



Eclética Química

ISSN: 0100-4670

ISSN: 1678-4618

ecletica@journal.iq.unesp.br

Universidade Estadual Paulista Júlio de Mesquita Filho
Brasil

de Souza Duarte, Lujza; Toledo Martins Pereira, Mariana; Bitencourt Pascoal, Vinicius D'Ávila; Cristina Rheder Fagundes Pascoal, Aislan
Campomanesia genus – a literature review of nonvolatile secondary metabolites, phytochemistry, popular use, biological activities, and toxicology
Eclética Química, vol. 45, no. 2, 2020, pp. 12-22
Universidade Estadual Paulista Júlio de Mesquita Filho
Brasil

DOI: <https://doi.org/10.26850/1678-4618eqj.v45.2.2020.p12-22>

Available in: <https://www.redalyc.org/articulo.oa?id=42963115002>

- How to cite
- Complete issue
- More information about this article
- Journal's webpage in [redalyc.org](https://www.redalyc.org)

 [redalyc.org](https://www.redalyc.org)

Scientific Information System Redalyc
Network of Scientific Journals from Latin America and the Caribbean, Spain and Portugal

Project academic non-profit, developed under the open access initiative

Campomanesia genus – a literature review of nonvolatile secondary metabolites, phytochemistry, popular use, biological activities, and toxicology

Luiza de Souza Duarte¹, Mariana Toledo Martins Pereira^{1,2}, Vinicius D'Ávila Bitencourt Pascoal^{1,2} Aislan Cristina Rheder Fagundes Pascoal^{1,2+}

1. Universidade Federal Fluminense, Instituto de Saúde de Nova Friburgo, Rua Dr. Sílvio Henrique Braune, 22 Nova Friburgo, Rio de Janeiro, Brazil

2. Universidade Federal Fluminense, Instituto de Biologia, Programa de Pós-Graduação em Ciências e Biotecnologia, Alameda Barros Terra, Niterói, Rio de Janeiro, Brazil

*Corresponding author: Aislan Cristina Rheder Fagundes Pascoal, Phone: +55 22 2528-7663, Email address: aislanfagundes@id.uff.br

ARTICLE INFO

Article history:

Received: September 2, 2019

Accepted: March 18, 2020

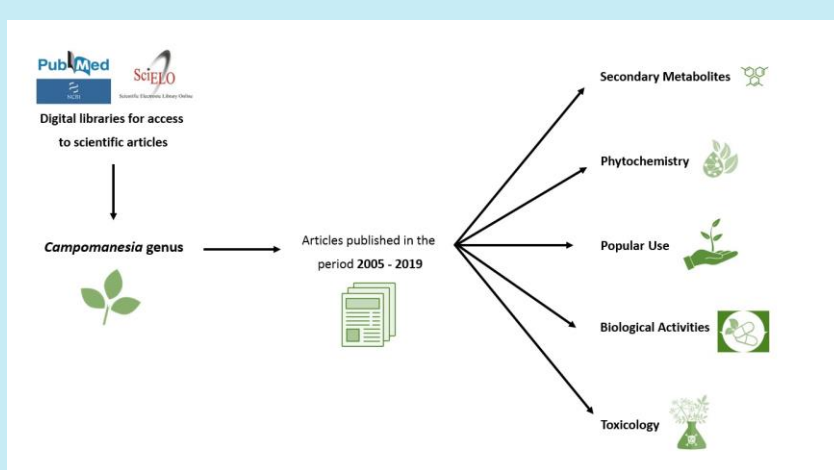
Published: April 1, 2020

Keywords:

1. Myrtaceae
2. natural products
3. biological activities
4. pharmacological potential
5. popular use

ABSTRACT: The genus *Campomanesia* belongs to the Myrtaceae family and has about 30 species. It is characterized by citrus-flavored fruits. Several articles describe the extensive use of its fruit, such as in the food industry, however, other parts of the plants are also used for food or pharmacological purposes such as the leaves, flowers, seeds, and roots. Analyzing works published on the genus in the period 2005-2019, we observed that the classes of main flavonoid compounds present are anthocyanins, chalcones, coumarins, tannins, and saponins. Species of this genus are also used as a medicine in the treatment of

wounds, toothaches, fractures, and bruises. Therapeutic activities have also been detected for *Campomanesia*, such as antimicrobial, antiulcerogenic, antiprotozoal, anti-inflammatory, and antidiarrheal activity, antiproliferative and antioxidant potential, antiplatelet, antithrombotic, and fibrinolytic activities, as well as hypotensive effects. There are a small number of works demonstrating the low toxic potential of plant extracts. Thus, the *Campomanesia* genus presents pharmacological potential to be explored.



CONTENTS

1. Introduction
2. Secondary metabolites and phytochemistry
3. Popular use
4. Biological activities
5. Toxicology
6. Conclusion and future perspectives
7. Acknowledgments
8. References

1. Introduction

Plants can be used as sources of alternative substances, including therapeutic resources for human medicines¹. Mesopotamian documents, dated 2600 BC, show the use of more than 1,000 production plants, including those that are now untreated, colds, parasitic, and inflammation². When we analyze the medicines released between 1981 and 2014, 4% are produced from natural

products, and 27% are synthetic compounds. However, considering the origin of the other products, 59.1% are semi-synthetic molecules, synthetic drugs with pharmacophoric groups, based on natural product structures, mimicking natural or botanical products³.

The use of medicinal plants as an alternative or additional therapeutic resources has increased significantly⁴. Although synthetic drugs are usually the first choice of treatment for many diseases, these chemical drugs sometimes have undesirable effects and, consequently, the acceptance of alternative medicines has increased substantially⁵. Also, in some pathologies, resistance is developing to the drugs already used in treatment. These data demonstrate the importance of natural products in drug research, and the development of new medicines, justifying work in this area. The Scielo and PubMed databases were searched, during the period 2005-2019, and the keywords used were: *Campomanesia*, Myrtaceae, "*Campomanesia* and biological activities," "*Campomanesia* and popular use," "*Campomanesia* and toxicology."

The Myrtaceae family comprises 175 genera and 5,970 species, native to all continents of the southern hemisphere⁶. They are divided into shrubs and trees with sebaceous glands in the leaves, lower or semi-inferior ovaries, flowers, usually, with numerous stamens, internal phloem, and traces of xylem vessels^{7,8}. The genus *Campomanesia* belongs to the Myrtaceae family and has about 30 species⁹. This genus is characterized by its citrus-flavored fruits¹⁰. However, although several articles describe the extensive use of the fruit, such as in the food industry, other parts of the plants are also used for food or pharmacological purposes, such as leaves, flowers, seeds, and roots.

The species include: *C. xanthocarpa*, *C. adamantium*, *C. corimbosa*, *C. cambessedean*, *C. pubescens*, *C. guazumifolia*, *C. reitziana*, and *C. lineatifolia*, among others.

2. Secondary metabolites and phytochemistry

A striking feature of the genus *Campomanesia* is the presence of the high content of phenolic compounds, mainly in *Campomanesia adamantium*. Analyzing works published in the period 2005-2019 for the genus, we observed that the main classes of flavonoid compounds present are anthocyanins, chalcones, coumarins, tannins,

and saponins. These compounds have in common the biosynthetic pathway derived from phenylpropanoids that contribute to all aspects of plant responses to biotic and abiotic stimuli¹¹.

However, changes occur in the formation, concentration, and type of secondary metabolites in the various species, which may be influenced by the environmental stress, climate, and soil of each region. For example, fruits of *Campomanesia xanthocarpa* contain a high concentration of phenolic compounds, including chlorogenic acid and ascorbic acid¹² and the leaves contain a large number of saponins, tannins, and terpenes, besides the consistent presence of flavonoids and phenolic compounds, such as gallic acid, quercetin, and chlorogenic acid^{13,14}.

Campomanesia adamantium is one of the most commonly studied species. It has shown significant therapeutic potential, in addition to the presence of phenolic compounds such as gallic acid, catechins, ellagic acid, and flavonoids^{15,16}.

Fruits of *Campomanesia pubescens*, when ripe, have a high content of vitamin C and phenolic compounds¹⁷, among them, flavanones and chalcones^{18,19}.

Few studies describe both the biological activities and compounds of *Campomanesia guazumifolia*. However, a survey by Catelan et al.²⁰ identified the presence of glycosylated flavonoids: quercetin pentose, quercetin deoxyhexoside, myricetin deoxyhexoside, and quinic acid. The fruits of the *C. reitziana* species contain dimethyl cardamomine as their main active compound²¹.

Phytochemical studies with the *C. lineatifolia* species revealed the presence of flavonoids, tannins, catechin, quercitrin, and champanones A, B, and C²². A survey by Osorio et al. showed that the beta-tricetones compound contributes to the fruity odor²³.

Campomanesia leaves are rich in volatile oils, which were reviewed by Stefanello et al. in 2011, who described geraniol, α -pinene, limonene, linalool, spathulenol, and caryophyllene²⁴. The essential oil from *C. guaviroba* was analyzed, and sixteen compounds were identified, of which the largest constituent was myrtenal²⁵.

3. Popular use

The Myrtaceae family presents a wide variety of fruits, which are consumed throughout the

Brazilian territory and present characteristics of a considerable amount of acidity through ascorbic acid, minerals, fibers, and monoterpene hydrocarbons. Fruits are used to make liqueurs, juices, and sweets. However, the population uses other parts such as the leaves, seeds, and roots in the form of powders, gums, teas, juices, oils, or different types associated with medicinal use^{10,26}. Native species from the Midwest region, such as *Campomanesia*, are used by indigenous peoples as food since they represent a source of vitamins and minerals²⁷. However, species of this genus are also used as a medicine in the treatment of wounds, toothaches, fractures, and bruises²⁸.

From the advances in research directed to natural products, the use of medicinal plants has significantly increased, to provide alternative or additional forms of treatments used in the daily life of the population. *C. xanthocarpa* is an example of this species which is associated with popular and traditional use, as it demonstrates extensive medicinal use: fruit peel infusions for the treatment of productive cough and dysentery, leaf tea for reducing cholesterol and fighting urinary and uterine infections, and the peel can be used to treat cystitis, diarrhea, and hemorrhoids^{13,28}. *C. pubescens* is used by the population of Mato Grosso (Brazilian State) as food (jelly, juices, and liqueurs) and also as a medicinal plant due to its purifying, antidiarrheal, and cholesterol-lowering action^{29,30}. Infusions of *C. velutina* leaves and branches are popularly used to treat diarrhea and intestinal cramps³¹.

4. Biological activities

One of the most commonly studied activities is *in vitro* antioxidant activity. DPPH is the most widely used method, probably because these are quick and cheap chemical tests³². This activity is related to the concentration of phenolic compounds present in samples. Antimicrobial activities against anti-inf, fungi, and protozoa are also widely studied^{22,33,34}.

The biological activities described are listed in Tab. 1, including anti-inflammatory, cytotoxic, antinociceptive, and protective activities of the gastric mucosa. These activities, in most cases, are related to flavonoid activities, which are effective in some cases³⁵.

C. xanthocarpa has been studied to confirm its popular use in treatment for hypercholesterolemic patients; this species was able to reduce blood

levels of TC and LDL¹³. In addition to this effect, it has been shown that this species has important therapeutic activities such as antimicrobial³⁶, antiulcerogenic³⁷, antiprotozoal³⁴, anti-inflammatory³⁸, and antidiarrheal³⁹ as well as antioxidant potential⁴⁰, antiplatelet, antithrombotic, and fibrinolytic activities^{41,42}, and, more recently, hypotensive effects¹⁴.

Campomanesia adamantium has the characteristic of being a small tree that produces edible fruits with beneficial effects on health, presenting activities such as antimicrobial^{18,27,33,43}, antidiarrheal⁴⁴, and antiproliferative^{45,46}. In addition, its leaves and roots have anti-inflammatory and antinociceptive activities⁴⁷.

In the studies conducted with *C. guazumifolia*, the antioxidant activity, antimicrobial activity, and anti-inflammatory potential with low toxicity of leaf infusions of this species were evidenced²⁰. Few biological activities are described for *C. reitziana* and *C. lineatifolia*. *C. reitziana* showed antinociceptive and gastroprotective potential, and *C. lineatifolia* demonstrated anti-inflammatory and gastroprotective effects^{21,48,49}.

5. Toxicology

Currently, plants are used as food, nutraceuticals, phytonutrients, medicinal plants, and herbal medicines, thus representing alternative therapies to existing treatments for various pathologies^{28,50}. Despite the widespread use of plants as medicine and functional food, there is often no scientific evidence to support their pharmacological properties and toxic potential^{51,52}. It is estimated that only three-quarters of the currently marketed natural products of plant origin have the safety information that enables their proper use⁵³. Regarding *Campomanesia*, this scenario is no different. Although these species are widely used as food and medicine in folk medicine, studies on the toxicology of many species are still scarce⁵⁴.

A study on the acute and subacute toxicity of ethanolic extract of *C. guazumifolia* leaves, where adult and female rats received the extract orally at different concentrations for 14 and 28 days respectively, showed that the doses used did not produce significant physiological or pathological changes, or mortality, indicating that the LD50 is greater than 2000 mg kg⁻¹⁵⁴. Leaf infusion of the same species was shown to have low toxicity in *in vivo* models of acute and subacute toxicity, with

no observed clinical signs or changes in hematological, biochemical, or histological parameters, suggesting that the LD50 is above 5000 mg kg⁻¹²⁰.

A similar study of acute and sub-chronic toxicity using the aqueous extract of *C. velutina* leaves and branches demonstrated different changes in male and female Swiss mice. The extracts at doses of 600 and 1200 mg kg⁻¹ showed signs of toxicity such as diarrhea, anemia, changes in the kidneys, brain, and heart, suggesting that the safest dose of the extracts is 300 mg kg⁻¹³¹. The ethanolic extract of *C. pubescens* leaves demonstrated cytotoxic and genotoxic effects through *Allium* strain bioassay, toxic effects were observed in the dividing cell and increased chromosomal alterations²⁰. *In vivo* studies with *Wistar* and *Drosophila melanogaster* rats showed that the ethanolic extract obtained from fruits of *C. pubescens* under the experimental conditions used did not demonstrate significant genotoxic or clastogenic effects, indicating that fruit consumption is safe⁵⁴.

The aqueous extract and essential oil of *C. xanthocarpa* leaves were also evaluated using the *Allium* strain test, allowing the observation of a genotoxic effect of the samples: mitotic index reduction and chromosomal mutations⁵⁵. The extract of the leaves of this same species, when submitted to acute toxicity test *in vivo*, showed no signs of toxicity³⁸. Hydroalcoholic extract from *C. adamantium* fruits, when subjected to acute and subacute toxicity tests in *Wistar* rats, proved to be safe, as no clinical signs of toxicity were observed⁵⁶.

Preclinical toxicity studies of herbal medicines are recommended by international regulatory agencies. In Brazil, the National Health Surveillance Agency (ANVISA) is the body responsible for regulating these products and includes, among its various resolutions, a specific one for toxicity tests, aiming to ensure and evaluate the safety and quality of herbal medicines before they are used by the population⁵⁷. However, toxicity tests with species of the genus *Campomanesia* are still scarce, requiring further studies in this area.

6. Conclusion and future perspectives

Several articles published in recent years demonstrate the importance of the genus *Campomanesia*, not only as food but also, mainly, for its pharmacological potential. In this sense, studies claim that different parts of the plants of this genus present promising results for various biological activities, ranging from antioxidant activity to antiproliferative activity, for example. The secondary metabolism of plants is responsible for the production of compounds that have these biological activities. In the case of the *Campomanesia* genus, phenolic acids and other groups of compounds such as flavonoids, anthocyanins, and tannins stand out. Through these studies, the potential of these species to treat different diseases becomes evident. However, for this genus to be used commercially, a lot of work is needed to produce a finished product. For herbal medicine, studies of the major compounds present, markers, and quantifications of these compounds should be performed. Besides, for the development of allopathic medications, active compounds must be isolated, and the structure identified, as well as analysis of the biological activities. Toxicity tests and possible mechanisms of action are also required. Given this, there is a vast territory to be explored, represented by the genus *Campomanesia*.

Table 1. Description of the studied species, parts, biological activity found, and identified compounds from the *Campomanesia* genus.

Genus	Part of the plant and extract	Biological Activities	Compounds	Reference
<i>C. adamantium</i>	The ethanolic crude extract of leaves and ethyl acetate and butanol fractions	Antioxidant activity	Isoquercitrin and quercetin	[58]
<i>C. adamantium</i>	Ethyl acetate and aqueous extracts of leaves	Antinociceptive and anti-inflammatory activities	Myricitrin, myricetin, and quercetin	[47]
<i>C. adamantium</i>	Fruit and leaf extracts	Antiproliferative activity in the PC-3 cells	Cardamonin	[45]
<i>C. adamantium</i>	Hydroalcoholic extract of fruit peels	Anti-inflammatory, antihyperalgesic and antidepressant activities	Quercetin, myricetin, 5,7-dihydroxy-6-methylflavanone, 5,7-dihydroxy-8-methylflavanone and 2',4'-dihydroxy6'-methoxycalcon and in the ethyl acetate fraction of 7-hydroxy-5-methoxy-6-methylflavanone, 5,7-dihydroxy-6,8-dimethylflavanone, and 2',4'-dihydroxy 3',5'-dimethyl-6'-methoxycalcone	[56]
<i>C. adamantium</i>	Hydroalcoholic fruit extract	Hepatoprotective activity <i>in vitro</i>	Presence of flavonoids	[48]
<i>C. adamantium</i>	Ethanolic extracts of leaves, bark, and seeds	Antifungal Potential	-	[59]
<i>C. adamantium</i>	Aqueous root extract	Antioxidant and antihyperlipidemic	Gallic acid and ellagic acid	[60]
<i>C. adamantium</i>	Peel Extract	Antidiarrheal, cytotoxic, and anti-inflammatory activities	Phenolic compounds	[44]
<i>C. adamantium</i>	Aqueous extract of leaves and roots	Antileukemic activity	di-hexoside/quinic acid, ellagic acid O-pentoside, ellagic acid, O-methyl ellagic acid O-hexoside, ellagic acid O-deoxyhexoside, and O-methyl ellagic acid sulfate, gallic acid, ellagic acid O-hexoside, O-methyl ellagic acid O-deoxyhexoside, and O-dimethyl ellagic acid sulfate	[61]
<i>C. adamantium</i>	Dichloromethane extracts from pulp and fruit peel	Antiproliferative activity	7-hydroxy-5-methoxy-6-C-methylflavanone, 5,7-dihydroxy-6-C-methylflavanone, 5,7-dimethoxy-6-C-methylflavanone, 5,7-dihydroxy-6, 8-C-methylflavanone, 4',6'-dihydroxy-30-methyl-20-methoxy-chalcone, Champanone C, 4',6'-dihydroxy-30, 5'-dimethyl-2'-methoxy-chalcone and Champanone D	[46]
<i>C. adamantium</i>	Methanolic bark extract	Potential antiplatelet effect	Phenolic Compounds, Total Flavonoids, Condensed Tannins	[62]
<i>C. guazumifolia</i>	Aqueous extract of the leaves	Anti-inflammatory potential with low toxicity	Quercetin pentose, quercetin deoxyhexoside, myricetin deoxyhexoside, and quinic acid.	[20]
<i>C. lineatifolia</i>	Methanolic seed extract	Antimicrobial activity	Champanone A, Champanone B, and Champanone C.	[22]
<i>C. pubescens</i>	Ethanolic Fruit Extract	Anxiolytic and antidepressant effects	1,2-hydroxy-3'-methyl-4', 6'-dimethoxychalcon and 2, 7-hydroxy-5-methoxy-6-methylflavanone, 3, 5-hydroxy-7-methoxy-8-methylflavanone; 4, 2', 4'-dihydroxy-3', 5'-dimethyl-6'-methoxychalcone; and 5, 2', 4'-dihydroxy-5'-methyl-6'-methoxychalcona	[63]

continuation of Table 1.				
<i>C. pubescens</i>	Fresh fruit ethanolic extract	Low acute and subchronic toxicity	2-hydroxy-3'-methyl-4', 6'-dimethoxychalcon; 7-hydroxy-5-methoxy-6-methylflavanone; 5-hydroxy-7-ethoxy-8-methylflavanone; 2', 4'-dihydroxy-3', 5'-dimethyl-6'-methoxychalcone and 2', 4'-dihydroxy-5'-methyl-6'-methoxychalcone.	[54]
<i>C. pubescens</i>	Ethanolic leaf extract	Antioxidant activity and suggested cytotoxic and genotoxic effects	7-hydroxy-6-methyl-5-methoxyflavanone, 5,7-dihydroxy-6-methylflavanone, 5,7-dihydroxy-8-methylflavanone, 2',4'-dihydroxy-6'-methoxychalcone, 5,7-dihydroxy-6,8- dimethylflavanone, 2',4'-dihydroxy-5'-methyl-6'-methoxychalcone and 2',4'-dihydroxy-3',5'-dimethyl-6'-methoxychalcone	[64]
<i>C. pubescens</i>	Ethanol extract of fruit pulp	Low toxicity without genotoxic or clastogenic effects.	High levels of flavonoids	[65]
<i>C. velutina</i>	Aqueous extract of leaves and branches	Acute and subchronic toxicity.	Presence of phenolic compounds including flavonoids and tannins	[31]
<i>C. xanthocarpa</i>	Aqueous extract of the leaves	Reduction in weight gain and blood glucose in animals	-	[66]
<i>C. xanthocarpa</i>	Hydroalcoholic extract of the leaves	Antiulcerogenic action and showed no acute toxic effects	Presence of flavonoids, saponins, and tannins	[37]
<i>C. xanthocarpa</i>	Aqueous extract of the leaves	Antiplatelet, antithrombotic, and fibrinolytic activity in mice and also in human blood and mice obtained antithrombotic activity.	Presence of saponins, tannins, and terpenes and a small presence of flavonoids	[41]
<i>C. xanthocarpa</i>	Fruits	Antioxidant activities	Phenolic compounds and ascorbic acid.	[40]
<i>C. xanthocarpa</i>	Aqueous extract	Anti- <i>Trichomonas vaginalis</i> activity	-	[34]
<i>C. xanthocarpa</i>	Extract of the leaves	Protective effect on the endothelium	-	[67]
<i>C. xanthocarpa</i>	Aqueous extract of fresh plant	Inhibit biofilm formation and bacterial growth.	-	[68]
<i>C. xanthocarpa</i>	Hydroalcoholic leaf extract	Anti-Inflammatory Activity without toxicity	2', 6'-dihydroxy-3'-methyl-4'-methoxychalcone and 2', 4'-dihydroxy-3', 5'-dimethyl-6'-methoxychalcone	[38]
<i>C. xanthocarpa</i>	Leaf extract	Antiplatelet Activity	-	[42]
<i>C. xanthocarpa</i>	Aqueous extract of the leaves	Hypotensive effect	Presence of gallic acid, chlorogenic aci, and quercetin, theobromine	[14]
<i>C. xanthocarpa</i>	Fruits	Antioxidant activity	Lutein, Zeaxanthin, β -cryptoxanthin, α -carotene, β -carotene, Lycopene, Thiamine, Riboflavin, Pantothenic Acid, Pyridoxine, Biotin, Vitamin C, Vitamin A	[69]
<i>C. xanthocarpa</i>	Aqueous extract of the leaves	Antioxidant activity, protective effect against DNA in blood cells and reduced LPO levels and increased SOD activity in kidney	Presence of quercetin, rutin, and ellagic, rosmarinic, caffeic, gallic, and chlorogenic acids in the extract.	[70]

7. Acknowledgments

This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001.

8. References

- [1] Brandão, H. N., David, J. P., Couto, R. D., Nascimento, J. A. P., David, J. M., Química e Farmacologia de Quimioterápicos Antineoplásicos Derivados de Plantas, Química Nova 33 (6) (2010) 1359-1369. <https://doi.org/10.1590/S0100-40422010000600026>.
- [2] Borchardt, J. K., The Beginnings of Drug Therapy: Ancient Mesopotamian Medicine, Drug News & Perspectives 15 (3) (2002) 187-192. <https://doi.org/10.1358/dnp.2002.15.3.840015>.
- [3] Newman, D. J., Cragg, G. M., Natural Products as Sources of New Drugs from 1981 to 2014, Journal of Natural Products 79 (3) (2016) 629-661. <https://doi.org/10.1021/acs.jnatprod.5b01055>.
- [4] Ríos, J. L., Recio, M. C., Medicinal plants and antimicrobial activity, Journal of Ethnopharmacology 100 (1-2) (2005) 80-84. <https://doi.org/10.1016/j.jep.2005.04.025>.
- [5] Sahib, N. G., Saari, N., Ismail, A., Khatib, A., Mahomoodally, F., Hamid, A. A., Plants' Metabolites as Potential Antiobesity Agents, The Scientific World Journal 2012 (436039) (2012) 1-8. <https://doi.org/10.1100/2012/436039>.
- [6] The Plant List., Myrtaceae, The Plant List: A working list of all plant species (2018). <http://www.theplantlist.org/1.1/browse/A/Myrtaceae>.
- [7] Wilson, P. G., O'Brien, M. M., Gadek, P. A., Quinn, C. J., Myrtaceae revisited: A reassessment of infrafamilial groups, American Journal of Botany 88 (11) (2001) 2013-2025. <https://doi.org/10.2307/3558428>.
- [8] Conti, E., Litt, A., Wilson, P. G., Graham, S. A., Briggs, B. G., Johnson, L. A. S., Sytsma, K. J., Interfamilial relationships in Myrtales: molecular phylogeny and patterns of morphological evolution, Systematic Botany 22 (4) (1997) 629-647. <https://doi.org/10.2307/2419432>.
- [9] Landrum, L. R., *Campomanesia*, *Pimenta*, *Blepharocalyx*, *Legrandia*, *Acca*, *Myrrhinium* e *Luma* (Myrtaceae), In: Flora Neotropica, The New York Botanical Garden: New York, United States of America, 1986, ch2.
- [10] Silva, C. A. de A., Fonseca, G. G., Brazilian savannah fruits: Characteristics, properties, and potential applications, Food Science and Biotechnology 25 (5) (2016) 1225-1232. <https://doi.org/10.1007/s10068-016-0195-3>.
- [11] Vogt, T., Phenylpropanoid Biosynthesis, Molecular Plant 3 (1) (2010) 2-20. <https://doi.org/10.1093/mp/ssp106>.
- [12] Furukawa, S., Fujita, T., Shimabukuro, M., Iwaki, M., Yamada, Y., Nakajima, Y., Nakayama, O., Makishima, M., Matsuda, M., Shimomura, I., Increased oxidative stress in obesity and its impact on metabolic syndrome, The Journal of Clinical Investigation 114 (12) (2017) 1752-1761. <https://doi.org/10.1172/JCI21625>.
- [13] Klafke, J. Z., Silva, M. A. da, Panigas, T. F., Belli, K. C., Oliveira, M. F. de, Barichello, M. M., Rigo, F. K., Rossato, M. F., Santos, A. R. S. dos, Pizzolatti, M. G., Ferreira, J., Viegas, P. R. N., Effects of *Campomanesia xanthocarpa* on biochemical, hematological and oxidative stress parameters in hypercholesterolemic patients, Journal of Ethnopharmacology 127 (2-3) (2010) 299-305. <https://doi.org/10.1016/j.jep.2009.11.004>.
- [14] Sant'Anna, L. S., Merlugo, L., Ehle, C. S., Limberger, J., Fernandes, M. B., Santos, M. C., Mendez, A. S. L., Paula, F. R., Moreira, C. M., Chemical composition and hypotensive effect of *Campomanesia xanthocarpa*, Evidence-Based Complementary and Alternative Medicine 2017 (1591762) (2017) 1-11. <https://doi.org/10.1155/2017/1591762>.
- [15] Espindola, P., da Rocha, P., Carollo, C., Schmitz, W., Pereira, Z., Vieira, M., dos Santos, E., Souza, K., Antioxidant and antihyperlipidemic effects of *Campomanesia adamantium* O. Berg Root, Oxidative Medicine and Cellular Longevity 2016 (7910340) (2016) 1-8. <https://doi.org/10.1155/2016/7910340>.
- [16] Alves, A. M., Dias, T., Hassimotto, N. M. A., Naves, M. M. V., Ascorbic acid and phenolic contents, antioxidant capacity and flavonoids composition of Brazilian Savannah native fruits, Food Science and Technology 37 (4) (2017) 564-569. <https://doi.org/10.1590/1678-457x.26716>.
- [17] Duarte, W. F., Dias, D. R., Pereira, G. V. de M., Garvácio, I. M., Schwan, R. F., Indigenous and inoculated yeast fermentation of gabioba (*Campomanesia pubescens*) pulp for fruit wine

production, *Journal of Industrial Microbiology & Biotechnology* 36 (4) (2009) 557-569. <https://doi.org/10.1007/s10295-009-0526-y>.

[18] Cardoso, C. A. L., Salmazzo, G. R., Honda, N. K., Prates, C. B., Vieira, M. do C., Coelho, R. G., Antimicrobial activity of the extracts and fractions of hexanic fruits of *Campomanesia* species (Myrtaceae), *Journal of Medicinal Food* 13 (5) (2010) 1273-1276. <https://doi.org/10.1089/jmf.2009.0047>.

[19] Cardoso, C. A. L., Salvador, M. J., Carvalho, J. E., Coelho, R. G., Avaliação das atividades antiproliferativa e antioxidante em frutos de *Campomanesia pubescens*/Evaluation of antioxidant and antiproliferative activities in fruits of *Campomanesia pubescens*, *Revista Instituto Adolfo Lutz* 72 (4) (2013) 309-315. <https://pesquisa.bvsalud.org/portal/resource/pt/lil-742458>.

[20] Catelan, T. B. S., Radai, J. A. S., Leitão, M. M., Branquinho, L. S., Vasconcelos, P. C. de P., Heredia-Vieira, S. C., Kassuya, C. A. L., Cardoso, C. A. L., Evaluation of the toxicity and anti-inflammatory activities of the infusion of leaves of *Campomanesia guazumifolia* (Cambess.) O. Berg, *Journal of Ethnopharmacology* 226 (2018) 132-142. <https://doi.org/10.1016/j.jep.2018.08.015>.

[21] Nesello, L. Â. N., Campos, A., Wagner, T., Feliciano, A. S., Buzzi, F. de C., Cechinel Filho, V., Chemical composition and antinociceptive potential of *Campomanesia reitziana* fruits, *Journal of Medicinal Food* 19 (5) (2016) 518-520. <https://doi.org/10.1089/jmf.2015.0092>.

[22] Bonilla, A., Duque, C., Garzón, C., Takaishi, Y., Yamaguchi, K., Hara, N., Fujimoto, Y., Champanones, yellow pigments from the seeds of champa (*Campomanesia lineatifolia*), *Phytochemistry* 66 (14) (2005) 1736-1740. <https://doi.org/10.1016/j.phytochem.2005.05.025>.

[23] Osorio, C., Alarcon, M., Moreno, C., Bonilla, A., Barrios, J., Garzón, C., Duque, C., Characterization of odor-active volatiles in champa (*Campomanesia lineatifolia* R. & P.), *Journal of Agricultural and Food Chemistry* 54 (2) (2006) 509-516. <https://doi.org/10.1021/jf052098c>.

[24] Stefanello, M. E. A., Pascoal, A. C. R. F., Salvador, M. J., Essential oils from neo-tropical Myrtaceae: chemical diversity and biological properties, *Chemistry & Biodiversity* 8 (1) (2011) 73-94. <https://doi.org/10.1002/cbdv.201000098>.

[25] Pascoal, A. C. R. F., Lourenço, C. C., Sodek, L., Tamashiro, J. Y., Franchi Junior, G. C., Nowill, A. E., Stefanello, M. E. A., Salvador, M. J., Essential oil from the leaves of *Campomanesia guaviroba* (DC.) Kiaersk. (Myrtaceae): chemical composition, antioxidant and cytotoxic activity, *Journal of Essential Oil Research* 23 (5) (2011) 34-37. <https://doi.org/10.1080/10412905.2011.9700479>.

[26] Kumar, G., Karthik, L., Rao, K. V. B., Haemolytic activity of Indian medicinal plants toward human erythrocytes: an *in vitro* study, *Elixir International Journal Applied Botany* 40 (2011) 5534-5537. [https://www.elixirpublishers.com/articles/1350647393_40%20\(2011\)%205534-5537.pdf](https://www.elixirpublishers.com/articles/1350647393_40%20(2011)%205534-5537.pdf).

[27] Vieira, R. F., Costa, T. da S. A., Silva, D. B. da, Ferreira, F. R., Sano, S. M., Frutas nativas da região Centro-Oeste, *Embrapa Recursos Genéticos e Biotecnologia*, Brasília, 2006. http://www.agabrasil.org.br/_Dinamicos/livro_frutas_nativas_Embrapa.pdf.

[28] Carvalho, P. E. R., Espécies arbóreas brasileiras. Coleção Espécies Arbóreas Brasileiras, Embrapa informações Tecnológica, Brasília, 2006, v2. <https://livimagens.sct.embrapa.br/amostras/00079500.pdf>.

[29] Alice, C. B., Plantas medicinais de uso popular: atlas farmacognóstico, Canoas, 1995, 205 p.

[30] Guerrero, F. M. G., Zimmerman, L. R., Cardoso, E. V., Lima, C. A. C. de, Perdomo, R. T., Alva, R., Carollo, C. A., Guerrero, A. T., Investigação sobre a toxicidade crônica de folhas de guavira (*Campomanesia pubescens*) em ratos machos, *Revista Fitos* 5 (2) (2013) 64-72. <https://www.arca.fiocruz.br/handle/icict/19179>.

[31] Araújo, M. C. de P. M., Barcellos, N. M. S., Vieira, P. M. de A., Gouveia, T. M., Guerra, M. O., Peters, V. M., Saúde-Guimarães, D. A., Acute and sub chronic toxicity study of aqueous extract from the leaves and branches of *Campomanesia velutina* (Cambess) O. Berg, *Journal of Ethnopharmacology* 201 (2017) 17-25. <https://doi.org/10.1016/j.jep.2017.02.043>.

[32] Alam, M. N., Bristi, N. J., Rafiquzzaman, M., Review on *in vivo* and *in vitro* methods evaluation of antioxidant activity, *Saudi Pharmaceutical Journal* 21 (2) (2013) 143-152. <https://doi.org/10.1016/j.jsps.2012.05.002>.

[33] Pavan, F. R., Leite, C. Q. F., Coelho, R. G., Coutinho, I. D., Honda, N. K., Cardoso, C. A. L., Vilegas, W., Leite, S. R. de A., Sato, D. N., Evaluation

of anti *Mycobacterium tuberculosis* activity of *Campomanesia adamantium* (Myrtaceae), *Química Nova* 32 (5) (2009) 1222-1226. <https://doi.org/10.1590/S0100-40422009000500026>.

[34] Brandelli, C. L. C., Vieira, P. de B., Macedo, A. J., Tasca, T., Remarkable Anti-*Trichomonas vaginalis* activity of plants traditionally used by the Mbyá-Guarani indigenous group in Brazil, *BioMed Research International* 2013 (826370) (2013) 1-7. <https://doi.org/10.1155/2013/826370>.

[35] Sandhar, H. K., Kumar, B., Prasher, S., Tiwari, P., Salhan, M., Sharma, P., A review of phytochemistry and pharmacology of flavonoids, *Internationale Pharmaceutica Scientia* 1 (1) (2011) 25-41.

[36] Moura-Costa, G. F., Nocchi, S. R., Ceole, L. F., Mello, J. C. P. de, Nakamura, C. V., Dias Filho, B. P., Temponi, L. G., Ueda-Nakamura, T., Antimicrobial activity of plants used as medicinals on an indigenous reserve in Rio das Cobras, Paraná, Brazil, *Journal of Ethnopharmacology* 143 (2) (2012) 631-638. <https://doi.org/10.1016/j.jep.2012.07.016>.

[37] Markman, B. E. O., Bacchi, E. M., Kato, E. T. M., Antiulcerogenic effects of *Campomanesia xanthocarpa*, *Journal of Ethnopharmacology* 94 (1) (2004) 55-57. <https://doi.org/10.1016/j.jep.2004.04.025>.

[38] Silva, É. R. S. da, Salmazzo, G. R., Arrigo, J. da S., Oliveira, R. J., Kassuya, C. A. L., Cardoso, C. A. L., Anti-inflammatory evaluation and toxicological analysis of *Campomanesia xanthocarpa* Berg, *Inflammation* 39 (4) (2016) 1462-1468. <https://doi.org/10.1007/s10753-016-0378-3>.

[39] Souza-Moreira, T. M., Salvagnini, L. E., Santos, E., Silva, V. Y. A., Moreira, R. R. D., Salgado, H. R. N., Pietro, R. C. L. R., Antidiarrheal activity of *Campomanesia xanthocarpa* fruit, *Journal of Medicinal Food* 14 (5) (2011) 528-531. <https://doi.org/10.1089/jmf.2009.0278>.

[40] Pereira, M. C., Steffens, R. S., Jablonski, A., Hertz, P. F., Rios, A. de O., Vizzotto, M., Flôres, S. H., Characterization and antioxidant potential of Brazilian fruits from the myrtaceae family, *Journal of Agricultural and Food Chemistry* 60 (12) (2012) 3061-3067. <https://doi.org/10.1021/jf205263f>.

[41] Klafke, J. Z., Silva, M. A. da, Rossato, M. F., Trevisan, G., Walker, C. I. B., Leal, C. A. M., Borges, D. O., Schetinger, M. R. C., Moresco, R. N., Duarte, M. M. M. F., Santos, A. R. S. dos, Viecili, P. R. N., Ferreira, J., Antiplatelet, Antithrombotic, and Fibrinolytic Activities of *Campomanesia xanthocarpa*,

Evidence-Based Complementary and Alternative Medicine 2012 (954748) (2012) 1-8. <https://doi.org/10.1155/2012/954748>.

[42] Otero, J. S., Hirsch, G. E., Klafke, J. Z., Porto, F. G., Almeida, A. S. de, Nascimento, S., Schmidt, A., Silva, B. da, Pereira, R. L. D., Jaskulski, M., Parisi, M. M., Guarda, N. dos S., Moresco, R. N., Aita, C. A. M., Viecili, P. R. N., Inhibitory effect of *Campomanesia xanthocarpa* in platelet aggregation: Comparison and synergism with acetylsalicylic acid, *Thrombosis Research* 154 (2017) 42-49. <https://doi.org/10.1016/j.thromres.2017.03.020>.

[43] Lima, N. V. de, Arakaki, D. G., Tschinkel, P. F. S., Silva, A. F. da, Guimarães, R. de C. A., Hiane, P. A., Nascimento, V. A. do, Investigation of *Campomanesia* Components: A Fruit of Brazilian Cerrado, In: Active Ingredients from Aromatic and Medicinal Plants, El-Shemy, H. A., ed., InTech: Houston, United States of America, 2017, Ch. 5. <https://doi.org/10.5772/66220>.

[44] Lescano, C. H., Oliveira, I. P. de, Zaminelli, T., Baldivia, D. da S., Silva, L. R. da, Napolitano, M., Silvério, C. B. M., Lincopan, N., Sanjinez-Argandoña, E. J., *Campomanesia adamantium* Peel extract in antidiarrheal activity: the ability of inhibition of heat-stable enterotoxin by polyphenols, *Plos One* 11 (10) (2016) 1-15. <https://doi.org/10.1371/journal.pone.0165208>.

[45] Pascoal, A. C. R. F., Ehrenfried, C. A., Lopez, B. G.-C., Araujo, T. M. de, Pascoal, V. D. B., Gilioli, R., Anhê, G. F., Ruiz, A. L. T. G., Carvalho, J. E. de, Stefanello, M. É. A., Salvador, M. J., Antiproliferative activity and induction of apoptosis in PC-3 cells by the chalcone cardamonin from *Campomanesia adamantium* (Myrtaceae) in a bioactivity-guided study, *Molecules* 19 (2) (2014) 1843-1855. <https://doi.org/10.3390/molecules19021843>.

[46] Silva M. C. B. L. e, Bogo, D., Alexandrino, C. A. F., Perdomo, R. T., Figueiredo, P. de O., Prado, P. R. do, Garcez, F. R., Kadri, M. C. T., Ximenes, T. V. N., Guimarães, R. de C. A., Sarmento, U. C., Macedo, M. R. L., Antiproliferative Activity of Extracts of *Campomanesia adamantium* (Cambess.) O. Berg and Isolated Compound Dimethylchalcone Against B16-F10 Murine Melanoma, *Journal of Medicinal Food* 21 (10) (2018) 1-11. <https://doi.org/10.1089/jmf.2018.0001>.

[47] Ferreira, L. C., Grabe-Guimarães, A., Paula, C. A. de, Michel, M. C. P., Guimarães, R. G., Rezende, S. A., Souza Filho, J. D. de, Saúde-Guimarães, D. A., Anti-inflammatory and antinociceptive activities of *Campomanesia adamantium*, *Journal of*

Ethnopharmacology 145 (9) (2013) 100-108. <https://doi.org/10.1016/j.jep.2012.10.037>.

[48] Cabral, C. de O., Campos, A., Silva, L. M. da, Boeing, T., Andrade, S. F. de, Cechinel Filho, V., Nesello, L. Â. N., Gastroprotective potential of methanolic extract and dimethyl cardamonin from *Campomanesia reitziana* fruits in mice, Naunyn-Schmiedeberg's Archives of Pharmacology 390 (6) (2017) 661-666. <https://doi.org/10.1007/s00210-017-1369-0>.

[49] Madalosso, R. C., Oliveira, G. C., Martins, M. T., Vieira, A. E. D., Barbosa, J., Caliari, M. V., Castilho, R. O., Tagliati, C. A., *Campomanesia lineatifolia* Ruiz & Pav. as a gastroprotective agente, Journal of Ethnopharmacology 139 (2012) 772-779. <https://doi.org/10.1016/j.jep.2011.12.014>.

[50] Ekor, M., The growing use of herbal medicines: issues relating to adverse reactions and challenges in monitoring safety, Frontiers in Pharmacology 4 (177) (2014) 1-10. <https://doi.org/10.3389/fphar.2013.00177>.

[51] França, I. S. X. de, Souza, J. A. de, Baptista, R. S., Britto, V. R. de S., Medicina popular: benefícios e malefícios das plantas medicinais, Revista Brasileira de Enfermagem 61 (2) (2007) 201-208. <https://doi.org/10.1590/S0034-71672008000200009>.

[52] Silveira, P. F. da, Bandeira, M. A. M., Arrais, P. S. D., Farmacovigilância e reações adversas às plantas medicinais e fitoterápicos: Uma realidade, Revista Brasileira de Farmacognosia 18 (4) (2008) 618-626. <https://doi.org/10.1590/S0102-695X2008000400021>.

[53] Raynor, D. K., Dickinson, R., Knapp, P., Long, A. F., Nicolson, D. J., Buyer beware? Does the information provided with herbal products available over the counter enable safe use? BMC Medicine 9 (94) (2011) 1-8. <https://doi.org/10.1186/1741-7015-9-94>.

[54] Villas Boas, G. R., Santos, A. C. dos, Souza, R. I. C., Araújo, F. H. S. de, Traesel, G. K., Marcelino, J. M., Silveira, A. P. S. da, Farinelli, B. C. F., Cardoso, C. A. L., Lacerda, R. B. de, Oesterreich, S. A., Preclinical safety evaluation of the ethanolic extract from guavira fruits (*Campomanesia pubescens* (D.C.) O. BERG) in experimental models of acute and short-term toxicity in rats, Food and Chemical Toxicology 118 (2018) 1-12. <https://doi.org/10.1016/j.fct.2018.04.063>.

[55] Pastori, T., Flores, F. C., Boligon, A. A., Athayde, M. L., Silva, C. de B. da, Canto-Dorow, T. S. do, Tedesco, S. B., Genotoxic effects of *Campomanesia xanthocarpa* extracts on *Allium cepa* vegetal system,

Pharmaceutical Biology. 51 (10) (2013) 1249-1255. <https://doi.org/10.3109/13880209.2013.786097>.

[56] Souza, J. C. de, Piccinelli, A. C., Aquino, D. F. S., Souza, V. V. de, Schmitz, W. O., Traesel, G. K., Cardoso, C. A. L., Kassuya, C. A. L., Arena, A. C., Toxicological analysis and antihyperalgesic, antidepressant, and anti-inflammatory effects of *Campomanesia adamantium* fruit barks, Nutritional Neuroscience: An International Journal on Nutrition, Diet and Nervous System 20 (1) (2017) 23-31. <https://doi.org/10.1179/1476830514Y.0000000145>.

[57] Carvalho, A. C. B., Balbino, E. E., Maciel, A., Perfeito, J. P. S., Situação do registro de medicamentos fitoterápicos no Brasil, Revista Brasileira de Farmacognosia 18 (2) (2008) 314-319. <https://doi.org/10.1590/S0102-695X2008000200028>.

[58] Pascoal, A. C. R. F., Ehrenfried, C. A., Eberline, M. N., Stefanello, M. É. A., Salvador, M. J., Free radical scavenging activity, determination of phenolic compounds and HPLC-DAD/ESI-MS profile of *Campomanesia adamantium* leaves, Natural Product Communications 6 (7) (2011) 969-972. <https://doi.org/10.1177/1934578X1100600711>.

[59] Breda, C. A., Gasperini, A. M., Garcia, V. L., Monteiro, K. M., Bataglion, G. A., Eberlin, M. N., Duarte, M. C., Phytochemical analysis and antifungal activity of extracts from leaves and fruit residues of brazilian savanna plants aiming its use as safe fungicides, Natural Products and Bioprospecting 6 (4) (2016) 195-204. <https://doi.org/10.1007/s13659-016-0101-y>.

[60] Espíndola, P. P. de T., Rocha, P. dos S. da, Carollo, C. A., Schmitz, W. O., Pereira, Z. V., Vieira, M. do C., Santos, E. L. dos, Souza, K. de P., Antioxidant and antihyperlipidemic effects of *Campomanesia adamantium* O. Berg Root, Oxidative Medicine and Cellular Longevity 2016 (7910340) (2016) 1-8. <http://doi.org/10.1155/2016/7910340>.

[61] Campos, J. F., Espíndola, P. P. de T., Torquato, H. F. V., Vital, W. D., Justo, G. Z., Silva, D. B., Carollo, C. A., Souza, K. de P., Paredes-Gamero, E. J., Santos, E. L. dos, Leaf and root extracts from *Campomanesia adamantium* (Myrtaceae) promote apoptotic death of leukemic cells via activation of intracellular calcium and caspase-3, Frontiers in Pharmacology 8 (466) (2017) 1-16. <https://doi.org/10.3389/fphar.2017.00466>.

[62] Lescano, C. H., Lima, F. F. de, Mendes-Silvério, C. B., Justo, A. F. O., Baldívia, D. da S., Vieira, C. P., Sanjinez-Argandoña, E. J., Cardoso, C. A. L., Mónica, F. Z., Oliveira, I. P. de, Effect of polyphenols from *Campomanesia adamantium* on platelet aggregation

and inhibition of cyclooxygenases: molecular docking and *in vitro* analysis, *Frontiers in Pharmacology* 9 (617) (2018) 1-13. <https://doi.org/10.3389/fphar.2018.00617>.

[63] Villas Boas, G. R., Silveira A. P. S. da, Farinelli, B. C. F., Cardoso, C. A. L., Arce, E., Oesterreich, A. S., The ethanolic extract obtained from *Campomanesia pubescens* (D.C.) O.BERG fruits exerts anxiolytic and antidepressant effects on chronic mild stress model and on anxiety models in Wistar rats. *Behavioral evidences, Nutritional Neuroscience: An International Journal on Nutrition, Diet and Nervous System* (2018) 1-11. <https://doi.org/10.1080/1028415X.2018.1466513>.

[64] Catelan, T. B. S., Brum, C. C. S., Heredia-Vieira, S. C., Crispim, B. A., Grisolia, A. B., Santos, R. C. S., Cardoso, C. A. L., Cytotoxicity, Genotoxicity, Antioxidant Potential and Chemical Composition of Leaves of *Campomanesia pubescens* (Mart. ex DC.) O.Berg, *Current Pharmaceutical Biotechnology* 19 (5) (2018) 416-421. <https://doi.org/10.2174/1389201019666180626102443>.

[65] Villas Boas, G. R., Araújo, F. H. S. de, Marcelino, J. M., Castro, L. H. A., Silveira, A. P. S. da, Nacer, R. S., Souza, F. R. de, Cardoso, C. A. L., Lacerda, R. B. de, Guterres, Z. da D. R., Oesterreich, S. A., Preclinical safety evaluation of the ethanolic extract from *Campomanesia pubescens* (Mart. ex DC.) O. BERG (guavira) fruits: analysis of genotoxicity and clastogenic effects, *Food & Function* 9 (7) (2018) 3707-3717. <https://doi.org/10.1039/c8fo01017j>.

[66] Biavatti, M. W., Farias, C., Curtius, F., Brasil, L. M., Hort, S., Schuster, L., Leite, S. N., Prado, S. R. T., Preliminary studies on *Campomanesia xanthocarpa* (Berg.) and *Cuphea carthagenensis* (Jacq.) J.F. Macbr. aqueous extract: weight control and biochemical parameters, *Journal of Ethnopharmacology* 93 (2-3) (2004) 385-389. <https://doi.org/10.1016/j.jep.2004.04.015>.

[67] Viecili, P. R. N., Borges, D. O., Kirsten, K., Malheiros, J., Viecili, E., Melo, R. D., Trevisan, G., Silva, M. A. da, Bochi, G. V., Moresco, R. N., Klafke, J. Z., Effects of *Campomanesia xanthocarpa* on inflammatory processes, oxidative stress, endothelial dysfunction and lipid biomarkers in hypercholesterolemic individuals, *Atherosclerosis* 234 (1) (2014) 85-92. <https://doi.org/10.1016/j.atherosclerosis.2014.02.010>.

[68] Brandelli, C. L., Ribeiro, V. B., Zimmer, K. R., Barth, A. L., Tasca, T., Macedo, A. J., Medicinal Plants Used by a Mbyá-Guarani Tribe Against Infections: Activity on KPC-Producing Isolates and Biofilm-Forming Bacteria, *Natural Product*

Communications 10 (11) (2015) 1847-1852. <https://doi.org/10.1177/1934578X1501001114>.

[69] Schmidt, H. de O., Rockett, F. C., Pagno, C. H., Possa, J., Assis, R. Q., Oliveira, V. R. de, Silva, V. L. da, Flôres, S. H., Rios, A. de O., Vitamin and bioactive compound diversity of seven fruit species from south Brazil, *Journal of the Science of Food and Agriculture* 99 (7) (2019) 3307-3317. <https://doi.org/10.1002/jsfa.9544>.

[70] Sousa, J. A. de, Prado, L. D. S., Alderete, B. L., Boaretto, F. B. M., Allgayer, M. C., Miguel, F. M., Sousa, J. T. de, Marroni, N. P., Lemes, M. L. B., Corrêa, D. S., Ferraz, A. B. F., Picada, J. N., Toxicological aspects of *Campomanesia xanthocarpa* Berg. associated with its phytochemical profile, *Journal of Toxicology and Environmental Health, Part A* 82 (1) (2019) 62-74. <https://doi.org/10.1080/15287394.2018.1562392>.