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Biotechnological potential of the *Carapa guianensis*, *Bertholletia excelsa* and *Copaifera* spp. oils

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The use of vegetable species for treatment or prevention of diseases is one of the most ancient medicine techniques in humanity. In Amazon rainforest, there are numerous of plant species that possess biotechnological potential, and due to this, this study aimed at carrying out a bibliographic review describing the biotechnological potential in *Carapa guianensis*, *Bertholletia excels*, and *Copaifera* spp. oils. This study is a systematic review of literature in the databases: SCIELO, VHL and PUBMED, by using the descriptors: *C. guianensis* oil, *B. excelsa* oil and *Copaifera* spp. After the selection, 87 articles were selected; 48 on *C. guianensis,* 9 on *B. excels*, and 30 on *Copaifera* spp. Oil seeds from Amazon rainforest possess a good biotechnological potential to be explored. This review has shown that *C. guianensis* and *Copaifera* spp. are strong candidates for the search of new insecticide, antiparasitict, anti-inflammatory and healing products. *Copaifera* spp. has also shown to be promising for the production of antibiotic and antifungic medicines, and *C. guianensis* for acaricide drugs. Future studies are indicated to deepen the knowledge already described and to investigate new biotechnological potentialities of Amazonian oil seeds. However, for this to happen, greater financial support is required from the Brazilian government and agencies, thus increasing the level of research in the region, which will consequently maximize the likelihood of new product discovery.

Key word: Biotechnology, oilseeds, Amazon rainforest.

INTRODUCTION

Ethnopharmacology is defined as “the interdisciplinary scientific exploration of biologically active agents

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Table 1. Amount of articles found in literature search.

Descriptor	SCIELO	VHL	PUBMED	Total
Carapa guianensis oil	26	52	30	108
Bertholletia excelsa oil	12	24	12	48
Copaifera spp oil[#]	23	64	12	99
Total	61	140	54	255

[#]Species searched: *Copaifera duckei* oil, *Copaifera langsdorffii* oil, *Copaifera martii* oil, *Copaifera paupera* oil, *Copaifera pubiflora* oil, and *Copaifera reticulata* oil.

traditionally employed or observed by man" (Bruhn and Holmstedt, 1981; Elisabetsky, 2003). This area combines information gained from medicinal flora users (communities and traditional specialists) with chemical and pharmacological studies (Elisabetsky, 2003).

The use of vegetable species for treatment and prevention of diseases is one of the most ancient medicine techniques in humanity (Dutra, 2009). Even though plants have been used for centuries for medicinal purposes, the vast majority have unknown biotechnological features by science (Meneguetti and Facundo, 2015).

Data show that about 95% of Brazilian native species still do not possess scientific studies on their possible applicabilities (Santos, 2009), representing a huge economic and biotechnological potential to be explored, especially in vegetable species from Amazon rainforest, as many have still not been catalogued by science (Cechinel and Rosendo, 1998; Abreu et al., 2001; Meneguetti and Facundo, 2015). It can present new chemical compounds and consequently new specific and efficient drugs (Lang et al., 2008).

There are plenty of plants species in Amazonian rainforest that possess biotechnological potential (Osakada, 2009), among them are presented *Carapa guianensis* (Andiroba), *Bertholletia excelsa* (Amazônia's nut) and *Copaifera* spp. (Copaíba). Furthermore, this study aimed at carrying out a bibliographic review describing the biotechnological potential of these species' oil.

MATERIALS AND METHODS

This study is a systematic review of literature based on Galvão and Pereira (2014), following the steps below:

(a) Creation of research question: What is the biotechnological potential described in literature of Andiroba, Amazônia's Nut, and Copaíba oils?
(b) Literature search: Search for scientific articles in the following databases: Scientific Electronic Library Online (SCIELO), Virtual Health Library (VHL) and National Institute of Health (PUBMED) by using the descriptors: *C. guianensis* oil, *B. excelsa* oil and *Copaifera* spp. oil of species (*Copaifera duckei* oil, *Copaifera langsdorffii* oil, *Copaifera martii* oil, *Copaifera paupera* oil, *Copaifera pubiflora* oil and *Copaifera reticulata* oil) because they were the main copaíba species in the Brazilian Amazon rainforest. Articles in Portuguese, English and Spanish published by 2018 were included. The amount of articles found in the survey is presented in Table 1.
(c) Article selection: This selection was performed by three researchers, and the articles rejected by two or three of them were removed from this research. The criteria for exclusion were repeated articles (found in more than one database), out of the research's aim, low methodological quality and with negative results for biotechnological potential.
d) Data gathering: After the selection, 87 articles were selected; 48 on *C. guianensis,* 9 on *B. excels*, and 30 on *Copaifera* spp. Those were used in the results of this study. Besides the selected articles, others were used for creation of introduction and improvement of this article's discussion.
e) Data synthesis: The data were organized into tables, and described in the text according to their biotechnological potential.
f) Results discussion writting: Description and discussion of the data are at "Results and Discussion" present in the sequence.

RESULTS AND DISCUSSION

Insecticide activity

The data showing that the oils searched have insecticide activity are shown in Table 2.

The *C. guianensis* and *Copaifera* spp. oils have shown a good potential in the medical entomology for vector control of tropical diseases, such as *A. aegypti*: Dengue, Chikungunya, and Zika virus vector (Aragão et al., 2018); *A. albopictus*: Yellow fever vector (IEC, 2018); and *C. quinquefasciatus*: that has been also found infected by Zika virus (Smartt et al., 2018).

C. guianensis develop products against ectoparasitosis due to their activity against *F. subrostratus* (popularly known as lice) that is a public health problem in Brazil. It is estimated that up to two thirds of deprived population and communities were affected in the beginning of the year 2000 (Heukelbach et al., 2003).

In livestock, *C. guianensis* has proven to be promising against two flies species: *M. domestica* and *H. irritans*, with this last one known popularly as "Horn Fly", which causes several problems in the Brazilian cattle (Klauck et al., 2014).

C. guianensis and *Copaifera* spp. may also be beneficial to agriculture, acting as anti-*S. frugiperda* popularly known as "Armyworm" (Santos et al., 2016), *A.*

Table 2. Insecticide oilseeds performance from Amazon rainforest.

Insect	*C. guianensis*	*B. excelsa*	*Copaifera* spp	Reference
Aedes aegypti (larvicide)	X	-	X	Mendonça et al. (2005)* Silva et al. (2006)* Abed et al. (2007)*** Silva et al. (2007)*** Geris et al. (2008)*** Rodrigues et al. (2014)***
Aedes aegypti (repellent)	X	-	-	Miot et al. (2004)* Jesus et al. (2017)*
Aedes albopictus (larvicide)	X	-	-	Silva et al. (2004)*
Atta sexdens rubropilosa	X	-	-	Ambrozin et al. (2006)*
Culex quinquefasciatus (larvicide)	-	-	X	Silva et al. (2003)***
Diabrotica speciosa	-	-	X	Barbosa et al. (2013)***
Felicola subrostratus	X	-	-	Barros et al. (2012)*
Haematobia irritans	X	-	-	Klauck et al. (2014)*
Musca domestica	X	-	-	Klauck et al. (2014)*
Spodoptera frugiperda	X	-	X	Santos et al. (2016)* Santos et al. (2016)***
Tribolium castaneum	-	-	X	Melo et al. (2015)***
Zabrotes subfasciatus	-	-	X	França et al. (2012)***

*Citations reference to *C. guianensis*; ** Citations referent to *B. excelsa*; *** Citations referent to Copaifera spp.

sexdens rubropilosa or “Sauba Ant” (Ambrozin et al., 2006), *D. speciosa* known as “vaquinha verde” (Barbosa et al., 2013), *Z. subfasciatus* known as “caruncho do feijão” (França et al., 2012) and *T. castaneum* as “May Beetle” (Melo et al., 2015), and they may cause jeopardy to diferrent types of crops.

In the databases, there were no articles found showing that *B. excels* has insecticide activity.

Acaricide activity

The *C. guianensis* oil was the most promising in this study; shown to be anti-*Anocentor nitens* (Farias et al., 2009; Farias et al., 2012)*, Rhipicephalus sanguineus* (Farias et al., 2009; Farias et al., 2012; Vendramini et al., 2012a; Vendramini et al., 2012b; Roma et al., 2013; Roma et al., 2015)*,* and *Rhipicephalus* (*Boophilus) microplus* (Farias et al., 2012; Chagas et al., 2012). The *B. excelsa* oil has also shown to be anti-*R. (B.) microplus*, however it was considered low (Villarreal et al., 2017).

The *A. nitens* tick is one of the species that affects horses, and it is vector of *Babesia caballi* protozoan, which is an etiologic agent of equine babesiosis, disease that promotes low development and death in animals (Borges and Leite, 1993; Bello et al., 2008). It is known as “Spinose Ear Tick”, and it is responsible for injuries in the pinna, productivity drop, irritation, blood spoliation, propensity to myiasis and secondary bacterial infections (Borges and Leite, 1993; Bello et al., 2008).

R. sanguineus has high prevalence in urban dogs, and is one of the species of parasites of these animals (Labruna and Pereira, 2001; Szabó et al., 2001; Soares et al., 2006; Paz et al., 2008). It is one responsible for pathogenic agent’s transmission, such as *Babesia canis* and *Eherlichia canis* (Smith et al., 1976; Gothe et al., 1989). There are records of infestation of this species in humans (Guglielmone et al., 2006), as they may become a secondary vector of Ehrlichiosis, Babesiosis and Spotted Fever (Fernandes et al., 2001; Paz et al., 2008).

R. (B.) microplus is the main species of ticks that affects cattle in Brazil, which causes reduction in milk production; the main economic impact due to it (Rodrigues and Leite, 2013). It may also cause jeopardy in meat and leather production, besides of several other diseases that can be transmitted by them (Massard and Fonseca, 2004; Andreotti et al., 2011; Santos et al., 2018).

Antiparasitic activity

Among the oils studied, parasitic activity was found against eight parasites species (Table 3).

The *C. guianensis* oil has shown activity against three species of goats and sheep gastronintestinal nematodes:

Table 3. Antiparasitic activity of Amazonian oleaginous oils.

Parasite	*C. guianensis*	*B. excelsa*	*Copaifera* spp.	Reference
Haemonchus sp.	X	-	-	Farias et al. (2010)*
Leishmania amazonenses	-	-	X	Santos et al. (2008a)*** Meneguetti et al. (2015)***
Leishmania chagasi	-	-	X	Rondon et al. (2012)*** Meneguetti et al. (2015)***
Oesophagostomum sp.	X	-	-	Farias et al. (2010)*
Plasmodium falciparum	X	-	-	Miranda juúnior et al. (2012)* Pereira et al. (2014)* Nardi et al. (2016)*
Plasmodium berghei	X	-	-	Pereira et al. (2014)*
Trichostrongylus sp	X	-	-	Farias et al. (2010)*
Trypanosoma evansi	-	-	X	Dorneles et al. (2013

*Citations reference to *C. guianensis*; ** Citations referent to *B. excelsa*; *** Citations referent to Copaifera spp.

Haemonchus sp., *Oesophagostomum* sp., and *Trichostrongylus* sp. (Farias et al., 2010). It has positive performance in veterinary and potential for future studies with helminths that affect humans.

C. guianensis was also antiparasitic against two species of *Plasmodium* gender, being the etiologic agent of malaria; disease among the four main epidemias in Latin America, with about 100 thousand new cases each year (Braz et al., 2006; Ferreira et al., 2012; Meneguetti et al., 2014). The anti-malaria potential is important because there is a need to search for new drugs against malaria, as it is resistant to nowadays drugs used, and being a threat to the disease control (Meneguetti et al., 2014).

Copaifera spp. has shown activity against trypanosomatids genders: *Leishmania* and *Trypanosoma,* Leishmaniasis and Chagas´ disease etiologic agents, diseases included in the group of Neglected Diseases, in which only 10% of the world's expenses with research in health are destined to diseases that account for 90% of the global illed people (Bezerra et al., 2012).

Leishmaniasis has shown the need for urgente new candidates for treatment drugs (Santos et al., 2013a), because today the first choice for leishmaniasis treatment have been pentavalent antinomials (Sb^{5+}), amidines, polyene, aminoglycosides, and hexadecylphosphocholine (miltefosine). However, some present toxicity for the patient (Bezerra et al., 2004; Figueredo et al., 2014; Meneguetti et al., 2015).

Currently the treatment of Chagas' disease presents only one drug available in Brazil, benzonidazole (2-nitroimidazole) introduced in the therapy in 1967 and to date a drug with satisfactory cure potential has not been developed and the drug used is inefficient and presents various side effects (Bezerra et al., 2012).

In the searched databases no articles were found that demonstrate the antiparasitic action of *B. excels*.

Antimicrobian activity

The oils studied showed antimicrobial activity against bacteria and fungi, as can be observed in Table 4. *Copaifera* spp. presented antimicrobial action; presented activity against 14 species, followed by *C. guianensis* that had action against 3 species. In the searched databases, no articles were found that demonstrate the antimicrobial action of *B. excelsa*.

The action against the microorganisms observed in Table 4, demonstrates the potential of the *Copaifera* spp. and *C. guianensis* oils for the development of drugs for the treatment of periodontal diseases, since it has had action against *A. actinomycetemcomitans, E. faecalis* and *P. gingivalis*. When they are present, several periodontal diseases are associated with cases of failure of endodontic treatment (Gasparetto et al., 2000; Carvalho and Cabral, 2007; Nacif and Alves, 2010).

Microbicidal activity against *E. coli*, *S. aureus*, *S. epidermidis* and *L. monocytogenes* is also highlighted, as they may cause several problems to human health, especially infections (Farbe and Peterkin, 1991; Lowy, 1998; Otto, 2009; Matos et al., 2015), which are often resistant to antibiotics (Santos, 2014), which demonstrates the importance of research for the development of new drugs.

The *Copaifera* spp. oil has an antifungal potential, with action against the dermatophyte *T. rubrum* (Dias et al., 2015) and species of the genus *Candida*, which causes the disease candidiasis (Calderone and Fonzi, 2001), which according to the *Associação de Obstetrícia e Ginecologia do Estado de São Paulo* (SOGESP - Association of Obstetrics and Gynecology of São Paulo State), affects 75% of women and of these, almost half will have a second episode and about 5% will present the condition more than once a year (Galileu, 2018). There is a large pharmacological market to be exploited for the

Table 4. Antimicrobial activity of Amazonian oleaginous oils.

Microrganism	*C. guianensis*	*B. excelsa*	*Copaifera* spp.	Reference
Actinobacillus actinomycetemcomitans	-	-	X	Dias et al. (2015)***
Bacillus cereus	-	-	X	Santos et al. (2013a)***
Bacillus subtilis	-	-	X	Santos et al. (2008b)***
Candida glabrata	-	-	X	Alencar et al. (2015)***
Candida krusei	-	-	X	Alencar et al. (2015)***
Enterococcus faecalis	X	-	X	Meccia et al. (2013)* Santos et al. (2008b)***
Escherichia coli	X	-	-	Brito et al. (2001)*
Listeria monocytogenes	-	-	X	Santos et al. (2013b)***
Microsporum canis	-	-	X	Dias et al. (2015)***
Porphyromonas gingivalis	-	-	X	Dias et al. (2015)***
Staphylococcus aureus	X	-	X	Brito et al. (2001)* Meccia et al. (2013)* Santos et al. (2008b)*** Santos et al. (2013a)*** Alencar et al. (2015)***
Staphylococcus epidermidis	-	-	X	Alencar et al. (2015)*** Santos et al. (2008b)***
Streptococcus mitis	-	-	X	Dias et al. (2015)***
Streptococcus sp	-	-	X	Ziech et al. (2013)***
Trichophyton rubrum	-	-	X	Dias et al. (2015)***

*Citations reference to *C. guianensis*; ** Citations referent to *B. excelsa*; *** Citations referent to *Copaifera* spp.

production of antifungal agents.

Other activities with biotechnological potential

Other activities of *C. guianensis*, *B. excelsa* and *Copaifera* spp. can be observed in Table 5.

The anti-inflammatory and healing effects of *C. guianensis* and *Copaifera* spp. are in agreement with their popular use, since both are used for these purposes, demonstrating the importance of the empirical knowledge of traditional populations for scientific research.

The antioxidant effect of *C. guianensis* and *B. excelsa* is very well seen in the pharmacological and food industry, since antioxidants prevent the formation of free radicals in the body, retarding cellular aging (Silva and Ferrari, 2011), which if added to the antigenotoxic effect of *C. guianensis* (Lemes et al., 2017) may be an alternative for future studies of cancer treatment. In the case of *B. excelsa*, which is used for the production of olive oils (Valdez et al., 2009) and other beverages (Felberg et al., 2009), the antioxidant characteristic, together with its nutritional power (Spini et al. 2006) further yields economic value to the product.

In addition to all the activities observed in Table 5, in a study with rats, *C. guianensis* did not produce toxic effects (Costa-Silva et al., 2008), genotoxic (Milhomem-Paixão et al., 2016), did not provoke chromosome aberrations in bone marrow cells (Arrebola et al., 2013) and did not interfere in the fertility and development of offspring (Costa-Silva et al., 2006). These data demonstrate a safety for the production of drugs from this species.

Copaifera spp. has also demonstrated safety for the use of oil as a therapeutic agent, since it does not present acute toxicity and neurotoxic effects (Sachetti et al., 2009) and still has neuroprotective action (Santos et al., 2012). When used in combination with vaginal cream and applied to rats, it has been shown to be safe during pregnancy (Lima et al., 2011).

B. excelsa has also been shown to be a safe species for use, since its almond is already widely used in food. This species still presents biodiesel production potential, as was observed in *C. guianensis* (Stachiw et al., 2016), which has also been shown to be a good catalyst (Tiosso et al., 2014).

Conclusion

It was verified that the Amazonian oilseeds have a good

Table 5. Other activities of Amazon rainforest oleaginous oils.

Activity	*C. guianensis*	*B. excelsa*	*Copaifera* spp	Reference
Antiallergic	X	-	-	Penido et al. (2005)* Nardi et al. (2016)* Ferraris et al. (2011)* Ferraris et al. (2012)* Henriques and Penido, 2014)*
Anti-inflammatory	X	-	X	Penido et al. (2005)* Penido et al. (2006)* Henriques and Penido, 2014)* Nardi et al. (2016)* HiguchI et al. (2017)* Wanzeler et al. (2018)* Carvalho et al. (2005)*** Muniz et al. (2009)*** Teixeira et al. (2017)***
Antioxidant	X	X	-	Milhomem-Paixão et al. (2016)* Vieira and Regitano-D'arce, 1999)*)* Gomes et al. (2016)*)*
Antigenotoxic	X	-	-	Lemes et al. (2017)*
Healing	X	-	X	Botelho-Brito et al. (2001)* Santos et al. (2013a)* Silva et al. (2015)* Wanzeler et al. (2018)* Estevão et al. (2009)*** Estevão et al. (2013)*** Feitosa Junior et al. (2018)***
Neuroprotective	-	-	X	Santos et al. (2012)***

biotechnological potential to be explored. The present review showed that *C. guianensis* and *Copaifera* spp. are strong candidates in searching for new products with insecticidal, antiparasitic, anti-inflammatory and cicatrizing activity.

Copaifera spp. has also been shown to be promising for the production of antibiotics and antifungals and *C. guianensis* for acaricidal drugs.

Future studies are indicated to deepen the knowledge already described and to investigate new biotechnological potentialities of Amazonian oilseeds. However, for this to happen, greater financial support is required from the Brazilian government and agencies and the interaction between different researchers, laboratories and research groups to form multidisciplinary and interdisciplinary teams, thus increasing the level of research in the region, which will consequently maximize the likelihood of new product discovery.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

REFERENCES

Abed RAAA, Cavasin GM, Silva HHG, Geris RG, Silva IG (2007). Alterações morfohistológicas em larvas de *Aedes aegypti* (Linnaeus, 1762) (Diptera, Culicidae) causadas pela atividade larvicida do óleo-resina da planta medicinal *Copaifera reticulata* Ducke (Leguminosae). Revista De Patologia Tropical 36(1):75-86. https://doi.org/10.5216/rpt.v36i1.1819

Abreu AS, Barbosa OS, Müller AH, Guilhon GMSP (2001). Constituintes químicos do caule e das cascas do caule de C*roton pullei* var. Glabrior (Euphorbiaceae). Revista Virtual de Iniciação Acadêmica da UFPA 1(2):1-9.

Alencar EM, Xavier-Júnior FH, Morais AR, Dantas TR, Dantas-Santos N, Verissimo LM (2015). Chemical Characterization and Antimicrobial Activity Evaluation of Natural Oil Nanostructured Emulsions. Journal of Nanoscience and Nanotechnology 15(1):880-888. http://dx.doi.org/10.1166/jnn.2015.9187

Ambrozin ARP, Leite AC, Bueno FC, Vieira PC, Fernandes JB, Bueno OC (2006). Limonoids from andiroba oil and Cedrela fissilis and their insecticidal activity. Journal of the Brazilian Chemical Society 17(3):542-547.http://dx.doi.org/10.1590/S0103-50532006000300017

Andreotti R, Guerrero FD, Soares MA, Barros JC, Miller RJ, Léon AP (2011). Acaricide resistance of *Rhipicephalus (Boophilus) microplus* in State of Mato Grosso do Sul, Brazil. Revista Brasileira de Parasitologia Veterinária 20(2):127-133. http://dx.doi.org/10.1590/S1984-29612011000200007

Aragão CF, Cruz ACR, Neto JPN, Monteiro HAO, Silva EVP, Silva SP (2018). Circulation of Chikungunya virus in *Aedes aegypti* in

Maranhão, Northeast Brazil. Acta Tropica 15(1):880-888. http://dx.doi.org/10.1016/j.actatropica.2018.06.022
Barbosa FS, Leite GLD, Martins ER, D'avila VA, Cerqueira VM (2018). Medicinal plant extracts on the control of *Diabrotica speciosa* (Coleoptera: Chrysomelidae). Revista Brasileira de Plantas Medicinais 15(1):142-149. http://dx.doi.org/10.1590/S1516-05722013000100020
Barros FN, Farias MPO, Tavares JPC, Alves LC, Faustino MAG (2012). In vitro efficacy of oil from the seed of *Carapa guianensis* (andiroba) in the control of *Felicola subrostratus*. Revista Brasileira de Farmacognosia 22(5):1130-1133. http://dx.doi.org/10.1590/S0102-695X2012005000047
Bello AC, Cunha AP, Leite RC, Oliveira PR, Ribeiro AC, Domingues LN (2008). Controle de *Anocentor nitens* (Neumann, 1897) (Acari: Ixodidae) em Equinos. Revista Brasileira de Parasitologia Veterinária 17(1):59-63.
Bezerra RJS, Leon L, Genestra M (2004). Recentes avanços da quimioterapia das leishmanioses: moléculas intracelulares como alvo de fármacos. Revista Brasileira de Ciências Farmacêuticas 40(2):141-148. http://dx.doi.org/10.1590/S1516-93322004000200003
Bezerra WS, Meneguetti DUO, Camargo LMA (2012). A Busca de fármacos para tratamento da Tripanossomíase Americana: 103 anos de negligência. Saúde (Santa Maria) 38(1):09-20. http://dx.doi.org/10.5902/223658344813
Borges LMF, Leite RC (1993). Aspectos biológicos do *Dermacentor nitens* (Neumann, 1897) em condições de laboratório. Arquivo Brasileiro de Medicina Veterinária e Zootecnia 45(6):586-591.
Botelho-Brito NM, Silva PRFS, Silva GCF, Casella SFM, Sampaio ARS, Carvalho RA (2001). Avaliação macroscópica de feridas cutâneas abertas, em ratos, tratadas com óleo de andiroba/Macroscopic evaluation of the cicatrization of treated open cutaneous wounds with oil andiroba in rats. Revista Paraense Medicina 15(2):17-22.
Braz RM, Andreozziii VL, Kale PL (2006). Detecção precoce de epidemias de malária no Brasil: uma proposta de automação. Epidemiologia e Serviços de Saúde 15(2):21-33. http://dx.doi.org/10.5123/S1679-49742006000200004
Brito MVH, Brazão RV, Siqueira RBP, Santos MT (2001). Efeito do óleo de andiroba em cultura de *Staphylococcus aureus* e *Escherichia coli*: estudo in vitro. Revista Paraense Medicina 15(1):36-40.
Bruhn JG, Holmstedt B (1981). Ethnopharmacology, objectives, principles and perspectives. In: Reinhard JLE. Natural products as medicinal agents. Stuttgart: Hippokrates, 1981.
Calderone RA, Fonzi WA (2001). Virulence factors of *Candida albicans*. Trends in Microbiology 9(7):327-335.
Carvalho C, Cabral CT (2007). Papel da *Porphyromonas Gingivalis* na Doença Periodontal. Revista Portuguesa de Estomatologia, Medicina Dentária e Cirurgia Maxilofacial 48(3):167-171. https://doi.org/10.1016/S1646-2890(07)70136-X
Carvalho JC, Cascon V, Possebon LS, Morimoto MS, Cardoso LG, Kaplan MA (2005). Topical antiinflammatory and analgesic activities of *Copaifera duckei* dwyer. Phytotherapy Research 19(11):946-950.
Cechinel FV, Rosendo AY (1998). Estratégias para a obtenção de compostos farmacologicamente ativos a partir de plantas medicinais. Conceitos sobre modificação estrutural para otimização da atividade. Química Nova 21(1):99-105. http://dx.doi.org/10.1590/S0100-40421998000100015
Chagas SAC, Barros LD, Cotinguiba F, Furlan M, Giglioti R, Sena Oliveira MC, Bizzo HR (2012). In vitro efficacy of plant extracts and synthesized substances on Rhipicephalus (Boophilus) Microplus (Acari: Ixodidae). Parasitology Research 110(1):295-303.
Costa-Silva JH, Lima CR, Silva EJ, Araújo AV, Fraga MC, Ribeiro A (2008). Acute and subacute toxicity of the *Carapa guianensis* Aublet (Meliaceae) seed oil. Journal of Ethnopharmacology 116(3):495-500. http://dx.doi.org/10.1016/j.jep.2007.12.016
Costa-Silva JH, Lyra MM, Lima CR, Arruda VM, Araújo AV, Ribeiro A (2007). A toxicological evaluation of the effect of *Carapa guianensis* Aublet on pregnancy in Wistar rats. Journal of Ethnopharmacology 112(1):122-126. http://dx.doi.org/10.1016/j.jep.2007.02.004
Dias FGG, Casemiro LA, Martins CHG, Dias LGGG, Pereira LF, Nishimura LT (2015). Endodontics pastes formulated with *copaiba oil*: action on oral microbiota and dentin bridge formation in dogs. Ciência Rural 45(6):1073-1078.
Dutra MG (2009). Plantas medicinais, fitoterápicos e saúde pública: um diagnóstico situacional em Anápolis, Goiás. Dissertação (Mestrado) - Centro Universitário de Anápolis, Anápolis - Goiás.
Elisabetsky E (2003). Etnofarmacologia. Ciencia e Cultura 55(3):35-36.
Estevão LRM, Medeiros JP, Baratella-Evêncio L, Simões RS, Mendonça FS, Evêncio-Neto J (2013). Effects of the topical administration of copaiba oil ointment (*Copaifera langsdorffii*) in skin flaps viability of rats. Acta Cirurgica Brasileira 28(12):863-869. http://dx.doi.org/10.1590/S0102-86502013001200009
Estevão LRM, Medeiros JP, Scognamillo-Szabó MVR, Baratella-Evêncio L, Guimarães EC, Câmara CAG, Evêncio-Neto J (2009). Neoangiogênese de retalhos cutâneos em ratos tratados com óleo de copaíba. Pesquisa Agropecuária Brasileira 44(4):406-412.
Farbe JM, Peterkin PI (1991). Listeria monocytogenes, a food-borne pathogen. Microbiological Reviews 55(3):476-511.
Farias MPO, Sousa DP, Arruda AC, Wanderley AG, Teixeira WC, Alves LC, Faustino MAG (2009). Potencial acaricida do óleo de andiroba *Carapa guianensis* Aubl. sobre fêmeas adultas ingurgitadas de *Anocentor nitens* Neumann, 1897 e *Rhipicephalus sanguineus* Latreille, 1806. Arquivo Brasileiro de Medicina Veterinária e Zootecnia 61(4):877-882.
Farias MPO, Teixeira WC, Wanderley AG, Alves LC, Faustino MAG (2010). Avaliação in vitro dos efeitos do óleo da semente de Carapa guianensis Aubl. sobre larvas de nematóides gastrintestinais de caprinos e ovinos. Revista Brasileira de Plantas Medicinais 12(2):220-226.
Farias MPO, Wanderley AG, Alves LC, Faustino MAG (2012). Cálculo da CI50 (concentração inibitória média) e CL50 (concentração letal média) do óleo da semente de andiroba (*Carapa guianensis*, Aubl.) sobre *Rhipicephalus (Boophilus) microplus* (Canestrini, 1887), *Anocentor nitens* (Neumann, 1897) e *Rhipicephalus sanguineus* (Latreille, 1806) (Acari: Ixodidae). Arquivos do Instituto Biológico 79(2):255-261. http://dx.doi.org/10.1590/S1808-16572012000200014
Feitosa Junior DJS, Carvalho LTF, Rocha IRO, Brito CN, Moreira RA, Barros CAV (2018). Effects of Copaiba oil in the healing process of urinary bladder in rats. International Brazilian Journal of Urology 44(2):384-389. http://dx.doi.org/10.1590/s1677-5538.ibju.2017.0143
Felberg I, Antoniassi R, Deliza R, Freitas SC, Modesta RCD (2009). Soy and Brazil nut beverage: processing, composition, sensory, and color evaluation. Food Science and Technology 29(3):609-617. http://dx.doi.org/10.1590/S0101-20612009000300002
Fernandes FF, Freitas EP, Silva JR, Silva OR, Silva IG (2001). Efeitos toxicológicos e ineficiência in vitro de deltametrina sobre larvas de *Rhipicephalus sanguineus*, de Goiânia, Goiás, Brasil. Revista da Sociedade Brasileira de Medicina Tropical 34(2):159-165. http://dx.doi.org/10.1590/S0037-86822001000200002
Ferraris FK, Moret KH, Figueiredo AB, Penido CC, Henriques MD (2012). Gedunin, a natural tetranortriterpenoid, modulates T lymphocyte responses and ameliorates allergic inflammation. International Immunopharmacology 14(1):82–93. http://dx.doi.org/10.1016/j.intimp.2012.06.002
Ferraris FK, Rodrigues R, Silva VP, Figueiredo R, Penido C, Henriques MD (2011). Modulation of T lymphocyte and eosinophil functions in vitro by natural tetranortriterpenoids isolated from *Carapa guianensis* Aublet. International Immunopharmacology 11(1):1-11. http://dx.doi.org/10.1016/j.intimp.2010.09.010
Ferreira GM, Zan RA, Ramos LJ, Souza RAA, Meneguetti DUO (2012). Panorama Epidemiológico da Malária no Município de Ariquemes, Rondônia, Amazônia Ocidental: Um Inquérito de Seis Anos (2005 a 2010). Revista de Epidemiologia e Controle de Infecção 2(4):128-132. http://dx.doi.org/10.17058/reci.v2i4.27
Figueredo FG, Tintino SR, Brito DIV, Braga MFBM, Leite NF, Lucena BFF (2014). Avaliação das potenciais atividades tripanocida e antileishmania do extrato de folhas de *Piper arboreum* (Piperaceae) e de suas frações. Revista de Ciências Farmacêuticas Básica e Aplicada 35(1):149-154. http://dx.doi.org/10.1590/1983-084X/15_215
França SM, Oliveira JV, Esteves Filho AB, Oliveira CM (2012). Toxicity and repellency of essential oils to *Zabrotes subfasciatus* (Boheman) (Coleoptera, Chrysomelidae, Bruchinae) in *Phaseolus vulgaris* L. Acta Amazônica 42(3):381-386. http://dx.doi.org/10.1590/S0044-59672012000300010

Galileu V (2018). Candidíase: saiba tudo sobre a doença que afeta 75% das mulheres. Disponível em <https://revistagalileu.globo.com/Ciencia/Saude/noticia/2017/07/candidiase-saiba-tudo-sobre-doenca-que-afeta-75-das-mulheres.html>.

Galvão TF, Pereira MG (2014). Revisões sistemáticas da literatura: passos para sua elaboração. Epidemiologia e Serviços de Saúde 23(1):183-184. http://dx.doi.org/10.5123/S1679-49742014000100018

Gasparetto A, Arana-Chavez VE, Avila-Campos MJ (2000). Aderência de *Actinobacillus actinomycetemcomitans* às células epiteliais bucais: estabilidade e aspectos ultra-estruturais. Pesquisa Odontológica Brasileira 14(4):311-318. http://dx.doi.org/10.1590/S1517-74912000000400002

Geris R, Silva IG, Silva HH, Barison A, Rodrigues-Filho E, Ferreira AG (2008). Diterpenoids from *Copaifera reticulata* Ducke with larvicidal activity against *Aedes aegypti* (l.) (Diptera, culicidae). Revista do Instituto de Medicina Tropical de São Paulo 50(1):25-28. http://dx.doi.org/10.1590/S0036-46652008000100006

Gomes S, Torres AG (2016). Optimized extraction of polyphenolic antioxidant compounds from Brazil nut (*Bertholletia excelsa*) cake and evaluation of the polyphenol profile by HPLC. Journal of the Science of Food and Agriculture 96(8):2805-2814. http://dx.doi.org/10.1002/jsfa.7448

Gothe R, Wegerot S, Walden R, Walden A (1989). Epidemiology of *Babesia canis* and *Babesia gibsoni* infections in dogs in Germany. Kieintierpraxis 34(7):309-320.

Guglielmone AA, Beati L, Barros-Battesti DM, Labruna MB, Nava S, Venzal JM (2006). Ticks (Ixodidae) on humans in South America. Experimental and Applied Acarology 40(2):83-100. http://dx.doi.org/10.1007/s10493-006-9027-0

Henriques Md, Penido C (2014). The therapeutic properties of *Carapa guianensis*. Current Pharmaceutical Design 20(6):850-856. http://dx.doi.org/10.2174/13816128113199990048

Heukelbach J, Oliveira FAZ, Feldmeier H (2003). Ectoparasitoses e saúde pública no Brasil: desafios para controle. Cadernos de Saúde Pública 19(5):1535-1540. http://dx.doi.org/10.1590/S0102-311X2003000500032

Higuchi K, Miyake T, Ohmori S, Tani Y, Minoura K, Kikuchi T (2017). Carapanosins A-C from Seeds of Andiroba (*Carapa guianensis*, Meliaceae) and Their Effects on LPS-Activated NO Production. Molecules 22(3):e502. http://dx.doi.org/10.3390/molecules22030502

Instituto Evandro Chagas (IEC) (2018). Instituto Evandro Chagas detecta vírus da Febre Amarela em mosquito *Aedes albopictus* no Brasil. Disponível em <www.iec.gov.br/portal/descoberta/>.

Jesus FLM, Almeida FB, Duarte JL, Oliveira AEMFM, Cruz RAS, Souto RNP (2017). Preparation of a Nanoemulsion with *Carapa guianensis* Aublet (Meliaceae) Oil by a Low-Energy/Solvent-Free Method and Evaluation of Its Preliminary Residual Larvicidal Activity. Evidence-Based Complementary and Alternative Medicine 2017:e6756793. https://doi.org/10.1155/2017/6756793

Klauck V, Pazinato R, Stefani LM, Santos RC, Vaucher RA, Baldissera MD (2014). Insecticidal and repellent effects of tea tree and andiroba oils on flies associated with livestock. Medical and Veterinary Entomology 28(suppl.1):33-39. http://dx.doi.org/10.1111/mve.12078

Labruna MB, Pereira MC (2001). Carrapato em Cães no Brasil. Clínica Veterinária 30(1):24-32.

Lang G, Mayhundin NA, Mitova MI, Sun L, Van Der Sar S, Blunt JW (2008). Evolving trends in the dereplication of natural products extracts: New methodology for rapid, small-scale investigation of natural products. Journal of Natural Productsa 71(9):1595-1599. http://dx.doi.org/10.1021/np8002222

Lemes SR, Chaves DA, Júnior NJS, Carneiro CC, Chen-Chen L, Almeida LM, Gonçalves PJ, Melo-Reis PR (2017). Antigenotoxicity protection of Carapa guianensis oil against mitomycin C and cyclophosphamide in mouse bone marrow. Anais da Academia Brasileira de Ciências 89(3):2043-2051.

Lima CS, Medeiros BJ, Favacho HA, Santos KC, Oliveira BR, Taglialegna JC (2011). Pre-clinical validation of a vaginal cream containing copaiba oil (reproductive toxicology study). Phytomedicine 18(12):1013-1023. http://dx.doi.org/10.1016/j.phymed.2011.05.004

Lowy FD (1998). *Staphylococcus aureus* Infections. The New England Journal of Medicine 339:520-532.

Massard CL, Fonseca AH (2004). Carrapatos e doenças transmitidas, comuns ao homem e aos animais. A Hora Veterinária 135(1):15-23.

Matos BN, Pieri FA, Penatti M, Orlandi PP (2015). Adherence and virulence genes of *Escherichia coli* from children diarrhoea in the Brazilian Amazon. Brazilian Journal of Microbiology 46(1):131-137. http://dx.doi.org/10.1590/S1517-838246120130917

Meccia G, Quintero P, Rojas LB, Usubillaga A, Velasco J, Diaz T (2013). Chemical composition of the essential oil from the leaves of *Carapa guianensis* collected from Venezuelan Guayana and the antimicrobial activity of the oil and crude extracts. Natural Product Communications 8(11):1641-1642. http://dx.doi.org/10.1177/1934578x1300801135

Melo BA, Almeida FAC, Silva JF, Silva RM (2015). Atividade inseticida do óleo de *Copaifera langsdorffii* Desf. (copaiba) sobre *Tribolium castaneum* (Coleoptera: Tenebrionidae). Revista Cubana de Plantas Medicinales 20(4):419-428.

Mendonça FA, Silva KF, Santos KK, Ribeiro Júnior KA, Sant'ana AE (2005). Activities of some Brazilian plants against larvae of the mosquito *Aedes aegypti*. Fitoterapia 76(7-8):629-636. https://doi.org/10.1016/j.fitote.2005.06.013

Meneguetti DUO, Facundo VA (2015). Análise genotóxica e antiparasitária de extratos e substâncias isoladas de *Maytenus guianensis* Klotzsch ex Reissek (Celastraceae), Chichuá (Xixuá) amazônico. Revista Pan-Amazônica de Saúde 6(4):69-70. http://dx.doi.org/10.5123/S2176-62232015000400010

Meneguetti DUO, Cunha RM, Lima RA, Oliveira FAZ, Medeiros DSS, Passarini GM, Medeiros PSM, Militão SLT, Facundo VA (2014) Antimalarial ethnopharmacology in the Brazilian Amazon. Revista de Ciências Farmacêuticas Básica e Aplicada 35(4):577-587.

Meneguetti DUO, Lima RA, Macedo SRA, Barros NB, Facundo JB, Militao JSLT, Nicolete R, Facundo VA (2015). Plantas da Amazônia Brasileira com potencial leishmanicida *in vitro*. Revista de Patologia Tropical 44(4):359-374. http://dx.doi.org/10.5216/rpt.v44i4.39236

Milhomem-Paixão SSR, Fascineli ML, Roll MM, Longo JPF, Azevedo RB, Pieczarka JC (2016). The lipidome, genotoxicity, hematotoxicity and antioxidant properties of andiroba oil from the Brazilian Amazon. Genetics and Molecular Biology 39(2):248-256. http://dx.doi.org/10.1590/1678-4685-gmb-2015-0098

Miot HA, Batistella RF, Batista KA, Volpato DEC, Augusto LST, Madeira NG, Haddad-Jr V, Miot LDB (2004). Comparative study of the topical effectiveness of the Andiroba oil (*Carapa guianensis*) and DEET 50% as repellent for *Aede*s sp. Revista do Instituto de Medicina Tropical de São Paulo 46(5):253-256.

Muniz JWC, Bozza PT, Nascimento JLM, Reis PA (2009). Atividade Anti-Inflamatória do Óleo-Resina da *Copaífera Reticulata* em Modelo Inflamatório de Edema de Pata. Revista Paraense de Medicina 23:15-21. http://dx.doi.org/10.1590/0100-69912016006006

Nacif MCAM, Alves FRF (2010). *Enterococcus faecalis* na endodontia: um desafio ao sucesso. Revista Brasileira de Odontologia 67(2):209-214. http://dx.doi.org/10.18363/rbo.v67n2.p.209

Nardi M, Lira-Guedes AC, Cunha HFA, Guedes MC, Mustin K, Gomes SC (2016). Artisanal Extraction and Traditional Knowledge Associated with Medicinal Use of Crabwood Oil (Cara*pa guianensis* Aublet.) in a Peri-Urban Várzea Environment in the Amazon Estuary. Evidence-Based Complementary and Alternative Medicine 2016:e5828021. http://dx.doi.org/10.1155/2016/5828021

Osakada A (2009). Desenvolvimento inicial de sangue-de-dragão (*Croton lechleri* MULL. ARG) sob diferentes classes de solos, corretivos e níveis de luminosidade na Amazônia central. Dissertação (Mestrado) Instituto Nacional de Pesquisas da Amazônia, Manaus, - AM.

Otto M (2009). *Staphylococcus epidermidis* - the 'accidental' pathogen. Nature Reviews Microbiology 7(8):555–567. http://dx.doi.org/10.1038/nrmicro2182

Paz GF, Leite RC, Oliveira PR (2008). Controle de *Rhipicephalus sanguineus* (Latreille, 1806) (Acari: Ixodidae) no canil da Escola de Veterinária da UFMG, Belo Horizonte, Minas Gerais, Brasil. Revista Brasileira de Parasitologia Veterinária 17(1):41-44. http://dx.doi.org/10.1590/S1984-29612008000100009

Penido C, Costa KA, Pennaforte RJ, Costa MF, Pereira JF, Siani AC (2005). Anti-allergic effects of natural tetranortriterpenoids isolated from *Carapa guianensis* Aublet on allergen-induced vascular permeability and hyperalgesia. Inflammation Research 54(7):295-

303. http://dx.doi.org/10.1007/s00011-005-1357-6
Penido C, Conte FP, Chagas MS, Rodrigues CA, Pereira JF, Henriques MG (2006). Antiinflammatory effects of natural tetranortriterpenoids isolated from *Carapa guianensis* Aublet on zymosan-induced arthritis in mice. Inflammation Research 55(11):457-464. http://dx.doi.org/10.1007/s00011-006-5161-8
Rodrigues DS, Leite RC (2013). Impacto econômico de Rhipicephalus (Boophilus) microplus: estimativa de redução de produção de leite. Arquivo Brasileiro de Medicina Veterinária e Zootecnia 65(5):1570-1572. http://dx.doi.org/10.1590/S0102-09352013000500039
Rodrigues ECR, Ferreira AM, Vilhena JCE, Almeida FB, Cruz RAS, Florentino AC, Souto RNP, Carvalho JCT, Fernandes CP (2014). Development of a larvicidal nanoemulsion with Copaiba (*Copaifera duckei*) oleoresin. Revista Brasileira de Farmacognosia 24(6):699-705.
Roma GC, Camargo-Mathias MI, Nunes PH, Remédio RN, Faria AU, Bechara GH (2015). Effects of andiroba (*Carapa guianensis*) oil in ticks: Ultrastructural analysis of the synganglion of *Rhipicephalus sanguineus* (Latreille, 1806) (Acari: Ixodidae). Acta Tropica 141(PtA):7-15. http://dx.doi.org/10.1016/j.actatropica.2014.06.018
Roma GC, Mathias MI, Faria AU, Oliveira PR, Furquim KC, Bechara GH (2013). Morphological and cytochemical changes in synganglion of *Rhipicephalus sanguineus* (Latreille, 1806) (Acari: Ixodidae) female ticks from exposure of andiroba oil (*Carapa guianensis*). Microscopy Research and Technique 76(7):687-696. http://dx.doi.org/10.1002/jemt.22219
Rondon FCM, Bevilaqua CML, Accioly MP, Morais SM, Andrade-Júnior HF, Carvalho CA (2012). In vitro efficacy of *Coriandrum sativum*, *Lippia sidoides* and *Copaifera reticulata* against *Leishmania chagasi.* Revista Brasileira de Parasitologia Veterinária 21(3):185-191. http://dx.doi.org/10.1590/S1984-29612012000300002
Sachetti CG, Fascineli ML, Sampaio JA, Lameira OA, Caldas ED (2009). Avaliação da toxicidade aguda e potencial neurotóxico do óleo-resina de copaíba (*Copaifera reticulata* Ducke, Fabaceae). Revista Brasileira de Farmacognosia 19(4):937-941. http://dx.doi.org/10.1590/S0102-695X2009000600025
Santos ACV, Fernandes CC, Lopes LM, Sousa AH (2016). Inseticidal oils from amazon plants in control of fall armyworm. Revista Caatinga 29(3):642-647. http://dx.doi.org/10.1590/1983-21252016v29n314rc
Santos AO, Ueda-Nakamura T, Dias Filho BP, Veiga Junior VF, Pinto AC, Nakamura CV (2008a). Effect of Brazilian copaiba oils on *Leishmania amazonensis.* Journal of Ethnopharmacology 120(2):204-208. http://dx.doi.org/10.1016/j.jep.2008.08.007
Santos AO, Ueda-Nakamura T, Dias Filho BP, Veiga Junior VF, Pinto AC, Nakamura CV (2008b). Antimicrobial activity of Brazilian copaiba oils obtained from different species of the *Copaifera genus*. Memórias do Instituto Oswaldo Cruz 103(3):277-281. http://dx.doi.org/10.1590/S0074-02762008005000015
Santos ECG, Donnici CL, Camargos ER, Rezende AA, Andrade EH, Soares LA, Farias LM, Carvalho MAR, Almeida MG (2013a). Effects of Copaifera duckei Dwyer oleoresin on the cell wall and cell division of Bacillus cereus. Journal of Medical Microbiology 62(Pt7):1032-1037.
Santos OJ, Malafaia O, Ribas-Filho JM, Czeczko NG, Santos RH, Santos RA (2013b). Influence of *Schinus terebinthifolius* Raddi (Aroeira) and *Carapa guianensis* Aublet (andiroba) in the healing process of gastrorraphies. Arquivos Brasileiros de Cirurgia Digestiva 26(2):84-91. http://dx.doi.org/10.1590/S0102-67202013000200003
Santos FS (2009). As plantas Brasileiras, os jesuítas e os indígenas do Brasil: história e ciência na triaga brasílica (séc. XVII-XVIII). Casa do Novo Autor.
Santos SFA, Paulino VT, Katiki LM, Veríssimo CJ (2018). Perfil do produtor de leite da região de Joanópolis/SP: como ele lida com o controle do carrapato *Rhipicephalus microplus* e de outras doenças de importância veterinária. Pesquisa Veterinária Brasileira 38(1):77-88. http://dx.doi.org/10.1590/1678-5150-pvb-4825
Silva CES, Santos OJ, Ribas-Filho JM, Tabushi FI, Kume MH, Jukonis LB, Cella IF (2015). Effect of *Carapa guianensis* Aublet (Andiroba) and *Orbignya phalerata* (Babassu) in colonic healing in rats. Revista do Colégio Brasileiro de Cirurgiões 42(6):399-406. http://dx.doi.org/10.1590/0100-69912015006009
Silva HHG, Geris R, Rodrigues Filho E, Rocha C, Silva IG (2007). Larvicidal activity of oil-resin fractions from the Brazilian medicinal plant *Copaifera reticulata* Ducke (Leguminosae-Caesalpinoideae) against *Aedes aegypti* (Diptera, Culicidae). Revista da Sociedade Brasileira de Medicina Tropical 40(3):264-267. http://dx.doi.org/10.1590/S0037-86822007000300002
Silva IG, Zanon VOM, Silva HHG (2003). Larvicidal activity of *Copaifera reticulata* ducke oil-resin against *Culex quinquefasciatus* Say (Diptera: Culicidae). Neotropical Entomology 32(4):729-732. http://dx.doi.org/10.1590/S1519-566X2003000400029
Silva OS, Prophiro JS, Nogared JC, Kanis L, Emerick S, Blazius RD, Romão PR (2006). Larvicidal effect of andiroba oil, *Carapa guianensis* (Meliaceae), against *Aedes aegypti*. Journal of the American Mosquito Control Association 22(4):699-701.
Silva OS, Romão PR, Blazius RD, Prohiro JS (2004). The use of andiroba *Carapa guianensis* as larvicide against *Aedes albopictus*. Journal of the American Mosquito Control Association 20(4):456-457.
Silva WJM, Ferrari CKB (2011). Metabolismo Mitocondrial, Radicais Livres e Envelhecimento. Revista Brasileira de Geriatria e Gerontologia 14(3):441-451. http://dx.doi.org/10.1590/S1809-98232011000300
Smartt CT, Shin D, Kang S, Tabachnick WJ (2018). *Culex quinquefasciatus* (Diptera: Culicidae) From Florida Transmitted Zika Virus. Frontiers in Microbiology 9:e768. http://dx.doi.org/10.3389/fmicb.2018.00768
Smith RD, Sells DM, Stephenson EH, Ristic M, Huxoll DL (1976). Development of *Ehrlichia canis*, causative agent of canine ehrlichiosis, in the tick *Rhipicephalus sanguineus* and its differentiation from a symbiotic rickettsia. American Journal of Veterinary Research 37(2):119-126.
Soares AO, Souza AD, Feliciano EA, Rodrigues AF, D'agosto M, Daemon E (2006). Evaluation of ectoparasites and hemoparasites in dogs kept in apartments and houses with yards in the city of Juiz de Fora, Minas Gerais, Brazil. Revista Brasleira de Parasitologia Veterinária 15(1):13-16.
Spini VBMG, Ferreira FR, Paduani GF, Souza CS, Kerr WE (2006). Efeito da adição de castanha-do-pará à dieta de arroz e feijão sobre o ganho de peso em camundongos. Bioscience Journal 22(3):89-93.
Stachiw R, Ribeiro SB, Jardim MAG, Possimoser D, Alves WC, Cavalheiro WCS (2016). Potencial de produção de biodiesel com espécies oleaginosas nativas de Rondônia, Brasil. Acta Amazonica 46(1):81-90. http://dx.doi.org/10.1590/1809-4392201501151
Szabó MP, Cunha TM, Pinter A, Vicentini F (2001). Ticks (Acari: Ixodidae) associated with domestic dogs in Franca region, São Paulo, Brazil. Experimental and Applied Acarology 25(10):909-916. https://doi.org/10.1023/A:1020433003028
Teixeira FB, Brito Silva R, Lameira OA, Webber LP, D'almeida Couto RS, Martins MD, Lima RR (2017). Copaiba oil-resin (*Copaifera reticulata* Ducke) modulates the inflammation in a model of injury to rats' tongues. BMC Complementary and Alternative Medicine 17(1):e313. http://dx.doi.org/10.1186/s12906-017-1820-2
Tiosso PC, Carvalho AKF, Castro HF, Moraes FF, Zanin GM (2014). Utilization of immobilized lipases as catalysts in the transesterification of non-edible vegetable oils with ethanol. Brazilian Journal of Chemical Engineering 31(4):839-847. http://dx.doi.org/10.1590/0104-6632.20140314s00003006
Valdez IL, Farfan O, Sterner O, Turba AG (2009). Estudios preliminares de la caracterización química de ácidos grasos del aceite de frutos de *Bertholletia excelsa* por cromatografia de gases. Biofarbo 17(1):47-53.
Vendramini MC, Mathias MI, Faria AU, Furquim KC, Souza LP, Bechara GH (2012a). Action of andiroba oil (*Carapa guianensis*) on *Rhipicephalus sanguineus* (Latreille, 1806) (Acari: Ixodidae) semi-engorged females: morphophysiological evaluation of reproductive system. Microscopy Research and Technique 75(12):1745-1754. http://dx.doi.org/10.1002/jemt.22126
Vendramini MC, Camargo-Mathias MI, Faria AU, Bechara GH, Oliveira PR, Roma GC (2012b). Cytotoxic effects of andiroba oil (*Carapa guianensis*) in reproductive system of *Rhipicephalus sanguineus* (Latreille, 1806) (Acari: Ixodidae) semi-engorged females. Parasitology Research 111(5):1885-1894. http://dx.doi.org/10.1007/s00436-012-3031-6
Vieira TMF, Regitano-D'arce MA. Antioxidant concentration effect on

stability of Brazil nut (*Bertholletia excelsa*) crude oil (1999). Archivos Latinoamericanos de Nutrición 49(3):271-274.
Villarreal JPV, Santos PR, Silva MAMP, Azambuja RHM, Gonçalves CL, Escareño JJH (2017). Evaluation of phytotherapy alternatives for controlling *Rhipicephalus (Boophilus) microplus in vitro*. Revista Brasileira de Parasitologia Veterinária 26(3):299-306. http://dx.doi.org/10.1590/s1984-29612017052
Wanzeler AMV, Júnior Sma GJT, Gouveia EHH, Henriques HYB, Chaves RH (2018). Therapeutic effect of andiroba oil (*Carapa guianensis* Aubl.) against oral mucositis: an experimental study in golden Syrian hamsters. Clinical Oral Investigations 22(5):2069-2079. http://dx.doi.org/10.1007/s00784-017-2300-2
Ziech RE, Farias LD, Balzan C, Ziech MF, Heinzmann BM, Lameira OA, Vargas AC (2013). Atividade antimicrobiana do oleorresina de copaíba (*Copaifera reticulata*) frente a *Staphylococcus coagulase* positiva isolados de casos de otite em cães. Pesquisa Veterinária Brasileira 33(7):909-913. http://dx.doi.org/10.1590/S0100-736X2013000700011.