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Infectious diseases are the world’s leading cause of premature deaths, killing almost 50,000 people every day. In recent years, drug resistance to human pathogenic bacteria has been commonly reported from all over the world (N’guessan et al., 2007). The abusive and indiscriminate use of antimicrobial compounds over many years is the main factor responsible for the appearance of the phenomenon of bacterial resistance to such compounds (Andremont, 2001). With increased incidence of resistance to antibiotics, natural products from plants could be interesting alternatives (Lu et al., 2007; Mbwambo et al., 2007). Some plant extracts and phytochemicals are known to have antimicrobial properties, and can be of great significance in therapeutic treatments. In the last few years, a number of studies have been conducted in different countries to demonstrate such efficacy (Benoit-Vical et al., 2006; Senatore et al., 2007; Singh et al., 2007). On the other hand, free radicals are known to be the major cause of various chronic and degenerative diseases. Oxidative stress is associated with pathogenic mechanisms of many diseases including atherosclerosis, neurodegenerative diseases, cancer, diabetes and inflammatory diseases, as well as aging processes. It is defined as an imbalance between production of free radicals and reactive metabolites, so-called oxidants, and it also includes their elimination by protective mechanisms, referred to as antioxidative systems. This imbalance leads to damage of important biomolecules and organs with potential impact on the whole organism. Antioxidants can delay, inhibit or prevent the oxidation of oxidizable materials by scavenging free radicals and diminishing oxidative stress (Duracková, 2010; Reuter et al., 2010). Natural antioxidants have been studied extensively for decades in order to find compounds protecting against a number of diseases related to oxidative stress and free radical-induced damage. To date, many plants have been claimed to pose beneficial health effects such as antioxidant properties (Kaur & Arora, 2009; Newman & Cragg 2007). According to World Health Organization (WHO), 65 - 80% of the world populations rely on traditional medicine to treat various diseases (Kaur & Arora, 2009). The WHO recommends...
research into the use of the local flora for therapeutic purposes, with the intention of reducing the number of people excluded from effective therapy in the government health systems, which could constitute an economically viable alternative treatment of several diseases, especially in developing countries (Gonçalves et al., 2005; WHO, 2002). The potential of higher plants as source for new drugs is still largely unexplored. Among the estimated 250,000 - 500,000 plant species, only a small percentage has been investigated phytochemically and the fraction submitted to biological or pharmacological screening is even smaller (Mahesh & Satish, 2008). In this scenario, the screening of plant extracts has been of great interest to scientists for the discovery of new drugs effective in the treatment of several diseases, and about 20% of the plants or their extracts in the world have been submitted to biological or pharmacological tests (Rayne & Mazza, 2007; Suffredini et al., 2004). The phytochemical research based on ethnopharmacological information is considered an effective approach in the discovery of new agents from higher plants (Chen et al., 2008; Duraipiyan, 2006). Thus, in this study, methanol extracts of different parts of 70 species, most of them commonly used in Brazil for treating conditions likely to be associated with microorganisms, were evaluated for their antimicrobial and antioxidant activity. Furthermore, a phytochemical screening of the bioactive extracts was performed.

2. Materials and methods

2.1 Plant material

Specimens of 70 species (Table 1) were collected in Juiz de Fora, Minas Gerais, Brazil. A voucher specimen was deposited at the Herbarium Leopoldo Krieger (CESJ) of Federal University of Juiz de Fora.

2.2 Preparation of plant extracts

The dried parts of the plant (50 g each) were powdered and macerated with methanol (3 x 200 mL) for five days at room temperature. After evaporation of the solvent under reduced pressure, the respective methanol extracts were obtained. All the extracts were kept in tightly stoppered bottles under refrigeration (4 °C) until used for the biological testing and phytochemical analysis.

2.3 Antioxidant activity

2.3.1 DPPH assay

The free radical scavenging activity of samples and standard α-tocopherol solutions in methanol was determined based on their ability to react with stable 1,1-diphenyl-2-picrylhydrazyl (DPPH) free radical (Govidarajan et al., 2003). The plant samples at various concentrations (7.8 to 250 μg/mL) were added to a 152 μM solution of DPPH in methanol. After incubation at 37 °C for 30 min, the absorbance of each solution was determined at 517 nm. The antioxidant activity of the samples was expressed as IC_{50} (inhibitory concentration), which was defined as the concentration (in μg/mL) of sample required to inhibit the formation of DPPH radicals by 50%. Ascorbic acid, α-tocopherol, BHT, rutin and quercetin were used as positive control.
| Family      | Botanical name                  | Common name                  | Plant parts used* | Ethnomedical uses                                                                 |
|------------|--------------------------------|------------------------------|-------------------|----------------------------------------------------------------------------------|
| Amaranthaceae | Alternanthera brasiliana (L.) Kuntze [CESJ 48585] | Acônito-do-mato, caaponga, cabeça-branca | F, L              | Diuretic, digestive, depurative, liver and bladder diseases, astringent, laxative, cough |
| Apocynaceae | Allamanda cathartica L. [CESJ 47443] | Alamanda, buiussu, carolina, cipó-de-leite | B, F, L, La       | Scabies and lice elimination, purgative, parasitosis, fever, treatment of jaundice, complications of malaria, enlarged spleen, laxative |
|             | Aspidosperma olivaceum Müll. Arg. [CESJ 49229] | Guatambu, guatambu-branco, guatambu-amarelo, tambu | No use reported   |                                                                                   |
| Asteraceae  | Acanthospermum australe (Loefl.) Kuntze [CESJ 47438] | Picão-da-prata, carrapicho-rasteiro, mata-pasto | AP                | Liver diseases, diaphoretic, gonorrhea, malaria                                     |
|             | Achillea millefolium L. [CESJ 46087] | Novalgina, erva-de-carpinteiro, aquiléia, milefólio | L                 | Fever, head and general aches, colds indigestion                                   |
|             | Anthemis cotula L. [CESJ 48584] | Camomila-do-campo | F, L              | Fever, gastrointestinal disorders, dysentery, gouty arthritis                       |
|             | Baccharis trimera (Less.) DC. [CESJ 46074] | Carqueja                     | L                 | Gastrointestinal and liver diseases, diabetes, inflammation                        |
|             | Bidens segetum Mart. ex Colla [CESJ 47437] | Picão-do-mato                | No use reported   |                                                                                   |
|             | Cardaus marianus L. [CESJ 48581] | Cardo-mariano, cardo-santo, cardo-de-nossa-senhora, cardo-branco | S, SB             | Appetite stimulant, diuretic, tonic, liver cell regenerator, gastrointestinal disorders, bile flow stimulant, cirrhosis, hepatitis |
|             | Matricaria chamomilla L. [CESJ 47435] | Camomila, camomila-romana, camomila-comum | F                 | Digestive, sedative, colic treatment, appetite stimulant, carminative              |
|             | Piptocarpha macropoda (DC.) Baker [CESJ 49448] | Arnica, erva-de-lagarto, erva-lanceta, espiga-de-ouro | L                 | Stomachic, astringent                                                             |
**Vernonanthura divaricata** (Spreng.) H. Rob. [CESJ 49450]
- Cambará-açu
- No use reported

**Vernonia condensata** Baker [CESJ 46086]
- Boldo, alumã, alcachofra, figatil, cidreira-da-mata

**Bignoniaceae**

**Stenolobium stans** (L.) Seem [CESJ 46071]
- Ipê-de-jardim, ipê-amarelo-de-jardim, ipêzinho-de-jardim

**Bixa orellana** L. [CESJ 46077]
- Urucum

**Commelinaceae**

**Commelina robusta** Kunth [CESJ 50021]
- Batata-ovo, manobiaça, trapoeraba-açu

**Commelina robusta** Kunth [CESJ 50021]
- Batata-ovo, manobiaça, trapoeraba-açu

**Euphorbiaceae**

**Alchornea triplinervia** (Spreng.) Müll. Arg. [CESJ 49442]
- Tapiá-vermelho, tapiá-guaçu-branco, pau-óleo

**Acalypha brasiliensis** Müll. Arg. [CESJ 50011]
- Tapa-buraco

**Fabaceae**

**Chamaecrista desvauxii** (Collad.) Killip [CESJ 23372]
- Sene, acácia, carquejado-tabuleiro, flor-de-lilás, capim reis

**Sananea tubulosa** (Benth.) Barneby & J.W. Grimes [CESJ 49743]
- Amendoim-de-veado, árvore-da-chuva e pau-de-cangalha

**Senna macranthera** (DC. ex Collad.) H.S. Irwin & Barneby [CESJ 46159]
- Manduirana, pau-fava, aleluia, mamangá, fedegoso

**Senna multiflora** (Rich.) H.S. Irwin & Barneby [CESJ 49783]
- Pau-cigarra, canafístula, aleluia

**Stylosanthes scabra** Vogel [CESJ 47436]
- Alfafa do nordeste, alfafa do campo

**Senna multijuga** (Rich.) H.S. Irwin & Barneby [CESJ 49783]
- Pau-cigarra, canafístula, aleluia

**Senna multiflora** (Rich.) H.S. Irwin & Barneby [CESJ 49783]
- Pau-cigarra, canafístula, aleluia

**Bignoniaceae**

**Stenolobium stans** (L.) Seem [CESJ 46071]
- Ipê-de-jardim, ipê-amarelo-de-jardim, ipêzinho-de-jardim

**Bixa orellana** L. [CESJ 46077]
- Urucum

**Commelinaceae**

**Commelina robusta** Kunth [CESJ 50021]
- Batata-ovo, manobi-açu, trapoeraba-açu

**Commelina robusta** Kunth [CESJ 50021]
- Batata-ovo, manobi-açu, trapoeraba-açu

**Euphorbiaceae**

**Alchornea triplinervia** (Spreng.) Müll. Arg. [CESJ 49442]
- Tapiá-vermelho, tapiá-guaçu-branco, pau-óleo

**Acalypha brasiliensis** Müll. Arg. [CESJ 50011]
- Tapa-buraco

**Fabaceae**

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- Sene, acácia, carquejado-tabuleiro, flor-de-lilás, capim reis

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- Amendoim-de-veado, árvore-da-chuva e pau-de-cangalha

**Senna macranthera** (DC. ex Collad.) H.S. Irwin & Barneby [CESJ 46159]
- Manduirana, pau-fava, aleluia, mamangá, fedegoso

**Senna multiflora** (Rich.) H.S. Irwin & Barneby [CESJ 49783]
- Pau-cigarra, canafístula, aleluia

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**Senna multijuga** (Rich.) H.S. Irwin & Barneby [CESJ 49783]
- Pau-cigarra, canafístula, aleluia

**Bignoniaceae**

**Stenolobium stans** (L.) Seem [CESJ 46071]
- Ipê-de-jardim, ipê-amarelo-de-jardim, ipêzinho-de-jardim

**Bixa orellana** L. [CESJ 46077]
- Urucum

**Commelinaceae**

**Commelina robusta** Kunth [CESJ 50021]
- Batata-ovo, manobi-açu, trapoeraba-açu

**Commelina robusta** Kunth [CESJ 50021]
- Batata-ovo, manobi-açu, trapoeraba-açu

**Euphorbiaceae**

**Alchornea triplinervia** (Spreng.) Müll. Arg. [CESJ 49442]
- Tapiá-vermelho, tapiá-guaçu-branco, pau-óleo

**Acalypha brasiliensis** Müll. Arg. [CESJ 50011]
- Tapa-buraco

**Fabaceae**

**Chamaecrista desvauxii** (Collad.) Killip [CESJ 23372]
- Sene, acácia, carquejado-tabuleiro, flor-de-lilás, capim reis

**Sananea tubulosa** (Benth.) Barneby & J.W. Grimes [CESJ 49743]
- Amendoim-de-veado, árvore-da-chuva e pau-de-cangalha

**Senna macranthera** (DC. ex Collad.) H.S. Irwin & Barneby [CESJ 46159]
- Manduirana, pau-fava, aleluia, mamangá, fedegoso

**Senna multiflora** (Rich.) H.S. Irwin & Barneby [CESJ 49783]
- Pau-cigarra, canafístula, aleluia

**Stylosanthes scabra** Vogel [CESJ 47436]
- Alfafa do nordeste, alfafa do campo

**Senna multijuga** (Rich.) H.S. Irwin & Barneby [CESJ 49783]
- Pau-cigarra, canafístula, aleluia

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| Family               | Genus                  | Species                                      | Common Names                      | Uses                                                                 |
|---------------------|------------------------|----------------------------------------------|-----------------------------------|----------------------------------------------------------------------|
| Flacourtiaceae      | Casearia sylvestris    | Sw.                                          | Guaçatonga, bugre-branco, café-bravo, café-de-frade | Burns, cutaneous injuries, herpes, tonic, depurative, rheumatism, inflammation, analgesic, hemostatic, gastritis |
|                     |                        | [CESJ 49218]                                 |                                   | No use reported                                                       |
| Hypericaceae        | Vismia magnolifolia    | Schltdl. & Cham.                             |                                   |                                                                      |
|                     |                        | [CESJ 49759]                                 |                                   |                                                                      |
|                     | Lacistema pubescens    | Mart.                                        | Espeto-vermelho, canela-vermelha, sabonete, cafezinho | No use reported                                                       |
|                     |                        | [CESJ 49751]                                 |                                   |                                                                      |
| Lamiaceae           | Hyptis suaveolens      | (L.) Poit                                    | Bamburral, erva-canudo, arbustoselvagem | AP Cramps, skin infections, respiratory tract infections, nasal congestion, fever, flu |
|                     |                        | [CESJ 46089]                                 |                                   |                                                                      |
|                     | Ocimum basilicum       | L.                                          | Manjeriako, alfavaca              | L Gastrointestinal disorders, fever, digestive, bacterial infections, parasitosis |
|                     |                        | [CESJ 46161]                                 |                                   |                                                                      |
|                     | Peptodon radicans      | Pohl                                        | Paracari, hortelá-doma, rabugem-de-cachorro | AP Expectorant, pertussis, cough, asthma, sneezing, carminative, dermatites, scorpion and snake bites, antispasmodic, syphilitic, parasitosis, diuretic |
|                     |                        | [CESJ 46158]                                 |                                   |                                                                      |
|                     | Plectranthus neochilus | Schltr.                                      | Boldo                             | L Treatment of respiratory infections or related symptoms            |
|                     |                        | [CESJ 46580]                                 |                                   |                                                                      |
|                     | Salvia officinalis     | L.                                          | Sálvia, salva                     | AP Infections diseases, astringent                                   |
|                     |                        | [CESJ 46579]                                 |                                   |                                                                      |
| Lauraceae           | Nectandra rigida       | (Kunth) Nees                                 | Canela-amarela                    | B Rheumatism                                                          |
|                     |                        | [CESJ 49221]                                 |                                   |                                                                      |
| Lythraceae          | Cuphea tigrina         | Cham. & Schltdl.                             | Sete-sangrias-do-campo            | WP Fever, venereal diseases, rheumatism                               |
|                     |                        | [CESJ 47432]                                 |                                   |                                                                      |
| Malpighiaceae       | Byrsonima variabilis   | A. Juss.                                     | Murici                            | No use reported                                                       |
|                     |                        | [CESJ 49240]                                 |                                   |                                                                      |
| Malvaceae           | Sida glaziovii         | K. Schum.                                    | Guanxuma-branca                   | No use reported                                                       |
|                     |                        | [CESJ 47439]                                 |                                   |                                                                      |
| Melastomataceae     | Miconia latercrenata   | (DC.) Naudin                                 | Pixirica-preta                    | No use reported                                                       |
|                     |                        | [CESJ 49990]                                 |                                   |                                                                      |
|                     | Tibouchina grandifolia | Cogn.                                       | Orelha-de-onça                     | No use reported                                                       |
|                     |                        | [CESJ 40445]                                 |                                   |                                                                      |

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| Family               | Species                          | Common Name       | Use Reporting     |
|----------------------|----------------------------------|-------------------|-------------------|
| **Monimiaceae**      | **Tibouchina granulosa**          | Quaresmeira       | No use reported   |
|                      | (Desr.) Cogn. [CESJ 49761]       |                   |                   |
|                      | **Tibouchina mutabilis**          | Manacá            | No use reported   |
|                      | (Vell.) Cogn. [CESJ 46175]       |                   |                   |
|                      | **Trembleya parviflora**          | Manacá            | No use reported   |
|                      | (D. Don) Cogn. [CESJ 49219]      |                   |                   |
|                      | **Mollinedia schottiana**         |                   | No use reported   |
|                      | (Spreng.) Perkins [CESJ 48921]   |                   |                   |
|                      | **Siparuna guianensis**           | Capitû, caã-pitiú, erva-santa, pedreita, negrâmina, negra-mena | SB Carminativo, stimulant, fever, antidisperse, diuretic, muscle spasms prevention, headache, inflammation |
|                      | Aubl. [CESJ 49778]               |                   |                   |
| **Myrtaceae**        | **Eugenia canina**               | Jambolão, cereja, jamelão, jalão | B Fr Diabetes |
|                      | (L.) Druce [CESJ 46601]          |                   |                   |
|                      | **Myrcia splendens**             | Guamirim, folha-miúda | No use reported |
|                      | (Sw.) DC. [CESJ 49230]           |                   |                   |
|                      | **Piper corcovadensis**           | João-brandinho L  | Mucous membranes anesthesia (mouth), rheumathism, cough |
|                      | (Miq.) C. DC. [CESJ 49993]       |                   |                   |
| **Poaceae**          | **Cymbopogon citratus**          | Capim-cheiroso, ervacistreia, capim-cideira, capim-limão | L Calmant, gastrointestinal disorders, infections diseases, colic treatment, anxiety |
|                      | (DC) Stapf. [CESJ 46582]         |                   |                   |
|                      | **Erionotrya japonica**           | Nespereira, ameixiira | FR L Cough, asthma, chronic bronchitis, phlegm, high fever and gastroenteric disorders |
|                      | (Thunb.) Lindl. [CESJ 47434]     |                   |                   |
|                      | **Rubus rosifolius**             | Morango-silvestre, amora-do-mato | AP Infectious and dolorous diseases |
|                      | Sm. [CESJ 48580]                 |                   |                   |
|                      | **Rubus urticifolius**            | Nhambuí, árvore-preta, amora-do-silva | Fr Throat diseases, diuretic |
|                      | Poir. [CESJ 46583]               |                   |                   |
| **Rubiaceae**        | **Amaroua intermedia**           | Canela-de-veado, vachila, carvoeiro, pimentão-bravo, marmelada-brava | No use reported |
|                      | Mart. [CESJ 49994]               |                   |                   |
| **Rutaceae**         | **Zanthoxylum rhoifolium**        | Mamica-de-cadela L SB Toothache, earache, malaria |
|                      | Lam. [CESJ 49782]                |                   |                   |
| Family         | Species                                                      | Common Name          | Use Reported          | Properties                                      |
|---------------|--------------------------------------------------------------|----------------------|-----------------------|-------------------------------------------------|
| Sapindaceae   | *Allophylus semidentatus* (Miq.) Radlk. [CESJ 49774]         | Fruta-de-faraó       | No use reported       | -                                              |
|               | *Capania oblongifolia* Mart. [CESJ 49447]                    | Pau-magro, cabocatã  | B, L Weight loss      | -                                              |
|               | *Sapindus saponaria* L. [CESJ 46172]                         | Sabão-de-soldado     | Fr, R SB Antitussive, adstringent, calmant, diuretic, expectorant | -                                              |
| Solanaceae    | *Solanum sellowianum* Dunal [CESJ 49225]                     | Barbaso, fruta-de-pombo | No use reported       | -                                              |
|               | *Solanum swartzianum* Roem. & Schult. [CESJ 49226]           | Capuchinha, chaguihã, acapararr-de-pobre, chagas, mastruço-do-peru | L Scurvy, sepse, expectorant, urinary, gastrointestinal and dermatological disinfectant | -                                              |
| Tropaeolaceae | *Tropaeolum majus* L. [CESJ 46586]                           | Chanana, flor-do-Guarujá | R Amenorrhea          | -                                              |
| Turneraceae   | *Turnera subulata* Sm. [CESJ 47442]                          | Taboa                | F, R Treatment of burns, wounds and inflammation, kidney stones and diarrhea | -                                              |
| Typhaceae     | *Typha dominguensis* Pers. [CESJ 49773]                      | Embaúba,umbaúba, torem | B, L Cough, expectorant, asthma and diabetes | -                                              |
| Urticaceae    | *Cecropia pachystachya* Trécul [CESJ 46591]                  | Capitão-do-matto, câmara, châ-de-frade, châ-de-pedestre, cidrilha | L Gastrointestinal disorders, expectorant, stimulant, rheumatism | No use reported |
| Verbenaceae   | *Lippia pseudo-thea* Schauer [CESJ 46171]                   | Ermidireira, ermidireira-do-campo, alecrim-do-campo, salsa | L R Hypertension, stomach cramps, nausea, coughs, colds | No use reported |
|               | *Lippia hermannioides* Cham. [CESJ 46088]                    | Ermidireira, ermidireira-do-campo, alecrim-do-campo, salsa | L R Hypertension, stomach cramps, nausea, coughs, colds | No use reported |
|               | *Lippia alba* (Mill.) N.E. Br. ex Britton & P. Wilson [CESJ 46177] | Ermidireira, ermidireira-do-campo, alecrim-do-campo, salsa | L R Hypertension, stomach cramps, nausea, coughs, colds | No use reported |
|               | *Lippia rubella* (Moldenke) T.R.S. Silva & Salimena [CESJ 46178] | Ermidireira, ermidireira-do-campo, alecrim-do-campo, salsa | L R Hypertension, stomach cramps, nausea, coughs, colds | No use reported |
Lippia sidoides Cham.  
[CESJ 46180]  
Alecrid-pimenta, alecrim-do-nordeste, estrepá-cavalo, alecrim-bravo  
F, L  
Allergic rhinitis, throat and mouth infections, antiseptic, skin and scalp disorders

Lantana camara L.  
[CESJ 47441]  
Camará, cambará, chumbinho, camará-de-chumbo  
L  
Treatment of respiratory diseases such as cough, bronchitis, pertussis, colds, flu, asthma, hoarseness, expectorant, antispasmodic, rheumatism, digestive, diuretic

Aloysia floribunda  
M. Martens & Galeotti  
[CESJ 46584]  
No use reported

Vitaceae  
Cissus verticillata (L.) Nicolson & C.E. Jarvis  
[CESJ 46587]  
Anil-trepador, cipó-pucá, cipo-pucá, puçá, insulina, insulina-vegetal  
AP, L  
Tachycardia, hypertension, dropsy, anemia, leakage, tremors, activator of blood circulation, diabetes, anticonvulsant

Zingiberaceae  
Hedychium coronarium  
J. König  
[CESJ 50022]  
Gengibre-branco, lírio-do-brejo, lágrima-de-moça, lírio-branco, borboleta, lágrima-de-vênus  
Fr, Rh  
Arthritis, diabetes, headache and hypertension

Table 1. Ethnomedical data on medicinal plants.

2.3.2 Reducing power assay

The reducing power was determined by the method of Oyazu (1986), based on the chemical reaction of Fe(III) to Fe(II). Ten mg of each sample were mixed with potassium phosphate buffer (0.2 M, pH 6.6) (2.5 mL) and potassium ferricyanide (10 g/L) (2.5 mL). The mixture was incubated at 50 °C for 20 min. A 2.5 mL aliquot of 10% trichloroacetic acid was added to the mixture, which was then centrifuged at 3,000 g for 10 min. The upper layer of the solution (2.5 mL) was mixed with distilled water (2.5 mL) and 0.1% FeCl₃ (0.5 mL), and the absorbance was measured at 700 nm. Ascorbic acid was used as reference material. All tests were performed in triplicate. Increase in absorbance of the reaction indicated the reducing power of the samples. A higher absorbance indicated a higher reducing power. EC₅₀ (effective concentration) values (µg/mL) were calculated and indicate the effective concentration at which the absorbance was 0.5 for reducing power.

2.3.3 β-carotene - linoleic acid assay

In this assay, antioxidant capacity is determined by measuring the inhibition of the volatile organic compounds and the conjugated diene hydroperoxides arising from linoleic acid oxidation (Dapkevicius et al., 1998). A stock solution of β-carotene/linoleic acid mixture was prepared as follows: 50 µL of β-carotene (10 mg/mL) in chloroform (HPLC grade), 20 µL linoleic acid, 200 µL Tween 40 and 1 mL of chloroform was added. Chloroform was completely evaporated using a vacuum evaporator. Then, 30 mL of distilled water saturated with oxygen (30 min 100 mL/min) were added with vigorous shaking, and 250 µL of the reactive mixture and 10 µL of the extracts (40 µg/mL) were added in a microplate and
incubated at 45 °C to accelerate oxidation reactions and start the bleaching of β-carotene. The absorbance readings were taken immediately at intervals of 15 min for 120 min in spectrophotometer at 470 nm (Duarte-Almeida et al., 2006). The same procedure was repeated with the antioxidant flavonoid quercetin as positive control, and a blank. After this incubation period, absorbances of the mixtures were measured at 490 nm. Antioxidative capacities of the extracts were expressed as percentage inhibition (1).

\[
\text{Inhibition (\%) } = \frac{\text{control absorbance } - \text{ sample absorbance}}{\text{control absorbance}} \times 100
\]

(1)

2.4 Antimicrobial assay

2.4.1 Microbial strains

The samples were evaluated against a panel of microorganisms, including the bacterial strains *Staphylococcus aureus* (ATCC 6538), *Pseudomonas aeruginosa* (ATCC 15442), *Salmonella enterica* serovar Typhimurium (ATCC 13311), *Shigella sonnei* (ATCC 11060), *Klebsiella pneumoniae* (ATCC 13866), *Escherichia coli* (ATCC 10536), *Bacillus cereus* (ATCC 11778), and the yeasts *Candida albicans* (ATCC 18804) and *Cryptococcus neoformans* (ATCC 32608).

2.4.2 Serial dilution assay for determination of the minimal inhibitory concentration (MIC)

The MIC of each extract was determined by using the broth microdilution techniques for bacteria and yeasts, respectively (Bouzada et al., 2009; NCCLS, 2002). MIC values were determined in RPMI 1640 buffered to pH 7.0 with MOPS for yeasts and Mueller Hinton broth (MHB) for bacteria. Bacterial strains were cultured overnight at 37 °C in Mueller Hinton agar (MHA). Yeasts were cultured for 48 h at 30 °C in Sabouraud dextrose agar (SDA). Sample stock solutions were two-fold diluted from 500 to 2.0 μg/mL (final volume = 80 μL) and a final DMSO concentration ≤ 1%. Then, RPMI or MHB (100 μL) was added onto microplates. Finally, 20 μL of 10^6 CFU/mL (values of 0.08 - 0.10 at 625 nm, according to McFarland turbidity standards) of standardized yeasts and bacterial suspensions were inoculated onto microplates and the test was performed in a volume of 200 μL. Plates were incubated at 30 °C for 48 h for yeasts and at 37 °C for 24 h for bacteria. The same tests were performed simultaneously for growth control (RPMI + yeast and MHB + bacteria) and sterility control (RPMI or MHB + extract). The MIC values were calculated as the highest dilution showing complete inhibition of the tested strain. Chloramphenicol and Amphotericin B were used as reference drugs for bacteria and yeasts, respectively.

2.5 Phytochemical studies

A portion of each extract that was subjected for the biological screening was used for the identification of the major secondary metabolites employing the protocols described by Matos (1997). Briefly, the extract (1 mg/mL) was submitted to the following identification reactions: The characterization for tannins was performed by gelatin, iron salt and lead acetate reactions. Triterpenoids and sterols were investigated by Liebermann-Burchard reagent and the alkaloids analysis was done by precipitation reactions with the reagents of Dragendorff, Bouchardat, Mayer and Bertrand. For the research of flavonoids, the reactions...
of Shinoda and aluminum chloride were employed and the presence of saponins was determined by the formation of foam.

2.6 Statistical analysis

DPPH, reducing power and β-carotene/linoleic acid assays were carried out in triplicates. The results were expressed as mean ± standard deviation (SD). All statistical analysis were conducted using Graph Pad Prism software.

3. Results and discussion

The paper describes the antimicrobial and antioxidant activities and the phytochemical profile of some methanol extracts belonging to Brazilian traditional medicinal plants, most of them commonly used for treating conditions likely to be associated with microorganisms.

The major classes of phytocompounds of the bioactive extracts are presented in Table 2.

| Plant species                  | Part testeda | Phytocompoundsb |
|--------------------------------|--------------|-----------------|
| Alternanthera brasiliana       | AP           | Al | Tr | St | Ta | Sa | Fl |
| Allamanda cathartica           | L            | +  | -  | +  | -  | -  | +  |
| Acanthospermum australe        | AP           | +  | -  | +  | +  | +  | +  |
| Achillea millefolium           | L            | +  | -  | +  | -  | -  | +  |
| Anthemis cotula                | L            | -  | +  | -  | -  | -  | +  |
| Anthemis cotula                | F            | -  | -  | +  | -  | -  | -  |
| Baccharis trimera              | AP           | -  | -  | +  | +  | -  | -  |
| Bidens segetum                 | L            | -  | -  | +  | +  | -  | +  |
| Carduus marianus               | L            | -  | -  | +  | +  | -  | +  |
| Matricaria chamomilla          | L            | +  | +  | -  | +  | -  | +  |
| Piptocarpa macropoda           | L            | +  | +  | -  | +  | -  | +  |
| Solidago chilensis             | L            | +  | +  | -  | +  | +  | +  |
| Vernonanthura divaricata       | L            | +  | -  | +  | +  | -  | +  |
| Stenolobium stans              | L            | +  | -  | +  | +  | -  | +  |
| Bixa orellana                  | L            | +  | +  | -  | +  | +  | +  |
| Alchornea triplinervia         | L            | +  | +  | -  | +  | -  | -  |
| Acalypha brasilensis           | L            | +  | +  | -  | +  | -  | +  |
| Chamaecrista desvauxii         | L            | +  | +  | -  | +  | -  | +  |
| Samanea tubulosa               | L            | +  | +  | -  | +  | -  | +  |
| Senna macranthera              | L            | +  | -  | +  | +  | -  | +  |
| Senna multijuga                | F            | +  | +  | -  | +  | -  | +  |
| Stylosanthes scabra            | A            | -  | -  | +  | +  | -  | +  |
| Casearia sylvestris            | L            | +  | -  | +  | +  | +  | +  |
| Vismia magnoliifolia           | L            | -  | +  | -  | +  | -  | +  |
| Plant species               | Part tested\(^a\) | Phytocompounds\(^b\) |
|----------------------------|------------------|---------------------|
|                            | L                | Al | Tr | St | Ta | Sa | Fl |
| Lacistema pubescens        | L                | -  | +  | -  | +  | -  | +  |
| Hyptis suaveolens          | L                | +  | -  | +  | -  | -  | +  |
| Ocimum basilicum           | L                | +  | -  | +  | +  | -  | +  |
| Peltoodon radicans         | L                | -  | +  | -  | -  | -  | +  |
| Salvia officinalis         | L                | +  | -  | +  | -  | -  | +  |
| Nectandra rigida          | L                | -  | +  | -  | -  | +  | -  |
| Cuphea ingrata            | AP               | +  | +  | +  | +  | +  | +  |
| Byrsonima variabilis       | L                | +  | -  | +  | +  | +  | +  |
| Sida glaziovii            | AP               | -  | -  | +  | -  | +  | +  |
| Miconia latecrenata       | L                | +  | -  | +  | -  | +  | +  |
| Tibouchina grandifolia    | L                | +  | +  | -  | +  | -  | +  |
| Tibouchina granulosa      | L                | -  | -  | +  |  + | -  | -  |
| Tibouchina mutabilis      | L                | +  | -  | +  | +  | +  | -  |
| Eugenia cumini            | L                | +  | +  | -  | -  | -  | +  |
| Myrcia splendens          | L                | +  | -  | +  | +  | -  | -  |
| Piper corcovadensis       | L                | -  | -  | +  | -  | +  | -  |
| Eriobotrya japonica       | L                | +  | -  | +  | -  | -  | +  |
| Rubus rosifolias          | L                | +  | -  | +  | +  | +  | +  |
| Amatoua intermedia        | L                | -  | +  | -  | -  | -  | +  |
| Cupania oblongifolia      | L                | -  | +  | -  | +  | -  | +  |
| Sapindus saponaria        | Fr               | +  | +  | -  | +  | +  | -  |
| Solanum swartzianum      | L                | +  | -  | +  | +  | -  | +  |
| Tropaeolum majus          | F                | +  | +  | -  | -  | -  | +  |
| Turnera subulata          | L                | +  | -  | +  | +  | -  | +  |
| Cecropia pachystachya     | L                | +  | +  | -  | +  | -  | +  |
| Lippia pseudo-thea        | L                | +  | +  | -  | +  | +  | +  |
| Lippia hermannioides      | L                | +  | +  | -  | +  | -  | +  |
| Lippia alba               | AP               | +  | +  | -  | +  | +  | +  |
| Lippia rubella            | AP               | +  | +  | -  | +  | +  | +  |
| Lippia sidoides           | AP               | +  | +  | -  | +  | -  | +  |
| Lantana camara            | L                | -  | -  | +  | -  | -  | +  |
| Lantana camara            | F                | -  | +  | -  | -  | +  | -  |
| Aloysia floribunda        | L                | -  | +  | -  | -  | -  | +  |
| Cissus verticillata       | L                | +  | -  | +  | -  | -  | +  |

\(^a\)AP, Aerial Parts; F, Flowers; Fr, Fruits; L, Leaves. \(^b\)Al, Alkaloids; Tr, Triterpenes; St, Sterols; Ta, Tannins; Sa, Saponins; Fl, Flavonoids

Table 2. Phytocompounds of methanol extracts of the active medicinal plants.
| Plant species             | Part tested | MIC (µg/mL) |
|--------------------------|-------------|-------------|
|                          |             | Sa | Pa | Bc | Ss | St | Ec | Kp | Ca | Cn |
| Alternanthera brasiliana | AP          | -  | -  | -  | -  | -  | -  | 39 | -  | -  |
| Allamanda cathartica     | L           | -  | -  | -  | -  | -  | -  | 39 | -  | -  |
| Achantospermum australe  | AP          | -  | -  | -  | -  | -  | -  | 39 | -  | -  |
| Anthemis cotula          | L           | -  | -  | -  | -  | -  | -  | 39 | -  | -  |
| Anthemis cotula          | F           | -  | -  | -  | 156 | -  | -  | 39 | -  | -  |
| Baccharis trimera        | AP          | -  | -  | -  | -  | -  | -  | -  | 39 | -  |
| Bidens senegatrum       | L           | -  | 156 | 156 | 156 | -  | -  | -  | -  | -  |
| Carduus marianus         | L           | -  | -  | -  | -  | -  | -  | 39 | -  | -  |
| Matricaria chamomilla    | L           | 300 | 78 | -  | -  | -  | -  | -  | -  | -  |
| Piptocarpha macrospora   | L           | -  | 78 | -  | -  | -  | -  | 78 | 300 | -  |
| Solidago chilensis       | L           | -  | -  | -  | -  | -  | -  | 39 | -  | -  |
| Vernonanthura diversicata| L           | -  | -  | -  | -  | -  | -  | 156 | -  | -  |
| Bixa orellana            | L           | -  | -  | -  | -  | -  | -  | -  | 156 | -  |
| Alchornea triplinervia   | L           | -  | -  | -  | -  | -  | -  | -  | 78  | -  |
| Acalypha brasiliensis    | L           | -  | -  | -  | -  | -  | -  | -  | 78  | -  |
| Chamaecrista desvauxii   | L           | 5  | 5  | -  | 78 | -  | 300 | -  | -  | -  |
| Samanea tubulosa         | L           | 39 | 39 | 39 | -  | -  | -  | 300 | 156 | -  |
| Senna macranthera        | L           | -  | 156 | 300 | 156 | -  | -  | -  | -  | -  |
| Senna multijuga          | F           | 300 | 78 | 39 | 156 | 78 | 300 | 39 | 20  | -  |
| Stylosanthes scabra      | AP          | 2  | 39 | 5  | -  | -  | -  | -  | -  | -  |
| Casearia sylvestris      | L           | -  | -  | -  | -  | -  | -  | -  | 39  | -  |
| Vismia magnoliolitifolia | L           | -  | -  | 39 | -  | -  | -  | 300 | 156 | -  |
| Lactestra pubescens      | L           | -  | -  | 39 | -  | -  | -  | -  | -  | -  |
| Nectandra rigida         | L           | -  | 300 | -  | -  | -  | -  | -  | -  | -  |
| Cuphea ingrata           | AP          | -  | 39 | -  | -  | -  | -  | 39 | -  | -  |
| Sida glaziovii           | AP          | -  | -  | -  | -  | -  | -  | 39 | -  | -  |
| Micromys lastrenata      | L           | -  | -  | -  | -  | -  | -  | -  | 300 | -  |
| Tibouchina grandifolia   | L           | 5  | -  | -  | 300 | -  | -  | -  | -  | -  |
| Tibouchina granulosa     | L           | 39 | 39 | 39 | -  | -  | -  | -  | -  | -  |
| Eugenia cumini           | L           | -  | -  | -  | -  | -  | -  | 39 | -  | -  |
| Myrcia splendens         | L           | -  | 300 | -  | -  | -  | -  | -  | -  | -  |
| Piper corcovadensis      | L           | -  | -  | -  | -  | -  | -  | -  | 78  | -  |
| Rubus rasefolius         | L           | -  | -  | -  | -  | -  | -  | -  | 39  | -  |
| Amoiaea intermedia       | L           | -  | -  | -  | -  | -  | -  | -  | 78  | -  |
| Cupania oblongifolia     | L           | 39 | 39 | 39 | 39 | -  | -  | -  | -  | -  |
| Sapindus saponaria       | Fr          | -  | -  | -  | -  | -  | -  | -  | 156 | 300 |
| Solanum swartziunum      | L           | -  | -  | -  | -  | -  | -  | -  | 78  | -  |
| Tropaeolum majus         | F           | -  | -  | -  | -  | -  | -  | -  | 39  | -  |
| Turnera subulata         | L           | -  | -  | -  | -  | -  | -  | 78 | -  | -  |
| Cecropia pachystachya    | L           | -  | -  | -  | -  | -  | -  | -  | 39  | -  |
| Lippia pseudothea        | L           | -  | 156 | -  | -  | -  | -  | -  | -  | -  |
| Lippia hermanniioides    | L           | -  | 78 | -  | -  | -  | -  | -  | -  | -  |
| Lippia sidoides          | AP          | -  | 78 | -  | -  | -  | -  | -  | -  | -  |
| Lantana camara           | L           | -  | -  | -  | -  | -  | -  | 39 | -  | -  |
| Lantana camara           | F           | -  | -  | -  | -  | -  | -  | 39 | -  | -  |
Table 3. Antimicrobial activity of methanol extracts of the medicinal plants.

The results of the antimicrobial screening of the most active extracts are summarized in Table 3. The MIC values presented in this study for the extracts tested ranged from 300 to 5 µg/mL. All the extracts exhibited activity against at least one organism tested. According to Cos et al. (2006), plant extracts with MIC values below 100 µg/mL are very promising. So, *Bidens segetum*, *Chamaecrista desvauxii* and *Stylosanthes scabra* presented a very strong activity against *Shigella sonnei* with MIC of 5 µg/mL. *Chamaecrista desvauxii* and *Stylosanthes scabra* were also very active against *Pseudomonas aeruginosa* with MIC of 5 and 20 µg/mL, respectively. Against *Staphylococcus aureus*, the extracts of *Tibouchina grandifolia*, *Chamaecrista desvauxii* and *Aloysia floribunda* presented an outstanding activity with MIC of 5 µg/mL. On the other hand, *Senna multijuga* displayed a broader spectrum of antibacterial activity, showing activity against all bacteria tested with MIC values varying from 300 to 39 µg/mL (Table 3). Infections still cause about one-third of all deaths worldwide and are the leading cause of death, mainly because of disease in developing countries.

*S. sonnei*, a gram-negative bacterium, is a significant cause of gastroenteritis in both developing and industrialized countries (Boumghar-Bourtchai et al., 2008). People infected with *Shigella* develop diarrhoea, fever and stomach cramps starting a day or two after they are exposed to the bacterium. It is typically associated with mild self-limiting infection (DeLappe et al., 2003). Recently, there has been a rise in strains resistant to multiple antibiotics. *P. aeruginosa*, an increasingly prevalent opportunistic human pathogen, is the most common gram-negative bacterium found in nosocomial infections. Three of the more informative human diseases caused by *P. aeruginosa* are bacteremia in severe burn victims, chronic lung infection in cystic fibrosis patients, and acute ulcerative keratitis in users of extended-wear soft contact lenses (Lyczak et al., 2000). *S. aureus* is a gram-positive bacterium that commonly colonises human skin and mucosa (e.g. inside the nose) without causing any problems. However, if either of these is breached due to trauma or surgery, *S. aureus* can enter the underlying tissue, creating its characteristic local abscess lesion, and if it reaches the lymphatic channels or blood can cause septicemia (Harris et al., 2002). Antifungal properties were presented by 35 extracts. Among them, *Acanthospermum australe*, *Sida glazioui*, *Cuphea ingrata*, *Lantana camara*, *Allamanda cathartica*, *Anthemis cotula*, *Carduus marianus*, *Alternanthera brasiliana*, *Rubus rosifolius*, *Solidago chilensis*, and *Aloysia floribunda* demonstrated a strong anti-candida activity with MIC of 39 µg/mL. By the other side, extracts from *Cecropia pachystachya*, *Eugenia cuminii*, *Baccharis trimera*, and *Tropaeolum majus* were active against *C. neoformans* with MIC values of 39 µg/mL, being *Senna multijuga* the most active with MIC of 20 µg/mL. Candidiasis is a common infection of the skin, oral
cavity, esophagus, gastrointestinal tract, vagina and vascular system of humans. Although most infections occur in patients who are immunocompromised or debilitated in some other way, the organism most often responsible for disease, *Candida albicans*, expresses several virulence factors that contribute to pathogenesis (Calderone & Fonzi, 2001). *Cryptococcus neoformans* is an encapsulated basidiomycete yeast responsible for disseminated infections in immunosuppressed patients. Meningoencephalitis and pneumonia are the most frequent visceral presentations of the disease, but other rare presentations have been reported (Braga et al., 2007; Charlier-Woerther et al., 2011). Some of the most active species had already been studied for their antimicrobial effects elsewhere. The essential oil of different parts of *B. segetum* presented antifungal activity (Nascimento et al., 2008). Flavonoids isolated from the leaves of *T. grandifolia* demonstrated antifungal activity against the phytopathogenic fungus *Cladosporium cucumerinum* (Kuster et al., 2009). Dichlorometane extract of *A. australis* showed positive results against *Bacillus subtilis*, *Micrococcus luteus*, *Listeria monocytogenes* and *S. aureus* (Vivot et al., 2007). Antimicrobial efficacy of flavonoids and crude alkaloids of *L. camara* was found against *C. Albicans*, *Proteus mirabilis*, *S. aureus*, *E. coli*, and *Trichophyton mentagrophytes* (Sharma & Kumar, 2009). The iridoid isolated from *A. cathartica* presented fungitoxicity against some dermatophytes that causes dermatomycosis (Tiwari et al., 2002). The wound healing activity of this specie has also been tested, and it presented significant results in tests *in vivo* (Nayak et al., 2006). Flavonoids from *A. cotula* flowers showed interesting antimicrobial activity against both gram-negative and gram-positive microorganisms (Quarenghi et al., 2000). Quercetin isolated from the ethyl acetate extract of *A. brasiliana* presented antibacterial action against *S. aureus* (Silva et al., 2011). Antimicrobial activity of aqueous and hydroalcoholic fractions from *R. rosifolius* leaves showed activity against *E. coli*, *S. aureus*, *P. aeruginosa* and *C. albicans* (Mauro et al., 2002) and *B. trimera* was active against *S. aureus* and *E. coli* (Avancini et al., 2000). The antifungal activity of the leaf oil of *S. chilenis* was assayed by paper disk agar diffusion test and showed that human pathogenic dermatophytes were very sensitive (Vila et al., 2002). The crude hydroalcoholic extract of *S. cumini* was active against *Candida krusei* and against multi–resistant strains of *P. aeruginosa*, *K. pneumoniae* and *S. aureus* (de Oliveira et al., 2007). However, antimicrobial activity for *C. desvauxii*, *S. scabra*, *A. floribunda*, *S. multijuga*, *S. glaziovii*, *C. ingrata*, *C. marianus*, *P. chrysanthaca* and *T. majus* were reported here for the first time. Preliminary phytochemical analysis revealed that almost all the antimicrobial extracts showed flavonoids and tannins in their chemical composition (Table 2). Flavonoids are a broad class of plant phenolics that are known to possess antimicrobial activity, essentially by enzyme inhibition of DNA gyrase (Cushnie & Lamb, 2005). The mode of tannins antimicrobial action may be related to their ability to inactivate microbial adhesions, enzymes, cell envelope transport protein, etc. They also complex with polysaccharides (Ya et al., 1988). Condensed tannins have been determined to bind cell walls of ruminal bacteria, preventing growth and protease activity (Jones et al., 1994). However, the extracts tested also contain triterpenoids, sterols, saponins and alkaloids. Saponins are known to interact with cell membranes, increasing permeability and producing cell damage (Francis et al., 2002). In this sense, saponins may be involved in antimicrobial properties. The mechanism of action of some alkaloids is attributed to their ability to intercalate with DNA (Phillipson & O’Neill, 1989). The antimicrobial activity of triterpenes and sterols may be related to lipophilic components of plant extracts. This components increase permeability and loss of cellular components, and a change variety of enzyme systems, including those involved in the production of cellular energy and synthesis of structural components, inactivating or destroying genetic material (Bagamboula et al., 2004; Kim et al., 1995). The antioxidant habiliy of the extracts was also measured.
Natural antioxidants have been studied extensively for decades in order to find compounds protecting against a number of diseases related to oxidative stress and free radical-induced damage. Antioxidants are believed to play a very important role in the body defense system against reactive oxygen species (ROS), which are the harmful byproducts generated during normal cell aerobic respiration (Gutteridge & Halliwell, 2000). There is a number of assays designed to measure overall antioxidant activity/reducing potential, as an indication of host total capacity to withstand free radical stress. DPPH assay is very convenient for the screening of large numbers of samples of different polarity because of its high throughput. It evaluates the ability of antioxidants to scavenge free radicals. These antioxidants donate hydrogen to free radicals, leading to non-toxic species and therefore to inhibition of the propagation of lipid oxidation. Hydrogen-donating ability is an index of primary antioxidants (Lugasi et al., 1998). Among all extracts, 24 showed an outstanding antioxidant activity with IC<sub>50</sub> ≤ 10 µg/mL. Cecropia pachystachya, Tibouchina mutabilis, Cupania oblongifolia, and Myrcia splendens were the most active (IC<sub>50</sub> ≤ 3 µg/mL) (Table 4).

| Plant species                  | Part tested<sup>a</sup> | DPPH (IC<sub>50</sub> µg/mL ± SD) | Reducing power (EC<sub>50</sub> µg/mL ± SD) | β-carotene/linoleic acid (% I ± SD) |
|-------------------------------|------------------------|----------------------------------|---------------------------------------------|-----------------------------------|
| Achillea millefolium          | L                      | 12.30 ± 1.16 14.86 ± 0.33        | 37.82 ± 8.70                                |
| Bidens segetum                | L                      | 6.52 ± 2.61 24.43 ± 0.06         | 67.67 ± 4.60                                |
| Stenolobium stans             | L                      | 7.45 ± 0.67 16.35 ± 0.30         | 41.98 ± 3.27                                |
| Bixa orellana                 | L                      | 8.07 ± 0.71 23.42 ± 0.03         | 78.75 ± 3.30                                |
| Alchornea triplinervia        | L                      | 11.20 ± 1.09 > 53.64             | 60.69 ± 1.16                                |
| Hyptis suaveolens             | L                      | 11.70 ± 1.43 30.48 ± 0.34        | 51.42 ± 9.82                                |
| Ocimum basilicum              | L                      | 8.17 ± 1.46 14.66 ± 0.01         | 32.76 ± 11.20                               |
| Peltodon radicans             | L                      | 4.46 ± 1.32 23.23 ± 0.07         | 50.33 ± 14.30                               |
| Salvia officinalis            | L                      | 9.59 ± 0.50 19.44 ± 0.06         | 61.66 ± 2.80                                |
| Nectandra rigida              | L                      | 6.63 ± 0.63 13.19 ± 0.08         | 52.10 ± 12.10                               |
| Byrsonima variabilis          | L                      | 10.7 ± 2.47 33.71 ± 0.08         | 31.67 ± 1.80                                |
| Tibouchina granulosa          | L                      | 7.50 ± 0.42 10.05 ± 0.61         | 62.37 ± 3.17                                |
| Tibouchina mutabilis          | L                      | 1.56 ± 0.24 5.54 ± 0.10          | 69.05 ± 8.06                                |
| Myrcia splendens              | L                      | 2.90 ± 0.20 12.31 ± 0.38         | 49.34 ± 2.31                                |
| Eriobotrya japonica           | L                      | 11.90 ± 0.87 13.98 ± 0.34        | 65.50 ± 2.00                                |
| Cupania oblongifolia          | L                      | 2.22 ± 0.10 6.29 ± 0.08          | 47.48 ± 4.8                                 |
| Cecropia pachystachya         | L                      | 2.11 ± 0.40 7.70 ± 0.22          | 79.28 ± 2.80                                |
| Lippia hermannioides          | L                      | 3.99 ± 0.31 13.68 ± 0.42         | 54.90 ± 5.22                                |
| Lippia alba                   | AP                     | 5.43 ± 0.34 14.40 ± 0.02         | 47.62 ± 27.30                               |
| Lippia rubella                | AP                     | 3.79 ± 0.27 10.27 ± 0.10         | 10.60 ± 5.60                                |
| Lantana camara                | L                      | 4.54 ± 0.26 14.04 ± 0.02         | 55.03 ± 8.80                                |
| Lantana camara                | F                      | 9.82 ± 1.79 27.99 ± 0.07         | 61.84 ± 9.20                                |
| Anamiaoua intermedia          | L                      | 8.41 ± 1.22 12.22 ± 0.08         | 58.13 ± 0.70                                |

*AP, Aerial Parts; F, Flowers; L, Leaves

Table 4. Antioxidant activity of methanol extracts of the selected medicinal plants.
The total antioxidant activity of the extracts is constituted by individual activities of each of the antioxidant compounds. Moreover, these compounds render their effects via different mechanisms such as radical scavenging, metal chelating activity, inhibition of lipid peroxidation, quenching of singlet oxygen, and so on to act as antioxidants. Even if a sample exhibits high activity with one method, it does not always show similar good results with all other methods. Therefore, it is essential to evaluate samples accurately by several methods. Hence, the antioxidant activity for those extracts was also evaluated by reducing power and β-carotene/linoleic acid assays. The reducing ability of a compound generally depends on the presence of reductants, which exhibited antioxidative potential by breaking the free radical chain, by donating a hydrogen atom. Antioxidant action of the reductones is based on the breaking of free radicals chain by the donation of a hydrogen atom. Reductones are believed not only to react directly with peroxides, but also prevent peroxide formation by reacting with certain precursors (Jamuna et al. 2010). The results found using this assay showed an outstanding antioxidant property of C. pachystachya, T. mutabilis, C. oblongifolia, and M. splendens and suggested that compounds present in those extracts were good electron and hydrogen donors, and could terminate the radical chain reaction by converting free radicals into more stable products. When employing β-carotene/linoleic acid assay, the more active inhibitors of β-carotene bleaching were C. pachystachya, T. mutabilis and B. orellana which showed values greater than 75% of inhibition. Interestingly, C. oblongifolia and M. splendens were not so effective in quenching β-carotene. It is well known that the value of this method appears to be limited to less polar compounds. They exhibit stronger antioxidative properties in emulsions because they concentrate at the lipid:air surface, thus ensuring high protection of the emulsion itself. On the other hand, polar antioxidants remaining in the aqueous phase are more diluted and are thus less effective in protecting the lipid (Koleva et al., 2002). It is well known that plants which possess antioxidative and pharmacological properties are related to the presence of phenolic compounds, specially phenolic acids and flavonoids (Fabri et al., 2009). Antioxidant activity had also been detected for C. pachystachya (Aragão et al., 2010) and B. orellana (Chisté et al., 2011). For T. mutabilis, C. oblongifolia and M. splendens, the antioxidant capacities were reported here for the first time. Polyphenolic compounds such as flavonoids and tannins found in the extracts (Table 2) are considered to be the major contributors to the antioxidant activity of medicinal plants. The antioxidant activities of polyphenols were attributed to their redox properties, which allow them to act as reducing agents, hydrogen donators and singlet oxygen quenchers, as well as their metal chelating abilities (Vladimir-Knezevic et al., 2011). It would seem that a great part of the extracts tested in this study for antimicrobial activity does not possess antioxidant effects (Table 3 and 4).

3. Conclusion
The results obtained represent a worthwhile expressive contribution to the characterization of antimicrobial and antioxidant activity of plant extracts of traditional medicinal plants from Brazilian flora and justify, in part, the popular uses of some of these species.

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Phytochemicals are biologically active compounds present in plants used for food and medicine. A great deal of interest has been generated recently in the isolation, characterization and biological activity of these phytochemicals. This book is in response to the need for more current and global scope of phytochemicals. It contains chapters written by internationally recognized authors. The topics covered in the book range from their occurrence, chemical and physical characteristics, analytical procedures, biological activity, safety and industrial applications. The book has been planned to meet the needs of the researchers, health professionals, government regulatory agencies and industries. This book will serve as a standard reference book in this important and fast growing area of phytochemicals, human nutrition and health.

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