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Physical, Chemical, and Sensory Properties of Robusta Coffee Effervescent Tablets Formulated in Various Organic Acids

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Abstract

Coffee effervescent products are an innovation in coffee formulation. The compounds that play a role in effervescent are acids and bases. Type of organic acid give an impact on the effervescent characteristics. This study aimed to examine the effect of type of organic acid on physical, chemical, and sensory properties of Robusta coffee effervescent tablets. This study used a completely randomized design with three acids in the formulation, namely citric acid, tartaric acid, and malic acid. Samples were analyzed in three replications. Making effervescent tablets was done by compression technique in a mixture of all ingredients according to the formula. The results showed that different acid had a significant effect on physical and chemical parameters. Malic acid caused a faster effervescent time than citric acid and tartaric acid. Malic acid and tartaric acid tended to lower the pH slightly than citric acid. Malic acid and citric acid tended to produce harder tablets than tartaric acid. However, tartaric acid slightly increased tablets' brightness (L*) compared to malic acid and citric acid. Tartaric acid and malic acid tended to reduce moisture compared to citric acid. The IC_{50} value of effervescent with malic acid and tartaric acid was lower than that of citric acid. However, there was a slight decrease in total phenol in both. Meanwhile, the sensory profiles of tablets and effervescent drinks did not differ due to different acids. The recommended formula was that the effervescent using malic acid had an effervescent time of 166 seconds, hardness 321 N, moisture 8%, IC_{50} 5.5 mg mL^{-1}, total phenol 4.2 mg gallic acid equivalent (GAE) g^{-1}, and a drink profile that has the best color, aroma, taste, and runs time.

Keywords: citric acid, effervescent tablets, malic acid, Robusta, tartaric acid

INTRODUCTION

Coffee is one of the most commonly consumed beverages worldwide for many purposes, including as a stimulant due to caffeine and antioxidant contents (Butt & Sultan, 2011). In Indonesia, Robusta coffee is an important plantation product that is traded domestically and export (ICO, 2021; Chandra *et al.*, 2013; Hasbullah *et al.*, 2021). Robusta coffee production in Indonesia in the 2019-2020 period reached 567 thousand tons (USDA, 2020), whereas the export volume in 2019 reached 359 thousand tons (BPS, 2020).

Coffee is traded in various forms, such as green beans, roasted beans, ground roasts, instant coffee granule, and instant coffee drinks (BPS, 2020). Besides being consumed in powder form, which is then brewed into a drink, coffee was also produced in the form of a ready-to-drink bottle. Along with the development of society, coffee consumption is not only enjoyed in hot but has begun to be served in cold condition, including added ice cubes. Some coffee products usually served cold are bottled coffee drinks and instant coffee drinks with creamer added. Products that being developed as coffee derivatives to be served in cold condition is effervescent (Supriyanto *et al.*, 2013; Ni'mah *et al.*, 2021b).

Effervescent products are generally in the form of granules or tablets. Effervescent granules are coarse powders containing an extract in a dry mixture, usually sodium bicarbonate, citric acid, and tartaric acid. When added to water, acids and bases will react by liberating carbon dioxide to produce air bubbles (Chuong *et al.*, 2018). While effervescent tablets are made by compressing the effervescent granules with a press to release air bubbles when mixed with water (Lynatra *et al.*, 2018).

Romantika *et al.* (2017) stated that effervescent tablets of baby Java oranges with 5% citric acid gives the best physical, chemical, and organoleptic properties. Effervescent leaves of Guazuma and Hibiscus petals using tartaric acid resulted in increased dissolution time and moisture of effervescent granules (Nurahmanto *et al.*, 2019). Regiarti & Susanto (2015) stated that using 20% malic acid to produce effervescent noni leaf extract gave the best physical, chemical, and organoleptic properties. Based on several previous studies, it has been shown that the type of acid affects the characteristics of the effervescent produced. This research will measure the effect of acid type on the physical, chemical, and sensory characteristics of effervescent Robusta coffee tablets.

MATERIALS AND METHODS

Coffee Extract Powder

Robusta coffee beans were roasted at a medium level in a roaster (SC-2.5 kg) at the initial temperature of 180°C for 10 minutes (Hasbullah *et al.*, 2018). Roasted beans that had been degassing for three days were powdered and sieved at 60 mesh. Robusta coffee powder was extracted by dissolving in distilled water at 93°C with a ratio of 1:5 (w/v), then stirred for 4 minutes, then filtered with a vacuum pump to obtain a coffee extract solution.

Coffee extract powder is made according to Ni'mah *et al.* (2021a). The coffee extract solution was added with 30% maltodextrin and 0.01% tween 80. The mixture was homogenized then boiled on teflon, and it was dried in a cabinet dryer at 50°C for 24 hours. Coffee extract powder was ground and sieved at 60 mesh.

Coffee Effervescent Tablet

The formula for coffee effervescent tablets consisted of coffee extract powder (60%), sucrose (20%), polyvinylpyrrolidone (PVP) (5%), organic acid (citric/tartaric/malic) (8%), sodium bicarbonate (5%), and polyethyleneglycol (PEG) 6000 (2%). The mixing and pressing tablets were conditioned at 17° C and 45% relative humidity (RH). Coffee extract powder was mixed with sucrose and sodium bicarbonate, then stirred. Furthermore, acid, PVP, and PEG 6000 were added during stirring until homogeneous (Ansar *et al.*, 2006). Tableting was done by direct compression method (Ansar, 2010). The homogeneous materials were put in a tablet mold and then compressed using a manual tablet press (MKS-TBL8 equipment). The effervescent tablets were immediately packaged in aluminum foil. The sample was made for three replications. Weight of effervescent tablet was 2 g $tablet^{-1}$.

Physical Analysis

Dissolving time of effervescent tablet was tested refers to modified Aslani & Daliri (2016). An effervescent tablet was placed in 200 mL of water drink and the time for dissolving was counted using a stopwatch. The tablet hardness was tested by reference Taymouri *et al*. (2019) with Universal Testing Machine (Zwick/ Z0.5). A tablet is pressed with an awl (4 kg) and the hardness value is shown on the monitor in Newtons. Meanwhile tablets density was 0.56 g mL^{-1}.

Color analysis refers to Keskin *et al*. (2021) with the Chromameter CR 300. The surface of an effervescent tablet was attached to the chromameter and the test included L*, a*, and b*. The L* value indicates the change in lightness with a range of values from 0 (black) to 100 (white). The a* value indicates the red-green mixed chromatic color with a positive value ranging from 0 to 100 for red, and a negative value ranging from 0 to -80 for green. The b* value represents the chromatic color of the blue-yellow. A positive value of b* from 0 to +70 for blue and a negative value from 0 to -70 for yellow. Moisture content was measured by AOAC (2005) reference using the principle of gravimetry.

Chemical Analysis

pH testing was carried out refers to Lynatra *et al*. (2018). The effervescent tablet was dissolved in 200 ml of distilled water then the pH was measured with a pH meter (Horiba pH 130-K). Antioxidant activity was analyzed based on the radical scavenging activity of DPPH (1,1 diphenyl-2-picrylhydrazyl) (Sun *et al*., 2006). A 3 mL of the sample was added to 0.7 mL of 1.2 mM DPPH solution in methanol. The solution was vortexed and incubated in the dark for 30 minutes at room temperature. The absorbance of the solution was measured with a UV-Vis Spectrophotometer (Spektroquant Prove 300) at a wavelength of 517 nm, with aquadest as a control (blank). The amount of radical scavenging activity was calculated by the formula:

% Inhibition =

((% Absorbance blank – Absorbance sample)/Absorbance blank) x 100%

The percentage of DPPH inhibition was calculated using the IC_{50} value (50% Inhibitor Concentration) obtained from the cut of the line between 50% inhibition and the concentration axis using a linear equation (y = bx + a) where y = 50 and x indicates IC_{50} (Molyneux, 2004).

Total phenol was calculated according to Olechno *et al*. (2020). A 0.5 mL of coffee extract was diluted in a measuring flask with distilled water up to 10 mL, then 1 mL was taken and reacted with 5 mL of 2% Na_2CO_3 in a test tube, and 0.5 mL of Follin-Ciocalteu reagent was added and vortexed for 1 minute. Incubation in the dark was done for 30 minutes. The absorbance of the sample was measured at a wavelength of 750 nm with a Spectrophotometer (Spektroquant Prove 300). The blank was distilled water which was treated as a sample. Total phenol content was calculated based on the standard curve of gallic acid expressed as mg GAE/g.

Sensory Analysis

The sensory test was done by a descriptive method. The test was carried out by ten trained panelists. The testing phase begins with the Focus Group Discussion (FGD) of recruited panelists to detect quality attributes expected to appear in the sample. Next, the panelists were introduced to the attributes to be measured. Panelists were trained to detect the intensity and standard of each attribute to be tested. After the panelists recognized and practiced the intensity of the tested attribute standards, the perception of the attributes and intensity was equalized before testing the sample. Sample testing was carried out on Robusta coffee effervesent tablets and effervescent drinks.

Parameters tested on tablets include coffee aroma, sweet aroma, color intensity, brown color, and tablet texture, while the parameters tested on effervescent drinks include coffee taste, sweet taste, sour taste, sour aftertaste, coffee aroma, sweet aroma, brown color, color intensity, body, dissolving time, bubble appearance, and foam appearance.

Data Analysis

Data was analyzed using one-way Anova test. If there was a significant difference, it will be continued with DMRT test with a 95% confidence level. Data analysis was carried out using SPSS version 24 software. Data were presented in mean with standard deviation from three replications.

RESULTS AND DISCUSSION

Physical Characteristics

Dissolution of Tablet

The dissolution rate score of effervescent tablets in water ranged from 4.89 to 5.69 in comparison score 1 for vitamin C tablet (IPI) and 10 for Redoxon tablet. It means that the tablet dissolves in water for a long time. Effervescent tablets were soluble in water due to the reaction of acids and bases in water to produce carbon dioxide gas (Rizal & Putri, 2014). Carbon dioxide produced in the reaction of acids and bases plays an essential role in the solubility of effervescent products in water (Olechno *et al.*, 2020).

Different types of acid caused significant differences in dissolution time. Effervescent tablets prepared with malic acid had the fastest dissolution time than citric acid and tartaric acid, i.e. 166 s, 233 s, and 276 s, respectively. The use of citric acid can cause a faster dissolution time than tartaric acid in developing effervescent tablets from fig leaf extract (*Ficus carica* L.) (Hakim, 2019). Citric acid has a faster solubility in water than tartaric acid, i.e. 160.8% and 143.6%, respectively (Peng *et al.*, 2001). The effervescent tablets from the extract powder of the seven jurai pea leaf (*Phaseolus lunatus* L.) using tartaric acid have a long dissolution time because tartaric acid was difficult to bind the extract powder, causing the reaction between acid and carbonic slow down (Sari, 2019). Previous research of decaffeinated coffee effervescent tablets has a dissolution time of 4.2 minutes (Dharmawan *et al.*, 2016). The different results was found by Regiarti & Susanto (2015), who used malic acid in effervescent extract of noni leaf (*Morinda citrifolia* L.) and gave long solubility time.

Tablet Hardness

The difference in acid type caused a significant difference in the hardness of the effervescent coffee tablets (Figure 1). The hardness of the tablets prepared with citric acid was greater than that of malic and tartaric acids, i.e. 351 N, 321 N, and 108 N, respectively. The hardness of the tablet has been related to the disintegration rate when dissolved in water (Ulfa *et al.*, 2018). It was also related to hygroscopicity. Citric acid has more water-binding properties than tartaric and malic acids (Nariswara *et al.*, 2013). The use of tartaric acid in the formulation causes the powder mixture to be difficult

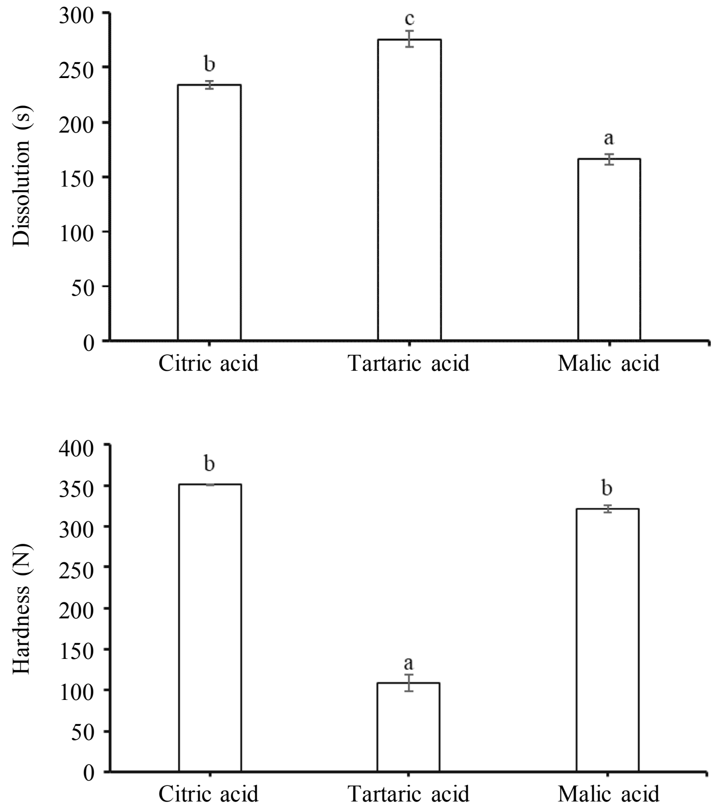

Figure 1. Dissolution time and hardness of coffee effervescent tablets (means of 3 tablets each 2 g) as affected by different acid formula. Data are presented with standard deviation lines. Different letter notations showed significantly different ($P<0.05$)

to agglomerate so that when it is molded into tablets, it produces a more brittle tablet. It also occurs in the effervescence of gambir leaf extract, which uses tartaric acid (Kailaku *et al*., 2012). In addition, the use of tartaric acid in temulawak (*Curcuma zanthorrhiza*) effervescent tablets reduces tablet hardness (Herlina *et al*., 2020).

Color

The L* value represents the dark to light level with a range of 0-100. The use of tartaric acid in coffee effervescent tablets caused the lightness (L*) of the tablets to be larger and significantly different from citric and malic acid treatments (Figure 2). The L* values of tablets with tartaric acid, citric acid, and malic acid were 57, 50, and 47, respectively. When tartaric acid formulated with sodium carbonate will cause the water content of effervescent tablet decrease (Nugroho, 2009). It gives a high lightness (L*) of effervescent coffee tablet. Citric acid is a hygroscopic acidulant (Aslani & Fattahi, 2013), so that decreasing the lightness of the tablet. Malic acid has hygroscopic properties that are almost the same as citric acid (Regiarti & Susanto, 2015), so it can be used as an alternative of citric acid in the manufacture of effervescent (Chemical Book, 2021). It may cause the lightness value the same as citric acid formula.

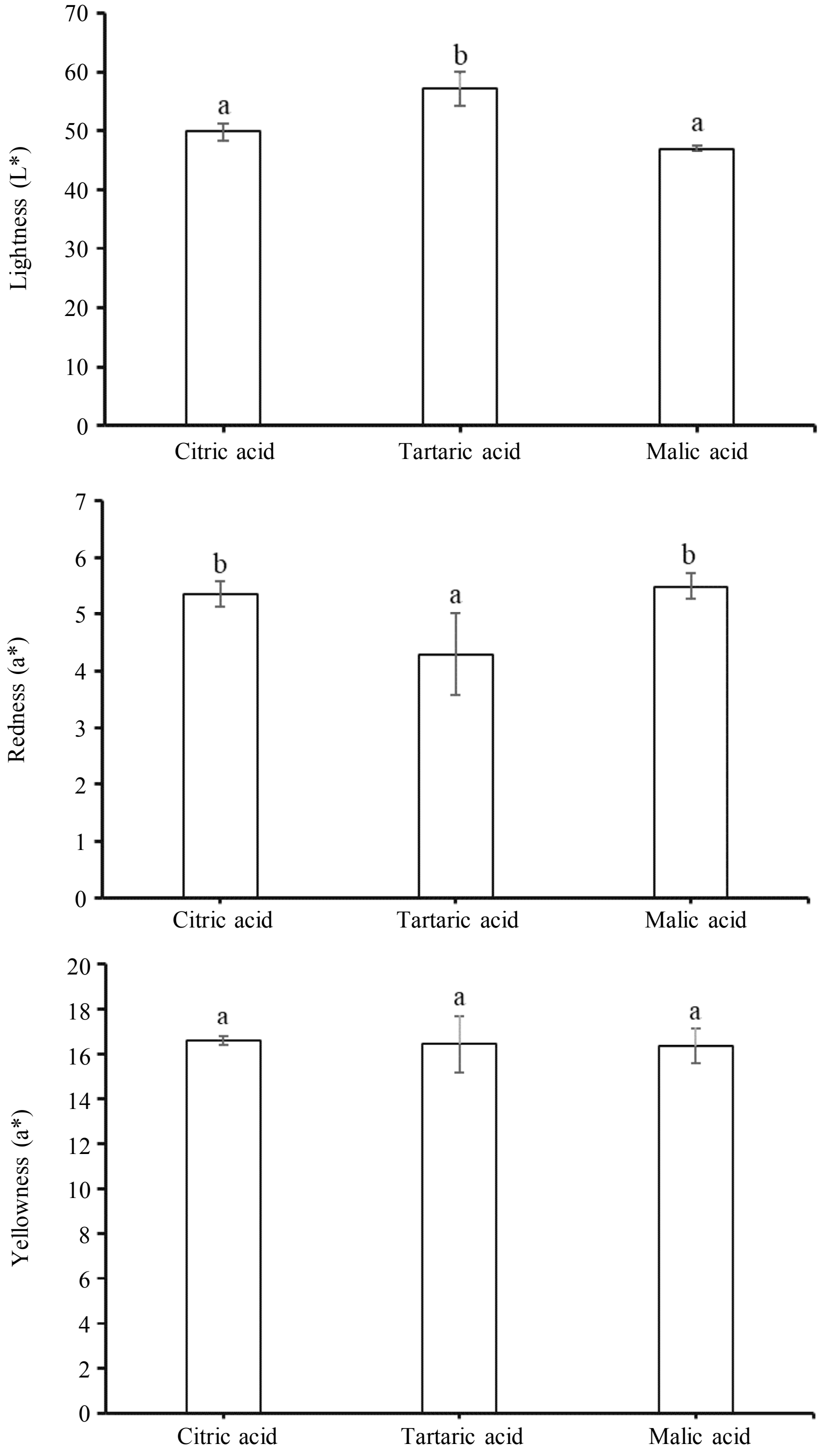

Figure 2. L*, a*, and b* values of coffee effervescent tablets as affected by different acid formula. Data are presented with standard deviation lines. Different letter notations showed significantly different ($P<0.05$)

The a* value of results of this study is positive, which indicates the red color (Yam & Papadakis, 2004). The use of tartaric acid caused a significantly lower redness value than the treatment of citric acid and malic acid (Figure 2). This difference was possible because the color of the citric and malic acid powder was the same, while the tartaric acid was slightly different (Chemical Book, 2021). The a* value of effervescent tablets as a result of this study ranged from 4.3 to 5.5.

The b* value of coffee effervescent tablets was positive indicating a yellow color (Yam & Papadakis, 2004). The different types of acid did not cause a significant difference in the value of yellowness (b*) (Figure 2). The yellowish value of the effervescent coffee tablets ranged from 16.3 to 16.6.

The sensory color intensity score of the effervescent coffee tablets ranged from 3.3 to 4.84 (Figure 5). It means that the tablet had a bright color intensity. The difference in acid used did not affect the sensory color intensity of the tablets. The light and dark color of the tablet was influenced by the intensity of the color of the coffee extract powder, which tends to be bright brown, and other additives, which are white. It was following the results of the tablet's lightness value (L*), which shows an equivalent value in the range of 47-57.

The sensory color intensity score of coffee drink given by the panelists ranged from 5.05 to 5.38. It means that the effervescent coffee drink was faint in color. Effervescent drinks have a fainter color than tablet form. The acid difference did not have a significant influence on the intensity of the drink's color.

.The brown color score of effervescent coffee tablets prepared with citric acid (5.65) was distinguishable from tablets with tartaric acid (4.43) and malic acid (4.43). It means that tablets made with citric acid were dark brown, while tablets with tartaric acid and malic acid were light brown. This difference may be related to the higher water content of tablets prepared with citric acid than the other two acids.

The brown color of the effervescent drink has a score ranging from 5.24 to 5.66. It means that the effervescent coffee drink was light brown. The brown color of coffee was formed during the roasting of beans due to the Maillard reaction and caramelization (Franca *et al.*, 2009).

Tablet Surface Texture

The sensory surface texture of the tablet was detected by touching it with a fingertip on the tablet. The coffee effervescent tablet texture score ranged from 6.05 to 6.42. It means that the surface texture of the tablet was relatively smooth. The difference of acid in tableting did not affect the surface texture of tablets.

Moisture Content

Moisture content was an important parameter and affects the stability of tablet quality (Bjerknes *et al.*, 2017). Different types of acid significantly affect the difference in moisture content of coffee effervescent tablets (Figure 3). The moisture content of tablets with citric acid was significantly higher than malic acid and tartaric acid, i.e. 8.9%, 8%, and 7.4%, respectively. It was due to the different levels of hygroscopicity of the three acids. Citric acid was more hygroscopic than tartaric and malic acids (Regiarti & Susanto, 2015). The moisture content of this effervescent coffee tablet was still lower than some effervescent tablets made from red dragon fruit skin (*Hylocereus polyrhizus*)

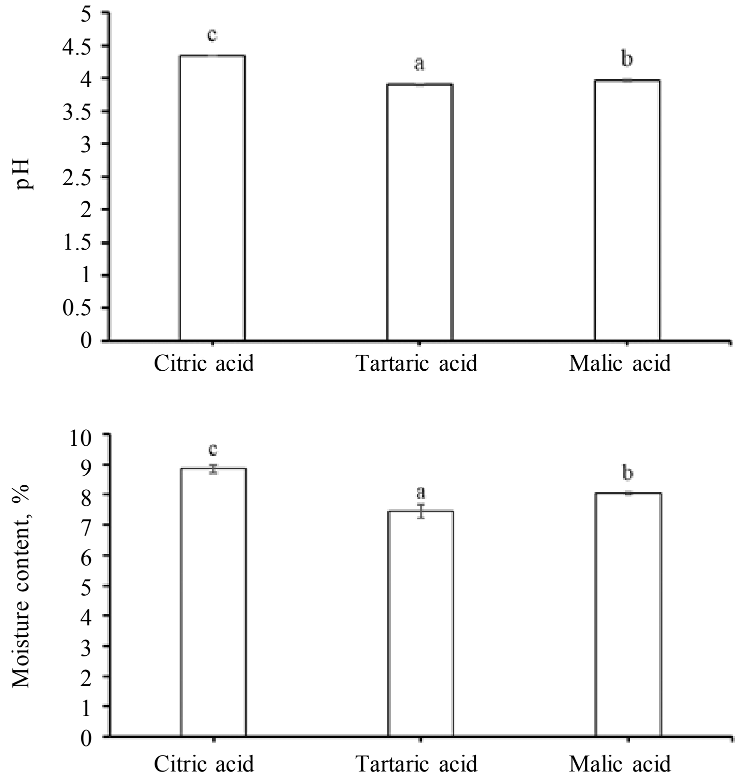

Figure 3. pH and moisture content of coffee effervescent tablets as affected by different acid formula. Data are presented with standard deviation lines. Different letter notations showed significantly different ($P<0.05$)

and bay fruit (*Syzygium polyanthum*) those are 11.2% (Pribadi *et al*., 2014), and jackfruit effervescent tablet (26.9%) (Mutiarahma *et al*., 2019). While other effervescent tablets have lower water content than this study, including ginger effervescent (1%) (Kartikasari *et al*., 2015), and temulawak (*Curcuma zanthorrhiza*) effervescent tablets (1.19% to 5.08%) (Herlina *et al*., 2020)

Bubble

Bubbles sensorily appear on the effervescent due to the release of carbon dioxide from the reaction of acids and bases (Anova *et al*., 2016; Kailaku *et al*., 2012). Bubble scores range from 4.33 to 4.89, it means that few bubbles are formed. The acid difference did not significantly impact on the amount of bubbles formed.

Foam

The panelists gave a score for the sensory appearance of foam ranging from 4.1-4.39. It means that only a tiny amount of foam was formed. Foam appears on the surface of the effervescent drink, due to the reaction of acids and bases in water to form carbon dioxide. Furthermore, this gas was trapped in the material matrix and become foam (Egeten *et al*., 2016). The acid difference did not affect the amount of foam formed.

Chemical Characteristics

pH

Different types of acids cause significantly different pH values (Figure 3). The use of citric acid resulted in higher effervescent pH than malic acid and tartaric acid, i.e. 4.35, 3.97, and 3.91, respectively. The closer to neutral pH, the better the effervescent tablet will be. This difference in effervescent pH may be related to the pH of the acid source. Jackfruit effervescent tablets with 10% citric acid resulted in a pH value of 8.2 (Mutiarahma *et al*., 2019), while the use of citric acid in effervescent probiotics produces a pH of 5-7 (Oktavia *et al*., 2018). Tartaric acid used to manufacture effervescent green tea extracts results in pH of 5.86 (Lestari & Desihapsari, 2011). Malic acid used in the manufacture of pandan effervescent produce a pH of 6.6 (Widyaningrum *et al*., 2015).

Antioxidant Activity

Antioxidant activity was expressed by the IC_{50} value, which indicates the inhibitory concentration of 50% diphenylpicrylhydrazil (DPPH) (Molyneux, 2004). The smaller the IC_{50} value, the higher the antioxidant activity. The IC_{50} value of effervescent coffee tablets with citric acid was significantly higher than malic acid and tartaric acid, i.e. 8.6 mg mL^{-1}, 5.5 mg mL^{-1}, and 5.3 mg mL^{-1}, respectively.

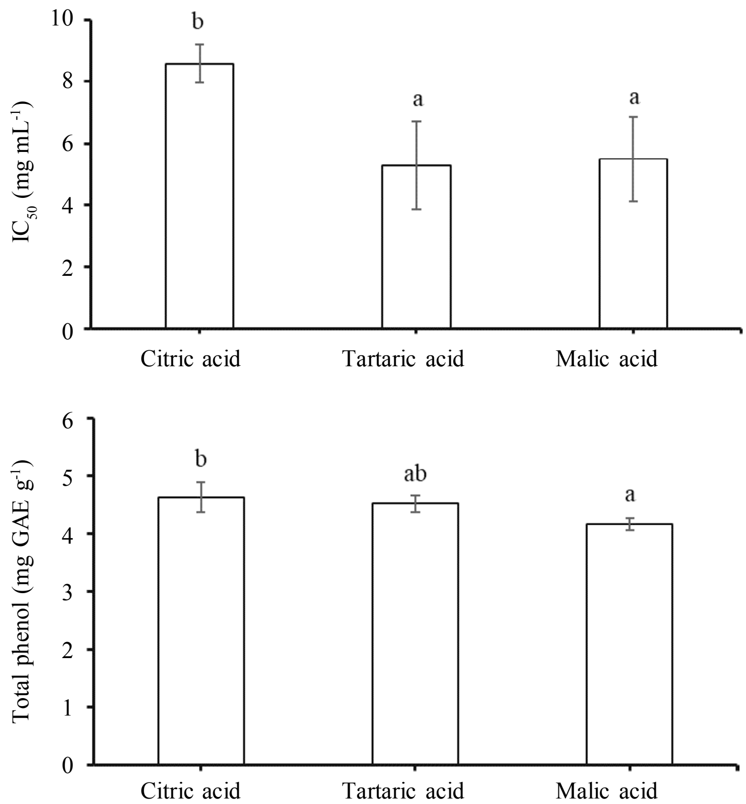

Figure 4. Antioxidant activity and total phenol of coffee effervescent tablets as affected by different acid formula. Data are presented with standard deviation lines. Different letter notations showed significantly different ($P<0.05$)

It indicates that the antioxidant activity of effervescent tablets prepared with citric acid was lower than the other two acids.

Several previous studies reported anti-oxidant activity on effervescent. Rachmaniar *et al*. (2016) reported that the effervescent red guava with citric acid 9.4% and tartaric acid 18.8% had an IC_{50} value of 22.6 ppm. The effervescent tablet combination of sensaat leaf extract (*Melastoma malabathricum* L.) and lactic acid bacteria curd using 14% tartaric acid and 12.5% citric acid had 54.5% anti-oxidant activity (Diza *et al*., 2019). Green tea effervescent tablets could inhibit linoleic acid oxidation by 50.6% at 10-day incubation (Rohdiana *et al*., 2005). Effervescent pandanus (*Pandanus amaryllifolius* Robx) made with tartaric acid, citric acid, and malic acid had IC_{50} values of 29.8 mg mL^{-1}, 33.01 mg mL^{-1}, and 36.7 mg mL^{-1}, respectively (Widyaningrum *et al*., 2015). Ant nest (*Myrmecodia platyrea*) effervescent drink tablets made with 5% citric acid and 5% tartaric acid had an antioxidant activity of 86.3% (Sari *et al*., 2015).

Total Phenol

According to Dungir *et al*. (2012), phenol compounds significantly contribute to anti-oxidant activity. The difference in acid used in producing of effervescent tablets of Robusta coffee tends significantly affect the total phenol content (Figure 4), but this results are contradictive with the previous study. The total phenol content of malic acid in coffee effervescent tablets was smaller than that of tartaric acid and citric acid, i.e. 4-4.2 mg GAE g^{-1}, 4.4-4.6 mg GAE g^{-1}, and 4.3-4.7 mg GAE g^{-1}, respectively. Effervescent powder of beluntas leaf extract (*Pluchea indica*) made with 12% citric acid and 10% tartaric acid, contain total phenol 2.5 mg GAE g^{-1} (Hudha & Widyaningsih, 2015). Meanwhile, the ant nest (*Myrmecodia platyrea*) effervescent tablet made with 5% citric acid and 5% tartaric acid had a total phenol 3 mg GAE g^{1} (Sari *et al.,* 2015). The effervescent tablet combination of sensaat leaf extract (*Melastoma malabathricum* L) and lactic acid bacteria curd using 14% tartaric acid and 12.5% citric acid had a total phenol of 0.86 mg GAE g^{1} (Diza *et al*., 2019). Lamtoro gung (*Leucaena leucocephala*) effer-vescent powder prepared with 34% citric acid and 8.4% malic acid had a total phenol of 55.4 mg 100 g^{-1} (Rosida *et al*., 2017).

Tablet Sensory Profile

Overall, the sensory profile of effervescent tablets prepared with tartaric and malic acids was distinguishable from that of effervescent tablets prepared with citric acid (Figure 5).

Sweet Aroma

Coffee effervescent tablets have a sweet aroma score ranging from 5.26 to 6.35, or moderately sweet aroma. The appearance of a sweet aroma is caused by sugar in the coffee extract powder. The compound that contributes to this sweet aroma was furaneol (2,5-dimethyl-4-hydroxy-(2H)-furan-3-one) which has a sweet and caramel description (Hameed *et al*., 2018).

The sweet aroma score of effervescent drinks ranged from 2.28 to 3.55 (weak). Slightly detectable sweet aroma in efferves-cent drinks is due to the presence of sucrose and maltodextrin in the formulation. The difference in acid used did not affect the sweet aroma of effervescent drinks.

The sweetness score of effervescent drinks ranged from 2.34 to 2.43, or no sweet-ness. The addition of sucrose did not affect the appearance of sweetness in effervescent drinks. The difference in acid used also did not affect the sweet taste.

Coffee Aroma

The coffee aroma score on the effervescent tablets ranged from 5.19 to 5.91, it means that the tablet had a weak coffee aroma. The difference of acid used in effervescent tablets did not affect the aroma of the tablet.

The aroma of coffee effervescent drinks ranged from 4.53 to 5.04. it was similar to the aroma of coffee effervescent tablets. The difference of acid used did not affect the aroma of the coffee.

Sourness

The sour taste score of effervescent drinks ranged from 4.89 to 5.07, or moderately sour taste. The difference in acid used did not affect the sour taste of effervescent drinks. The sour taste arises due to the addition of acid in the formulation by 8%.

Coffee Taste

Effervescent coffee flavor scores ranged from 3 to 3.19. The difference in acid used did not affect the taste of effervescent coffee. The taste of coffee due to the chlorogenic acid in the coffee beans which arise during roasting. It will react with proteins and polyphenolic compounds to form melanoidins. Melanoidin contributes to the formation of color and flavor in steeping. At the same time, the remaining chlorogenic acid contributes to the bitter taste sensation of coffee (Gafar, 2018). The caffeine content in coffee also contributes to the distinctive bitter taste of coffee (Rahmawati & Fibrianto, 2018; Poole & Tordoff, 2017; Ong *et al*., 2018). In addition, other compounds that cause a bitter taste in coffee include mozambioside, bengalensol, cafestol, and kahweol (Lang *et al*., 2020).

Sour Aftertaste

The sour aftertaste was the sour taste that remains after swallowing coffee drinks. The sour aftertaste score ranged from 4.18 to 5.17. It means that effervescent drinks have a weak acid aftertaste. The acid used difference did not cause a different aftertaste.

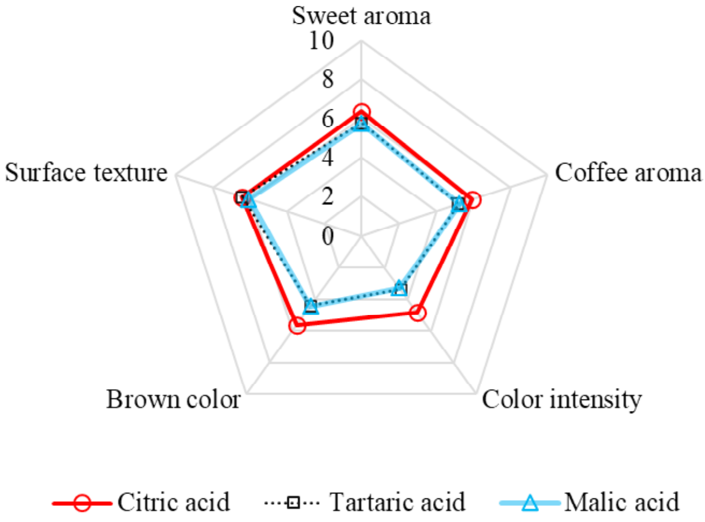

Figure 5. Descriptive profile of coffee effervescent tablets

Body

The body was the impression of heavy or light fluid in the mouth, especially felt between the tongue and the roof of the mouth. It was produced from dissolved solids and fats suspended in a liquid (Setyani *et al*., 2018). The average body score of effervescent drinks ranged from 3.49 to 4.3. It means that effervescent drinks have a weak body. The use of citric acid causes the body of the effervescent drink to approach the body of Robusta coffee, whereas the use of tartaric acid and malic acid causes the body approach the body of Arabica coffee drinks. The body in this effervescent drink arises because the primary raw material was Robusta coffee which contains lipids and polysaccharides (Mulato & Suharyanto, 2012). The body of Arabica coffee drinks was lower than Robusta, considering that Arabica coffee contains lower protein than Robusta (Tarigan *et al*., 2015).

CONCLUSIONS

Different types of organic acid cause significant differences in physical properties of Robusta coffee effervescent tablets including dissolution time, pH, hardness, and lightness (L*). Malic acid causes a faster dissolution time than citric acid and tartaric acid. Malic acid and tartaric acid tend to lower the pH slightly than citric acid. Malic acid and citric acid tend to produce harder tablets than tartaric acid. Tartaric acid slightly increased brightness (L*) of tablets compared to malic acid and citric acid. In addition, the different types of organic acids also cause significant differences in chemical properties, including moisture content, antioxidants, and total phenol. Tartaric acid and malic acid tend to reduce moisture compared to citric acid. The IC_{50} value of effervescent with malic acid and tartaric acid is lower than that of citric acid. However, there was a slight decrease in total phenol in both. In general, the different types of acid did not cause significant differences in the sensory profiles of tablets and effervescent drinks. The sensory profile of the effervescent tablet had a moderate sweet aroma, a light to dark brown tablet color, and a reasonably smooth surface texture. Meanwhile, the sensory profile of effervescent drinks had a weak sweet aroma, a weak aroma coffee, a mild sour taste, and weak body. The best acid treatment according to the main parameters is malic acid.

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