formation of rancid flavor and odor. Our previous study indicated that this reaction can be inhibited by addition of ascorbic acid microemulsion. However, the addition of ascorbic acid may have influence on the sensory properties of VCO. The aim of this study was to determine the sensory properties of VCO containing ascorbic acid microemulsion. The ascorbic acid microemulsion was prepared by dissolving the ascorbic acid in deionized water and mixing with ternary surfactants mixture (consisted of Span 80, Span 20, and Tween 20), and then mixing with dehydrated VCO. This ascorbic acid microemulsion was added into the VCO at the levels of 0, 50, 100, or 200 ppm. Twelve trained panelists were employed to perform sensory evaluation on appearance, odor, taste, and flavor using a Multiple Comparison Difference Analysis method. To identify the difference between this treated VCO and the original VCO in terms of sensory attributes, a Descriptive Sensory Analysis was used. The results indicated that VCO containing ascorbic acid microemulsion had the same characteristics in appearance, odor, taste, and flavor as that of the original VCO. But, it had slightly less nutty and latik odor. This study confirmed that the ascorbic acid microemulsion can be used to protect quality deterioration in VCO without significant influence on its sensory properties.

Keywords: virgin coconut oil, ascorbic acid microemulsion, sensory properties

INTRODUCTION

Virgin coconut oil (VCO) is oil that is obtained through wet processing from coconut milk under mild temperature. This extraction process ensures that its pleasant and slightly delicate flavor may be retained (1). Intake of VCO decreased total cholesterol, triglycerides, phospholipids, low density lipoprotein (LDL) and very low density lipoprotein (VLDL) and increased high density lipoprotein (HDL) in serum and tissues compared to copra oil (2). It also decreased the lipid peroxidation and increased the antioxidant enzymes content in rats (3), and had a more significant antithrombotic effect (4). Thus, VCO is marketed as functional food and its production has shown dramatic growth in the market.

During prolonged storage or display at retailers, VCO may undergo quality deterioration leading to rejection by consumers especially due to the presence of rancid flavor and odor. Objectionable odor and taste were clearly detected by panelists on samples having a peroxide value (PV) of 1.0 meq/kg or higher (5). Our previous study indicated that this reaction was initiated by singlet oxygen or known as photooxidation. Some the oxidation products further catalyze oxidation chain reaction, resulting quality deterioration of the oils. It has significant effect on not only its chemical properties, but also its sensory and nutritional properties. Therefore, it plays an important role in determining their use and shelf-life (6). Moreover, the oxidation products have negative effects for health.

The onset of undesirable photooxidation reaction can be inhibited by addition of singlet oxygen quenchers (SOQ). Ascorbic acid was reported as an effective SOQ in aqueous solutions (7,8,9). However, due to its very poor solubility in non-aqueous media, ascorbic acid cannot be easily dispersed in hydrophobic medium such as VCO. The water-in-oil (w/o) microemulsion system could be used to overcome this problem.

Microemulsion is defined as a system of water, oil and amphiphile which is a single optically isotropic and thermodynamically stable liquid solution (10). Because of its several advantages such as transparent, thermodynamically stable, low viscosity, easy formulation (low interfacial tension and almost spontaneous formation) and high surface area (high solubilisation capacity), the use of w/o microemulsion to include ascorbic acid was compatible in the VCO system. Our previous study indicated that the ascorbic acid microemulsion was successfully formulated using ternary nonionic surfactants and effectively inhibited photooxidation of VCO. However the sensory properties of that VCO have never been studied. The aim of this study was to evaluate the sensory properties of VCO containing ascorbic acid microemulsion, using both difference and descriptive tests.

MATERIALS AND METHOD

Materials

A freshly prepared VCO obtained from a local VCO producer was filtered using filter paper in the presence of anhydrous Na_2SO_4 to dehydrate VCO. It was then used as the continuous phase. Low HLB surfactant, i.e. sorbitan monooleate (Span 80) and medium HLB surfactant, i.e. sorbitan monolaurate (Span 20) were purchased from Sigma Chemical Company (St. Louis, MO), and high HLB surfactant, i.e. polyoxyethylene sorbitan monolaurate (Tween 20) was purchased from Merck (Darmstadt, Germany). Deionized water was used as the disperse phase. Ascorbic acid and ascorbyl palmitate were purchased from Sigma Chemical Company (St. Louis, MO).

Preparation of ascorbic acid microemulsion

The ascorbic acid microemulsion was prepared by dissolving 0.5 or 1% (weight/weight of total microemulsion system) ascorbic acid in the deionized water. This solution was subsequently added with surfactant mixtures which consist of 16.6% Tween 20, 15.0% Span 20, and 68.4% Span 80 and mixed on a hot-plate stirrer (SRS 710 HA, Advantec, Japan) at medium speed and the temperature was kept at 40±2ºC. After 10 minutes, the dehydrated VCO was added dropwise while stirring at high speed for up to 10 minutes.

Sensory panel and sample preparation for sensory analysis

The sensory panel was consisted of twelve persons (8 female and 4 male; aged between 25 and 40) trained in sensory analysis. Intensive training for panel members was performed to familiarize with specific sensory properties of fresh and photooxidized VCO. VCO without microemulsion, with microemulsion without ascorbic acid, or containing of 1 or 2% ascorbic acid microemulsion were used as fresh samples. The photooxidized VCO samples were prepared by illuminating the fresh samples with fluorescent light exposure at 4000 lux for 3x5 hours and then stored at room temperature (30±1ºC) for up to 2 weeks.

Sensory evaluation

The difference test was conducted with multiple comparison difference analysis method. A portion of each sample (15 mL) was placed in 20 mL transparent bottle with rubber caps, coded with 3 digit random numbers. The coded samples consisted of VCO containing 1 or 2% of microemulsion, VCO added with 1 or 2% of microemulsion containing 0.5% ascorbic acid, and VCO added with 1 or 2% of microemulsion containing 1% ascorbic acid. A freshly prepared VCO without microemulsion was used as reference (R). Each panelist received a series of six coded samples and R. They were asked to determine whether each of these six samples individually was different from R. Panelists identified appearance, odor, taste and flavor attributes. They smelled the sample upon opening the cup (odor attributes), and then tasted it. They were asked to express whether the sample was equal, superior or inferior to R, and then mark the level of difference (none, slight, moderate, much, or extreme). The ratings were given in numerical values. A score of 5 indicates no difference compared to R, while a score of 9 indicates extremely superior to R and 1 indicates extremely inferior to R. Between two different samples, the panelists cleaned their mouth with pear slices and water. To determine the specific odor and taste of samples, the descriptive test was conducted according to Villarino, Dy, and Lizada (11) and panelists evaluated the samples using 10 points of rating scale.

RESULTS AND DISCUSSION

Sensory evaluation concerns the interpretation of what the senses – sight, olfaction, taste, touch, audition – inform about the product. In this study, the difference test was used to evaluate the effect of ascorbic acid microemulsion addition on the appearance (turbidity), odor, taste, and flavor of fresh VCO (Figure 1), or the appearance (turbidity) and odor of photooxidized VCO (Figure 2).

Figure 1 showed that microemulsion, both with and without ascorbic acid, did not have significant effect ($P > 0.05$) on turbidity, odor, or flavor of fresh VCO, but had a significant effect on its taste ($P < 0.05$). VCO containing various levels of ascorbic acid microemulsion did not have a different taste score ($P > 0.05$) as compared with the reference (R). The VCO without ascorbic acid microemulsion had lower taste score ($P < 0.05$) as compared with R. It could be due to the presence of surfactants mixture in microemulsion which had a specific taste could affect the VCO taste. However, the presence of that specific taste was not detected by panelists when ascorbic acid was included into the microemulsion system. Thus, the VCO containing ascorbic acid microemulsion had equal taste as compared with fresh VCO (R).

Figure 2 showed that the light exposure and storage had no significant effect ($P > 0.05$) on turbidity score in all of the treatments. However, ascorbic acid microemulsion could protect VCO from photooxidation. The VCO containing ascorbic acid microemulsion had equal taste score as compared with R. Whereas the VCO without ascorbic acid microemulsion had significantly lower taste score ($P < 0.05$). A descriptive test was used to determine the specific odor and taste of VCO containing ascorbic acid microemulsion. The descriptive test results were shown in Figure 3 and Figure 4.

Figure 3 shows that the addition of microemulsion into the VCO did not affect the turbidity, sweet taste, and salty taste, but it affected the acid odor, latik odor, nutty odor, rancid odor, latik flavor, and nutty flavor. The fresh VCO containing microemulsion had lower latik flavor and odor as compared with R. It could be due to the present of unpleasant flavor from the surfactants mixtures, especially Tween 20. This predominant flavor covered the natural flavor of coconut oil which consisted of latik and nutty flavor. Flavor was the impressions perceived via the chemical sense from a product in the mouth, included the taste, odor, and chemical feeling factors. Because of that reason, the addition of microemulsion, which composed of Tween 20, into the VCO could decrease the odor score. The fresh VCO had odor which was identified as acid, latik, and nutty (Figure 4a). Whereas the VCO which had been exposed to fluorescent light and then stored for 2 weeks had odor which was identified as rancid, acid, latik, and nutty (Figure 4b).

After light exposure and storage for up to 2 weeks, rancid flavor dominated in the VCO without ascorbic acid microemulsion (Figure 4b). It indicated that the light exposure with relatively high intensity (4000 lux) was very effective for initiating photooxidation and oxidation chain reaction during storage. These sensory changes could be due to the secondary oxidation products evolving from the decomposition of hydroperoxides, mainly aldehydes, ketones, and alcohols. Some of these compounds had very low odor thresholds and thus affected the sensory quality at very low concentrations. However, the ascorbic acid microemulsion could overcome this problem. The ascorbic acid microemulsion could prevent the photooxidation and oxidation chain reaction, so it could prevent the formation of rancid odor and taste. This study confirmed that the ascorbic acid microemulsion can be used to protect the quality deterioration of VCO without significant influence on its sensory properties. Thus, consumers can enjoy the pleasant VCO and get the real benefit against quality deterioration during storage.

CONCLUSION

VCO containing ascorbic acid microemulsion has similar characteristics in appearance, odor, taste, and flavor with the freshly prepared original VCO. But, it has slightly less in nutty and latik odor. The addition of ascorbic acid microemulsion into VCO can protect VCO from photooxidation without the negative influence on its sensory properties.

ACKNOWLEDGEMENT

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REFERENCES

1. Marina AM, Che Man YB, Nazimah SAH, Amin I. 2009. Chemical properties of virgin coconut oil. *J Am Oil Chem Soc* 86:301-307.

2. Nevin KG, Rajamohan T. 2004. Beneficial effect of virgin coconut oil on lipid parameters and in vitro LDL oxidation. *Clin Biochem* 37(9):830-835.

3. Nevin KG, Rajamohan T. 2006. Virgin coconut oil supplemented diet increases the antioxidant status in rats. *Food Chem* 99:260-266.

4. Nevin KG, Rajamohan T. 2008. Influence of virgin coconut oil on blood coagulation factors, lipid levels and LDL oxidation in cholesterol fed Sprague-dawley rats. *e-SPEN, the Eur e-J Clin Nut Met* 3:e1-e8.

5. Rukmini A, Raharjo S. 2010. Pattern of peroxide value changes in virgin coconut oil (VCO) due to photo-oxidation sensitized by chlorophyll. *J Am Oil Chem Soc* 87:1407-1412.

6. Anwar F, Chatha SAS, Hussain AI. 2007. Assessment of oxidative deterioration of soybean oil at ambient and sunlight storage. *Grasas Y Aceites* 58(4):390-395.

7. Bodannes RS, Chan PC. 1979. Ascorbic acid as a scavenger of oxygen singlet. *Febs Letters* 105(2):195-196.

8. Jung MY, Kim SK, Kim SY. 1995. Riboflavin-sensitized photodynamic UV spectrophotometry for ascorbic acid assay in beverages. *J. Food Sci.* 60(2):P360-P363,P368.

9. Jung MY, Kim SK, Kim SY. 1995. Riboflavin-sensitized photooxidation of ascorbic acid: kinetics and amino acid effects. *Food Chem.* 53:397-403.

10. Pakpayat N, Nielloud F, Fortune R, Tourne-Peteilh C, Villarreal A, Grillo I, Bataille B. 2009. Formulation of ascorbic acid microemulsions with alkyl polyglycosides. *Eur. J. Pharm*. 72:444-452.

11. Villarino BJ, Dy LM, Lizada MCC. 2007. Descriptive sensory evaluation of virgin coconut oil and refined, bleached and deodorized coconut oil. *LWT Food Sci. and Tech.* 40:193-199.

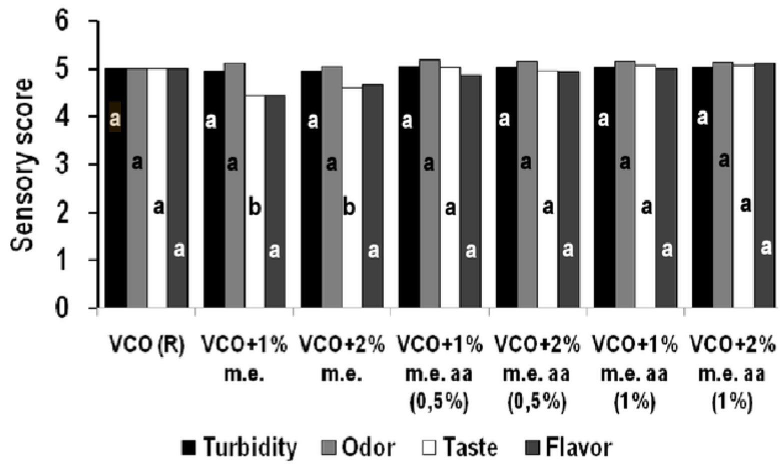

Figure 1. Turbidity, odor, taste, and flavor score of fresh VCO (R), and VCO containing various levels of microemulsion (m.e.) or ascorbic acid microemulsion (m.e. aa). Different letters in the same bar indicate significant difference (P < 0.05). Sensory score of 1: extremely inferior to R; 5: no difference compared to R; and 9: extremely superior to R.

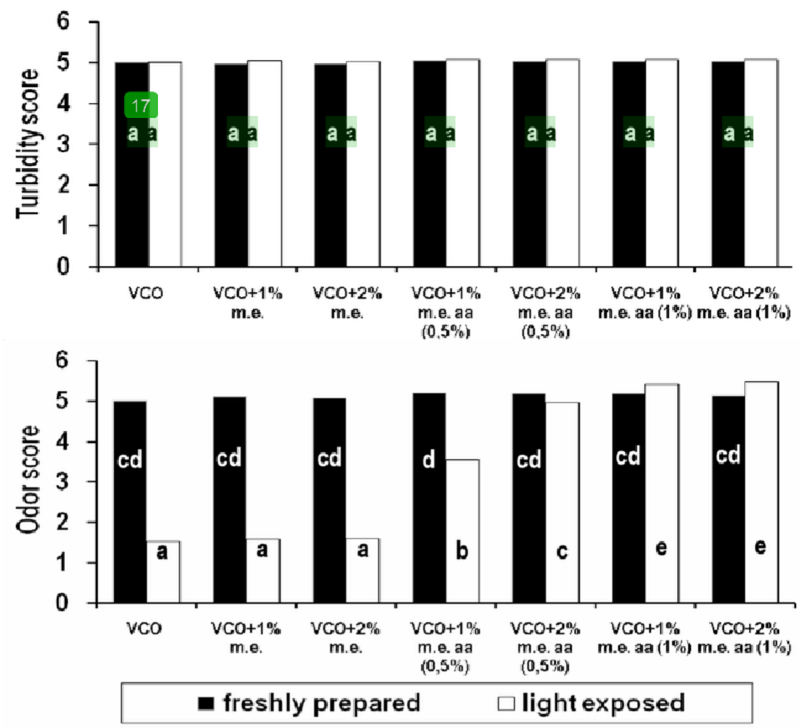

Figure 2. Turbidity, and odor score of VCO and VCO containing various levels of microemulsion (m.e.) or ascorbic acid microemulsion (m.e. aa) in fresh condition or after illumination and storage for 2 weeks. Different letters in the bar indicate significant difference ($P < 0.05$). Sensory score of 1: extremely inferior to R; 5: no difference compared to R; and 9: extremely superior to R.

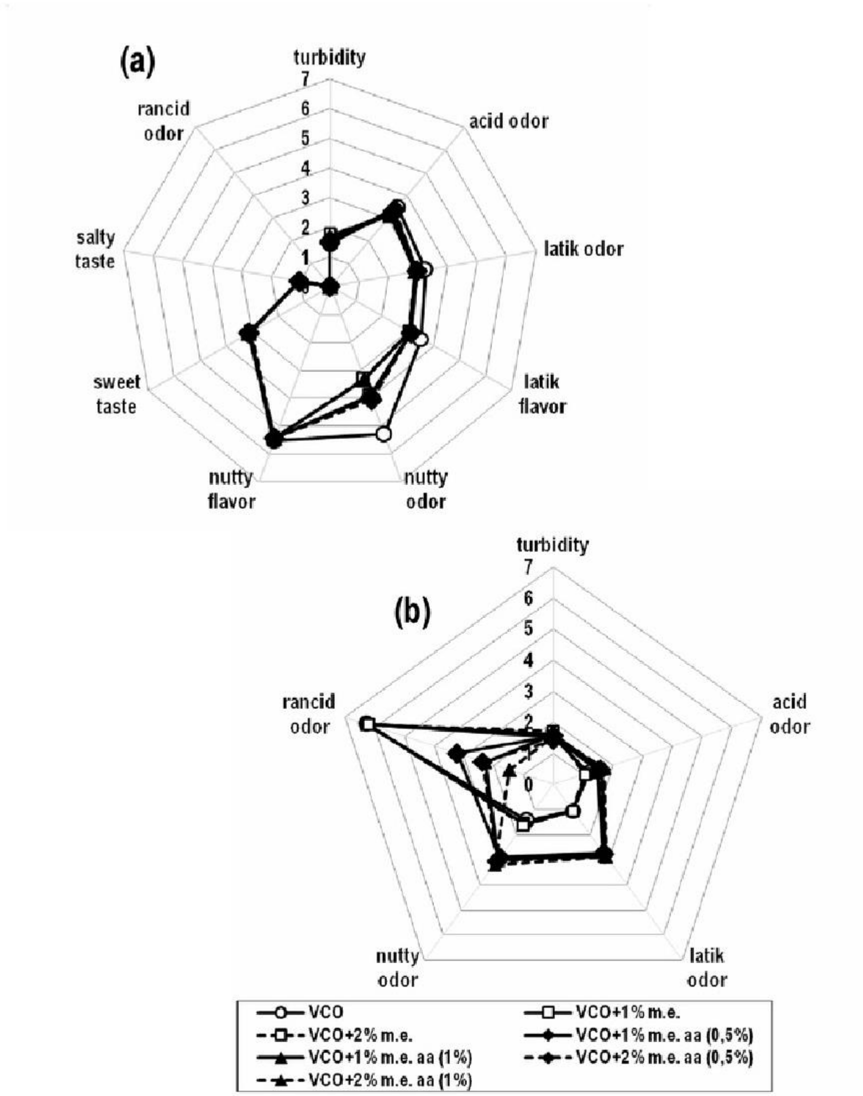

Figure 3. Sensory profile of VCO containing various levels of microemulsion (m.e.) or ascorbic acid microemulsion (m.e. aa) in fresh condition (a) or after illumination and storage for 2 weeks (b).

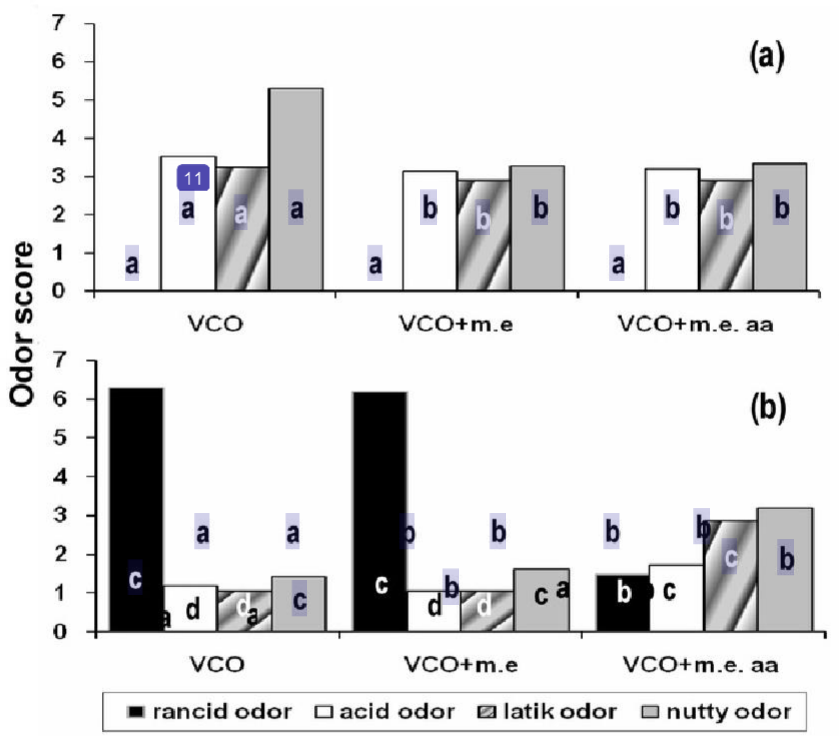

Figure 4. Odor profile of VCO containing microemulsion (m.e.) or ascorbic acid microemulsion (m.e. aa) in fresh condition (a) or after illumination and storage for 2 weeks (b). Different letters in the same bar indicate significant difference (P < 0.05)

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