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Phytochemical and Pharmacological Activities of Three Colors Fruit (Eugenia Uniflora L) As Antidiabetes and Antibacteries

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Abstract

Eugenia uniflora with local name Indonesia Dewandaru is a plant of the family Myrtaceae. It has green, orange, red, to blackish purple fruits which is widespread in South America, Asia, Africa and Australia. E. uniflora can be used as traditional medicine. The fruits is parts of plants that are widely used in various field nutrition, cosmetic and health, . The active secondary contained in this fuits were applied in anti inflammatory, anti diabetic, adstringent and antioxidant. Several active compounds found in fruits such a carotene esensial oil and polyphenols have been reported to have some biological activities such as antioxidant antidiabetic and antibacterial. The level maturity of fruits level is related to the contend of secondary metabolites such a fenoloic, carotene esential oils. The color of E. uniflora fruit is related to the active phytochemical content and antioxidant activity. Three colors of E. uniflora fruit contain beta carotene and phenolic compounds, essential oil, the highest content of phenolic compounds and antioxidants is found in purple fruit This review provides insight into the effort of discovery and development of pharmaceutical agents derived from fruits of Dewandaru (Eugenia uniflora) plants to make product.

Keywords
eugenia uniflora; phytochemicals; essential oil; antidiabetic; antibacterial

I. Introduction

Eugenia uniflora is a dicotyledonous plant group consisting of approximately 130 genera and 3800-5800 species of shrubs or trees. Eugenia uniflora has been found on all continents except Antarctica with local name Dewandaru (Santoso, et al, 2019) most in the tropics and subtropics (Consolini, et al., 2002). There are three types of Eugenia uniflora fruit which are abundant, fruit with orange, red and purple flesh (Purco, et al., 2008). Other plants belonging to this genus are usually included in perennial trees or shrubs that have a fruit form and can be consumed.Eugenia uniflora has been known to have many pharmacological antivities including antidiabetic, antirheumatic, anti-diarrheal, antipyretic, anti-inflammatory, antifungal, antibacterial, antioxidant and cytotoxic (Roccheti, et al., 2020). Some plant parts of Eugenia uniflora are reported to have potential as chemical ingredients in the manufacture of drugs that have antioxidant and anti-inflammatory (Roccheti, et al., 2020). Changes in volatile constituents and phenolic compounds were investigated during fruit development of three pitanga biotypes. The constituents were submitted to multivariate analysis and fruit samples were differentiated by selina-1,3,7 (11) -trien-8-one (38.2 ± 2.9%) and epoxide (26.4 ± 7.2%) for the biotype. red-orange; by curzerene (15.04 ± 2.1%) and atractylone (8.47 ± 2.1%) for red biotype; and by spathulenol (3.7 ± 0.8%) and germacrone (54.7 ± 3.1%) for the purple biotype (Ramalho et al., 2019). Hydrolyzed tannins such as mono-O-galloyl-d-

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glucose, 1,2,6-tri-O-galloyl-β-d-glucose, tellimagrandin II, and eugeniflorin D2 were identified, as well as oenothein B as the main compound (32.43 ± 7.1mg / g dried fruit). During the maturation of the pitanga, the anthocyanin content increases, while the flavonoid and tannin content decreases. The higher content of most phenolic compounds occurs in the red-orange biotype. The biosynthesis of phenolic compounds is influenced by the biotype and degree of maturity, while the chemovarization of the essential oil constituents is mainly due to the biotype, thus confirming the chemotype ofessential oil E. uniflora (Olievera et al., 2017).

Antioxidants are compounds that can capture free radicals, because they can donate one electron. Antioxidants are divided into two types, namely natural antioxidants derived from fruits and other plants and synthetic antioxidants. Several research results indicate that fruits have antioxidant activity, one of which is the fruit dewandaru (Eugenia uniflora). The antioxidant activity of dewandaru fruit is due to the presence of secondary metabolites such as flavonoids, phenolics, tannins and anthocyanins (Bagetti, et al. 2011)

Figure 1. *Eugenia uniflora* L

Changes in volatile constituents and phenolic compounds were investigated during fruit development of three pitanga biotypes. The constituents were submitted to multivariate analysis and fruit samples were differentiated by selina-1,3,7 (11) -trien-8-one (38.2 ± 2.9%) and epoxide (26.4 ± 7.2%).

II. Review of Literature

2.1. Phytochemical Constituents of Eugenia Uniflora

Antioxidants are compounds that can capture free radicals, because they can donate one electron. Antioxidants are divided into two types, namely natural antioxidants derived from fruits and other plants and synthetic antioxidants. Several research results indicate that fruits have antioxidant activity, one of which is the fruit dewandaru (*Eugenia uniflora*). The antioxidant activity of dewandaru fruit is due to the presence of secondary metabolites such as flavonoids, phenolics, tannins and anthocyanins (Bagetti *et al.,* 2011).

Carotenoids are pigments that give a yellow, orange, to red color. Carotenoids are the companion pigments of chlorophyll or leaf green substances that carry out the function of absorbing light energy for photosynthesis (Garg, *et al.,* 2016). The red color of the dewandaru fruit shows the red color of the dewandaru fruit which shows the content of carotenoid compounds (Stahi, *et al.,* 2005). In dewandaru leaves, phenolic compounds are found. Carotenoids and phenolics act as antioxidants to fight free radicals that enter the human body (Vison, *et al.,* 1998). Dewandaru fruit and leaves can also be used to increase astringent quality and reduce high blood pressure. In Brazilian folk medicine, dewandaru fruit is used as an antidiarrheal, diuretic, antirheumatic, antifebrile, and antidiabetic.

The fruit of *Eugenia uniflora* contains various volatiles of monoterpenes, namely trans-β-ocimene, cis β-ocimene and β-pinene which dominate (Mesquita, *et al.,* 2016), besides these compounds curzenene and bergaptene have also been reported to be present in dewandaru fruit (Mesquita, *et al.,* 2016). Monoterpenes (mass 75.3%) were found from the largest volatile class of dewandaru fruit including trans-β-ocimene (36.2%), cis-ocimene (13.4%), isomeric β -ocimene (15.4%) and β -pinene (10.3%). The volatile profile of dewandaru at the four maturation stages consists mostly of terpenoids (monoterpenes and sesquiterpenes), the volatile profile is also influenced by the maturation stage (Consolini, *et al.,* 2002). Based on the explanation above, an article review was conducted regarding the phytochemical content of the dewandaru fruit and its pharmacological activity.

The dewandaru fruit (*Eugenia uniflora*) is also known as Brazilian cherry or Surinam cherry. The phytochemical content of the Eugenia species revealed the presence of flavonoids, tannins, terpenoids, and essential oils (Weyerstahi, *et al.,* 1988). Dewandaru fruit also has health benefits. In the Brazilian food industry, dewandaru fruit is widely used to produce frozen juices and pulp. Pulp production has high economic potential because the product has consumer appeal and a high concentration of antioxidant compounds, such as anthocyanins, flavonols, and carotenoids.

Flavonoids are an important class of natural products included in plant secondary metabolites which have a polyphenol structure. Flavonoids are found in many fruits and plants, one of which is the dewandaru plant. Flavonoids have biochemical and antioxidant effects that have potential as anticancer, antidiabetic and antibacterial properties. Flavonoids can be associated with pharmacological effects and can be used as an important component in a variety of nutritional products, pharmaceuticals, pharmaceuticals and cosmetics. This use is due to the potential effects of flavonoids as antioxidants, anti-inflammatory, anti-mutagenic, and anti-carcinogenic (Khoo, *et al.,* 2017).

Anthocyanins are blue, red, or purple pigments found in plants, especially flowers, fruits, and tubers (Salehi, *et al.,* 2018). Under acidic conditions, anthocyanins appear as red pigments while blue pigments in alkaline conditions. Anthocyanin is considered as one of the flavonoids even though it has a positive charge on the oxygen atom from the C-ring in the basic flavonoid structure. Anthocyanin stability depends on pH, light, temperature, and structure (Escarpa, *et al.,* 2001).

Antioxidants are compounds that inhibit oxidation. Oxidation is a chemical reaction that can produce free radicals, causing a chain reaction that can damage the cells of the organism (Zamuz, *et al.,* 2018). Antioxidants, such as thiol or ascorbic acid (vitamin C) end this chain reaction (Rahmi, *et al.,* 2017). To balance the oxidative state, plants and animals maintain overlapping complex systems of antioxidants, such as glutathione and enzymes (for example, catalase and superoxide dismutase), produced internally, or dietary antioxidant vitamins C and E. Induction of antioxidant defenses or reduced levels of ROS / RNS endogenous is a fast and clear indicator of oxidative stress (Pawar, *et al.,* 2016). Tannins are astringents, bitter plant polyphenols that bind and precipitate or shrink proteins (Alice, *et al.,* 1991).

III. Research Methods

This review was carried out using bibliographic research , and in. We used specialized databases Web of Science, Scielo, Lilacs, Pubmed, Science Direct, Scopus, and an article selected from Google Scholar and included Eugenia and antimicrobial activity, fruit of Eugenia uniflora Eugenia and chemical composition as key words for the literature searches. The articles included in this manuscript were original articles. Further, articles containing isolated compounds identified t and articles reporting antimicrobial and antidiabet activity were included. Duplicate items or items that were not within the review area of interest were excluded. The three major compounds identified in the fruit studied were selected for the chemical composition of the essential oil poilyfenol and caroten.

IV. Result and Discussion

4.1. Essential Oils of Tree Colors

Based on the table of phenolic and beta carotene compounds found in the three fruit colors of dewandaru, according to Denardin et al., 2015 said that the content of secondary metabolite compounds such as phenolic and beta carotene is found in the three colors of dewandaru fruit, namely orange, red and purple. The content of secondary metabolites such as beta carotene and phenolic have potential as antidiabetic where phenolic compounds which are included in the flavonoid class can inhibit glucose reabsorption from the kidneys and can increase the solubility of blood glucose so that it is easily excreted in urine (de Carvalho et al., 2019)Artikel Dewandaru (Eugenia Uniflora L). (n.d.).

de Carvalho, F. A. L., Lorenzo, J. M., Pateiro, M., Bermúdez, R., Purriños, L., & Trindade, M. A. (2019). Effect of guarana (Paullinia cupana) seed and pitanga (Eugenia uniflora L.) leaf extracts on lamb burgers with fat replacement by chia oil emulsion during shelf life storage at 2 °C. Food Research International, 125(May), 108554. https://doi.org/10.1016/j.foodres.2019.108554.

Dewandaru contains flavonoid and phenolic monoterpene compounds (75.3%) found as the highest essential oil content in Dewandaru fruit. Other compounds are transbeta-ocimene (36.2%), cis-ocimene (13.4%), isomenic beta-ocimene (15.4%), and beta-pinene (10.3%). The therapeutic properties of leaf extracts such as selina-1,3,7 (11) -trien-8-one are also found in fruit volatile extracts (Consolini, et al., 2002). Essential oils from Eugenia species comprise approximately 300 compounds that have been previously identified, with cyclic sesquiterpenes predominating and monoterpenes found in smaller quantities. A few species produce aliphatic and aromatic compounds (Souza et al., 2018). Colors of Fruits of Eugenia uniflora orange, red , blackis purple have been investigated for their different composition , phenolic compounds and esential oil was influenced by biotype and maturity degree. Blackis purple is the fruit of the Dewandaru with the highest maturity level, so blackis purple is contain to high phenolic compounds and essential oils. This suggests the possibility of the fruit having therapeutic benefits such as leaf extract (Consolini, et al., 2002). The table of essential oil content in dewandaru fruit can be seen in Table 1.

COLOR OFFRUIT	ORANGE	RED	PURPLE	References
Type of oil and%.	Selina-1,3,7 (11) -trien-8-one (38.2 ± 2.9%) and epoxide (26.4 ± 7.2%), germacrene B (9.55,%), γ -elemene (8.55%), β-elements (7.37%), germacrene D (5.48%), γ-muurolene (5.28%) e β-caryophillene (7.09%), curzerene (20.50%).	Curzerene (15.04 ± 2.1%), atractylone (8.47 ± 2.1%), germacrene B (9.04%), γ-elements (8.14%), β-elements (4.99%), germacrene D (6, 08%), γ-muurolene (7.67%) e β-caryophillene (3.44%).	Spathulenol (3.7 ± 0.8%), germacrone (54.7 ± 3.1%) germacrene B (9.60%), γ-elements (7.97%), β-elements (9.26%)), germacrene D (6.46%), γ-muurolene (5.02%), e β-caryophillene (5.17%).	Ramalho *et al.,* 2019, Mesquita *et al.,* 2016.

Fruit ripening is a natural phenomenon that is easily detected due to various underlying chemical transformations involving volatile compounds that produce aroma. According to Jessica's 2019 research which has the aim of verifying the volatile profile emitted during the ripening process of pitanga fruit (*Eugenia uniflora*) using solid phase microextraction (HS-SPME) combined with gas chromatography-mass spectrophotometry (GC-NONA). By analyzing the volatile composition of the four volatiles at four different ripening stages, we identified 33 compounds. The volatile profile of pitanga at the four maturation stages consists mostly of terpenoids (monoterpenes and sesquiterpenes) (Silva, *et al.,* 2019). We also show that the volatile profile is influenced by the maturation stage. In addition, it has been observed that esters appear to be preferably biosynthesized at a later maturation stage. Multivariate statistical analysis allows organizing the data set in an easy-to-understand structure (Salehi, *et al.,* 2018)

According to Misquita *et al.,* 2016 the highest essential oil content is found in purple dewandaru fruit. Several other studies have stated that Dewandaru also has antimicrobial properties from its essential oil content. Research that has been conducted by Sobeh *et al.*,2016 on the antimicrobial ability of Dewandaru essential oil extract. The results of these studies indicate an inhibitory power against the growth of gram-positive bacteria such as *Staphylococcus aureus, S. epidermidis, Bacillus. licheniformis, B. subtilis, Enterococcus faecalis, and gram-negative bacteria such as Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa,* as well as the fungi *Candida parapsilosis* and *C. Albicans* (Sobeh, *et al.,* 2016).

According to the latest research,plant species *Eugeniasuch as E. calycina, E. pyriformis, E.umbelliflora, E.uniflora, and Eugenia uruguayensis* show that there are potential good barriers against gram-positive and gram-negative bacteria as well as fungi or yeast. Samples of ethanol, methanol and ketonic extracts and essential oils were evaluated against the stresses of several microorganisms showing MIC values ranging from 7 to 100 µg / ml (Souza, *et al.,* 2014). The antimicrobial activity that has been observed is attributed to different bioactive compounds which have an impact on the growth and metabolism of these microorganisms. This medicinal plant is known to produce antimicrobial substances that contain many chemicals such as alkaloids, lignins, phenolic compounds and terpenoids. Antimicrobial potential is being observed against stimulation in gram-positive and gram-negative bacteria as well as yeast or fungi. Where the resulting MIC values ranged from 156.2 to 500 µg / ml in dewandaru fruit (*Eugenia uniflora*) (Cavalcante, *et al.,* 1992).

The essential oil, leaf, stem, and seed extracts of *Eugenia uniflora* have been widely studied for their activity against gram-positive and gram-negative bacteria. As for some

species of yeast-like fungus and compared with standard medicinal activity. There are several studies on the antimicrobial activity of the isolated compounds (Souza, *et al.*, 2014).

4.2. Polyphenols and Cyanidins

Phenolic compounds are compounds produced by plants in response to environmental stress. Phenolic compounds function as protectors against UV-B rays and cell death to protect DNA from dimerization and damage (Consolini, *et al.*, 2002). The components in this compound are known to have an important role as a preventive agent and treatment of several diseases such as arteriosclerosis, brain dysfunction, diabetes and cancer (Consolini, *et al.*, 2002). The phenolic and beta carotene content in dewandaru fruit can be seen in Table 2.

COLOUR OF FRUIT	Phenolic compounds	References
ORANGE	- Carotenoids: lycopene, rubixanthin, cis-rubixanthin, β-cryptoxanthin, cis-lycopene, β-carotene, γ-carotene, zeaxanthin, lutein, violaxanthin, and β-carotene-5,6-epoxide - selina-1,3,7 (11) -trien-8-one (38.2 ± 2.9%) and epoxide (26.4 ± 7.2%) - lycopene, β-cryptoxanthin, and β-carotene lycopene, rubixanthin, cis-rubixanthin, β-cryptoxanthin, cis-lycopene, β-carotene, γ-carotene, zeaxanthin, lutein, violaxanthin, and β-carotene-5,6-epoxide	Denardin *et al.*, 2015, Bagetti *et al.*, 2011, Cristiane *et al.*, 2015, Ramalho *et al.*, 2019.
RED	- Quercetin, myricetin - Anthocyanins (Delphinidin-O-glucoside, Cyanidin3-O-glucoside, Cyanidin-O-galactoside, Petunidin-O-hexoside, Pelargonidin3-O-glucosidea, Pelargonidin-O-Routoside, Malvidin3-O-pentoside, glucosidea, Malvidin-O-pentoside, glucosidea Malvidin-O-acetylhexoside). - lycopene, β-cryptoxanthin, and β-carotene - Carotenoids: lycopene, rubixanthin, cis-rubixanthin, β-cryptoxanthin, cis-lycopene, β-carotene, γ-carotene, zeaxanthin, lutein, violaxanthin, and β-carotene-5,6-epoxide - Curzerene (15.04 ± 2.1%)	Migues *et al.*, 2018, Pathise *et al.*, 2017, Denardin *et al.*, 2015, Bagetti *et al.*, 2011, Cristiane *et al.*, 2015.

	and atractylone (8.47 ± 2.1%) lycopene, rubixanthin, cis-rubixanthin, β-cryptoxanthin, cis-lycopene, β-carotene, γ-carotene, zeaxanthin, lutein, violaxanthin, and β-carotene-5,6-epoxide.	
Purple	- Myricetin, quercetin, and lutein - Myricetin, quercetin and lutein - Quercetin, myricetin - Anthocyanins - pathulenol (3.7 ± 0.8%) and germacrone (54.7 ± 3.1%) - Carotenoids: lycopene, rubixanthin, cis-rubixanthin, β-cryptoxanthin, cis-lycopene, β-carotene, γ-carotene, zeaxanthin, lutein, violaxanthin, and β-carotene-5,6-epoxide lycopene, rubixanthin, cis-rubixanthin β-cryptoxanthin, cis-lycopene, β-carotene, γ-carotene, zeaxanthin, lutein, violaxanthin, and β-carotene-5,6-epoxide	Griffis *et al.*, 2013, Manners *et al.*, 2012, Oliveira et al., 2017, Denardin *et al.*, 2015, Cristiane *et al.*, 2015, Ramalho *et al.*, 2019.

Several species of *Eugenia* are used in traditional medicine as antibacterial and anti-inflammatory agents, attributable to high concentrations of polyphenolic compounds, hydrolysable tannins, and flavonoids. According to Dutta, 2005 beta carotene is a pigment organic yellow, orange or red naturally occurring orange in photosynthetic plants,algae, some types of fungi and bacteria. So the orange color of Dewandaru fruit has the highest beta carotene content.

4.3. Biological Activities

a. Antimicrobial Activity

The antimicrobial activity test with antibiotics has differences in the antifungal control used. Where the controls include agar diffusion, diffusion discs, bioautography, macrodilution, and microdilution.species were *Eugenia* tested against ATCC and clinical isolates of gram-positive and gram-negative bacteria, as well as yeast-like fungi (Peixoto, *et al.*, 2010). Dewandaru fruit red color indicates the content of carotenoid compounds. Carotenoids are long polyene chains that have 35-40 carbon atoms, these polyene chains are responsible for their function as antioxidants (Corol, *et al.*, 2002). Dewandaru fruit and leaves can also be used to improve astringent qualities and reduce high blood pressure. In Brazilian folk medicine, dewandaru fruit is used as an antidiarrheal, diuretic, antirheumatic, antifebrile, and antidiabetic.

Dewandaru leaf extract can be used as a hypotensive agent and inhibits the increase in plasma levels of triglycerides and glucose. The red Brazilian cherry, Eugenia uniflora, is widely used in traditional medicine. The aim of this study was to investigate the phytochemical composition of a methanol extract from leaves of E. uniflora and

characterization of the isolated compounds. In addition, we aimed to determine the antioxidant activities in vitro and in a cell-based (HaCaT cell) model. We also studied the anti-inflammatory, analgesic, antipyretic and antidiabetic activities in relevant rat models. The molecular mode of action of the antidiabetic activities was also investigated (Sobeh *et al.,* 2019).

A plethora of substantial pharmacological properties indicates that Eugenia uniflora is a good antioxidant and a sustainable by-product with solid therapeutic potential for treating diabetes, inflammation, pain and related oxidative stress diseases (Sobeh *et al.,* 2019).

Diabetes mellitus is a disease when the body cannot produce insulin or the amount of insulin is insufficient but it works poorly characterized by high levels of sugar in the blood (He K, *et al.,* 2011). This disease is motivated by environment and age, smoking, family history of diabetes mellitus (inherited), obesity and damage to the pancreas gland (no longer produces the hormone insulin or produces little of the hormone) (He K, *et al.,* 2011).

b. Antidibetic

One of the medicines that can be used for diabetes mellitus sufferers is dewandaru fruit (*Eugenia uniflora*). Dewandaru fruit (*Eugenia uniflora*) has chemical content, namely flavonoids and phenolics (Ramalho, *et al.,* 2019). The flavonoids contained in this plant are a class of compounds that can lower blood glucose levels. The flavonoid, phenolic, alkaloid and terpenoid groups are a class of compounds that have the potential to lower blood glucose levels. The hypoglycemic mechanism is thought to be caused by flavonoids which can inhibit glucose reabsorption from the kidneys and can increase the solubility of blood glucose so that it is easily excreted in the urine (De Cavarlho, *et al.,* 2019).

Based on research conducted by Paulo Berni *et al, 2020* beta carotene content is stated to have the potential to be anti-diabetic so it can be said that Dewandaru fruit has the potential to be anti-diabetic because Dewandaru fruit contains high beta carotene, especially in red dewandaru fruit (Bagetti, *et al.,* 2011). Not only in fruit, but also mentioned in the study by Goncalves *et al.,* 2010 Dewandaru leaves also have the potential to be anti-diabetic. Dewandaru fruit is also rich in antioxidants. Based on the analysis of Bagetti *et al.,, the* 2011highest antioxidants were found in dewandaru fruit which were still purple and orange in color. because it is rich in carotenoids. In addition, Dewandaru seeds are also rich in antioxidants due to their very high content of phenolic compounds (Cavalcante, *et al.,* 1992). According to research by Denardin *et al.,* 2015 states that fruits contain several phenolic compounds such as quercetin derivatives, quercitrin, isoquercitrin, and cyanidine derivatives, which can contribute differently to antioxidant capacity. The highest activity in the DPPH test was found in purple fleshy pitanga (IC50 36.78 mg / L), followed by orange and red fleshy pitanga, besides that the purple color of Eugenia fruit was widely used in the commercial industry in food (Denardin, *et al.,* 2015). These results indicate that some of the fruits grown in southern Brazil such as the purple fleshy pitanga (*Eugenia uniflora*) are rich in phenolic compounds and have great antioxidant activity.

4.4. Discussion

Fruit of *Eugenia* have been investigated in recent decades, revealing a great diversity in chemical composition. Hydrocarbons and oxygenated derivatives have been identified in the essential oils fruits of *Eugenia*, while in extracts of the aerial parts, the compounds polyfenols, flavonoids, and cyanidins have been identified. In view of the chemical diversity described, fruit of *Eugenia* are likely a promising source of bioactive compounds. Colors of Fruits of *Eugenia* uniflora orange, red , blackis purple have been investigated for their different composition, phenolic compounds and esential oil was influenced by biotype and

maturity degree and biological activity demonstrating a shortage of studies fruits of *E. uniflora* was the most activity against various microorganisms. According to Baggeti et al., 2011 Dewandaru fruit which has a blackis purple color has high antioxidant activity because there is a high phenolic compounds. Based on this statement, it is in accordance with research conducted by Ramalho et al., 2019 where the phenol and essential oil content depends on the level of maturity of the Dewandaru fruit. Several studies evaluating the antimicrobial activity of extracts and derivatives used in combination with commercial antimicrobials revealed synergistic effects against microorganisms, potentializing the efficacy of these agents. However, some studies evaluating the bioactivities did not present a positive control or use a comparator to infer value to the results obtained, such as MIC or IC_{50} values.

Studies exploring the association between the various phytochemicals and their biological activities may lead to the discovery of new bioactive compounds with therapeutic potential in fruits of *Eugenia* uniflora that are native to Brazilian flora. Natural sources should be further explored and may result in the discovery of chemically diverse and biologically active compounds, including promising drugs in the search for new antimicrobial agents. Detection of these agents is important, as the increase in pathogen resistance to commercially available antimicrobials is a global health problem. Thus, this review suggests that species in fruits of *Eugenia* uniflora have promising biological activities, supporting the need for future research on the development of drugs from the extracts and chemical constituents.

Eugenia was invesigated for their antibacterial and antifungal activities. Preparations of essential oils have been widely researched for their activities against gram-positive and gram-negative bacteria, as well as some species of yeast-like fungi, and compared to the activity of standard drugs. There are few studies on the antimicrobial activity of the isolated compounds. Different antimicrobial activity assays with different antibiotic and antifungal controls were used, including agar diffusion, disc diffusion, bioautography, macrodilution, and microdilution (Souza *et al.*, 2018).

V. Conclusion

Based on the results of the review of articles that have been conducted, it can be concluded that the fruit of dewandaru (Eugenia uniflora) contains phytochemicals and pharmacological activities as antidiabetic and antibacterial. The beta carotene and phenolic content in the purple, orange and red Dewandaru fruit can play an important role as an antidiabetic. The highest content of phenolic and antioxidant compounds is found in purple dewandaru fruit. As well as the content of the most types of essential oils found in the purple fruit of Dewandaru, the content of these essential oils has the potential to be antibacterial.

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