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Metal content in medicinal teas used in the Urubueua de Fátima river community, Abaetetuba-Pará State, Brazil

[Contenido de metal en tés terapéuticos utilizados en la comunidad del Río Urubueua de Fátima, estado de Abaetetuba-Pará, Brasil]

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Abstract: The content of certain metals in 13 medicinal teas made from 16 plant species was measured by flame photometer and atomic absorption spectrometer with flame methods. The measurements were evaluated against metal intake levels recommended by health authorities. The results indicate that the medicinal teas tested, regularly consumed by inhabitants of the Urubueua de Fátima River Community, Abaetetuba-Para, Brazil, present no risk of poisoning people older than six months. However, decoctions of *Mentha* sp., *Eleutherine bulbosa*, *Euterpe oleracea*, *Piper callosum* and *Hyptis mutabilis*, mostly given to children, had Mn values potentially exceeding the recommended maximum intake for infants in the 0-6 months age group, in the quantities customarily administered. Consequently, studies are needed to assess bioavailability for safe human consumption. Results also showed the consumption of medicinal tea alone is not enough to supply an adult's daily metal requirements or treat deficiencies. Additionally, cures emphasized by interviewed Community members might be associated with the bioactivity of organic substances that the medicinal teas contain.

Keywords: Amazon Community; Medicinal plants; Metal content; Medicinal teas.

Resumen: El contenido de algunos metales en 13 tés medicinales de las 16 especies consumidas por los habitantes de la comunidad del Río Urubueua de Fátima, Abaetetuba-Para, Brasil, se evaluó mediante un fotómetro de llama y un espectrómetro de absorción atómica con métodos de llama, y se comparó con los niveles recomendados por las agencias de la salud. Los tés medicinales evaluados no mostraron riesgo de intoxicación para las personas mayores de seis meses de edad, sino las decocciones de *Mentha* sp., *Eleutherine bulbosa*, *Euterpe oleracea*, *Piper callosum* y *Hyptis mutabilis*, en su mayoría dirigidos a la ingesta de niños, informaron valores de Mn superiores a la ingesta máxima recomendada para el grupo de infantes (0-6 meses), debido a que estos estudios son necesarios para evaluar la biodisponibilidad para un consumo humano seguro. Los resultados también mostraron que solo el consumo de té medicinal no es suficiente para satisfacer las necesidades diarias recomendadas de ingesta de minerales o para tratar las deficiencias. Además, los informes de curación, enfatizados por los habitantes, indican que la bioactividad observada podría estar asociada a sustancias orgánicas presentes en el té.

Palabras clave: Comunidad amazónica; Plantas medicinales; Contenido de Metal; Tés medicinales

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INTRODUCTION

Medicinal beverages, such as teas, are widely used in folk medicine. They are rich in organic and inorganic, biologically active substances that contribute to the prevention and cure of diseases (Malongane *et al*., 2017). Despite a common belief that they are *harmless natural remedies*, plants should be used as a therapeutic alternative with caution (Silveira *et al*., 2008), because they can cause undesirable side effects, some of which might be assigned to their metal content.

There is rapidly growing interest in assessing the implications and benefits attributed to the presence of metals in medicinal plant. In the Literature, there are reports that herb beverages, widely used in Brazilian traditional medicine, might act as nutritional supplements, due to their content of iron, copper and zinc (Andrade *et al*., 2005; Delaporte *et al*., 2005). Martins *et al*. (2009) report high levels of Ca, Mg and Fe in medicinal teas made from Amazonian plants, recommending such drinks as potential dietary mineral supplements.

Many determinations of the levels of macro and micronutrients in beverages, used in Brazilian tradicional medicine, have been made by flame atomic absorption spectrometry - F AAS, and flame photometry (Martins *et al*., 2009; Amarante *et al*., 2011; Diniz *et al*., 2013; Pereira Junior & Dantas, 2016). Both are single element techniques; flame photometry is a fast and low-cost instrumental method for measuring K and Na with satisfactory sensitivity (Okumura *et al*., 2004) and F AAS is a high-speed analytical technique that allows sequential determination of a large number of elements, including trace elements because it has detection limits in the range of $\mu g\ kg^{-1}$ (Feist *et al*., 2007).

Metals, in appropriate concentrations, are essential for proper performance of enzymes in metabolism. Ca and Mg have an important role in the formation of bones, teeth and other tissues (Lopes *et al*., 2002). Na and K, as electrolytes, are associated with maintenance of osmotic pressure and water distribution in various body fluid compartments, as well as regulating the heart and other muscles (Pohl *et al*., 2013).

Trace metals are also important for the human organism. Zn is important for tissue growth, wound healing, immune system function, prostaglandin production, bone mineralization and cognitive functions (Deshpande *et al*., 2013). Fe participates in many metabolic processes; for oxygen transport, in deoxyribonucleic acid (DNA) synthesis and for electron transport (Abbaspour *et al*., 2014). Cu is absorbed by plants in the Cu^{2+} form and is associated with biological transfer of electrons, synthesis of red blood cells and the maintenance of the structure and function of the nervous system (Pereira Junior & Dantas, 2016).

On the other hand, the intake of metals in concentrations above the maximum limits for daily intake, might prejudice health (Froslie, 2017). Excessive ingestion of Na and K have been linked to high blood pressure, cardiovascular disease and a variety of other conditions (Whelton, 2014). Mn is related to psychiatric disorders, known as manganism (Moura *et al*., 2018). Reporting on the performance of an infusion of senescent leaves of *Montrichardia linifera* (Arruda) Schott, for treatment of liver disease, Amarante *et al.* (2011) demonstrated that the infusion is toxic, when taken in a volume greater than 1 liter per day, because of its high Mn content.

Riparian populations of the Amazon floodplains preserve knowledge of the properties of species predominantly cultivated, or native to this environment (Santos & Coelho-Ferreira, 2012). The Urubueua de Fatima River Community regularly uses medicinal plants in teas given to all age groups, from newborn to elderly, to prevent and combat diseases or provide symptomatic relief.

Habitual and continuous consumption of herbal medicines in this Community led to an interest in the occurrence of metals in the teas. The aim of this study was to determine concentrations of Na, Ca, Mg, K, Fe, Cu, Mn, Zn in portions of these supposed medicinal teas, using F AAS and flame photometry. The potential for influencing the health of the Community was investigated by comparing the results with health authority recommendations (Institute of Medicine, 2004; Brazil, 2005; WHO/FAO, 2007).

MATERIALS AND METHODS

Preliminary Survey

Thirteen residents of the Urubueua of Fatima River

Community (S 01°37'92"; W 48°58'42") were interviewed; 85% women and 15% men aged between 28 and 93. With the prior consent of the Community, semi-structured questionnaires were applied (Albuquerque *et al*., 2010) and botanical samples were collected from the yards of the informants.

Plant Specimens

Plant species were identified by parataxonomist Carlos Alberto Santos Silva, and added to the João Murça Pires (MG) herbarium, at Museu Paraense Emílio Goeldi and the Marlene Freitas da Silva (MFS) herbarium at Universidade do Estado do Pará (Table No. 1).

Table No. 1
Plant species used by Urubueua de Fátima River Community evaluated in this study

Common name	Family	Species	Voucher
Açaí	Arecaceae	*Euterpe oleracea* Mart.	1261a, b, c, d
Babosa	Xanthorrhoeaceae	*Aloe vera* (L.) Burm.f.	318
Cidreira	Verbenaceae	*Lippia alba* (Mill.) N.E.Br. & P.Wilson	1352
Elixir paregórico	Piperaceae	*Piper callosum* Ruiz & Pav.	164
Escada de Jabuti	Fabaceae	*Bauhinia guianensis* Aubl.	301
Hortelã	Lamiaceae	*Mentha* sp.	100
Jucá	Fabaceae	*Libidibia ferrea* (Mart. ex. Tul.)	298
Lombrigueira	Gentianaceae	*Coutoubea ramosa* Aubl.	1313
Marupazinho	Iridaceae	*Eleutherine bulbosa* (Mill.) Urb.	95
Pariri	Bignoniaceae	*Fridericia chica* (Bonpl.) L.G.Lohmann	286
Pata de Vaca	Fabaceae	*Bauhinia forficata* Link	257
Quebra pedra	Phyllanthaceae	*Phyllanthus niruri* L.	1335
Salva do Marajó	Lamiaceae	*Hyptis mutabilis* (Rich.) Briq.	1323
Sucuuba	Apocynaceae	*Himatanthus sucuuba* (Spruce ex Müll.Arg.) Woodson	281
Sucuriju	Asteraceae	*Mikania lindleyana* DC.	1281
Urubucaá	Aristolochiaceae	*Aristolochia trilobata* L.	309

Instruments and Accessories

Eight metals were investigated: macroelements Ca, Na, K, Mg and trace elements Cu, Fe, Mn and Zn. The determinations of K and Na were made with a Corning brand, model 400 flame photometer. Quantification of Ca, Mg, Cu, Mn, Zn and Fe was with a Scientific Instruments GC, AA 904 model, F ASS, equipped with background correction with deuterium lamp. The instrumental parameters for the determination of Ca, Mg, Cu, Mn, Zn, and Fe by F AAS are shown in Table No. 2.

Table No. 2
F ASS Instrumental parameters used for quantification of Ca, Mg, Cu, Mn, Zn, and Fe in samples of medicinal teas used in traditional medicine by Urubueua de Fatima River Community

Parameters	Ca	Cu	Fe	Mg	Mn	Zn
Wavelength (nm)	422.0	324.7	248.3	285.2	279.5	213.9
Lamp Current (mA)	10	4	5	4	5	5
Spectral resolution (nm)	0.5	0.5	0.2	0.5	0.2	1

Reagents and Solutions

All reagents used were of analytical grade. Teas and metal analysis reference solutions were prepared with high purity deionized water (18.2 MΩ cm resistivity) obtained from a Milli-Q system, Millipore. The linear range was built from standard curves using standard solutions obtained by serial dilution of stock solution at 1,000 mg/L Titrisol (Merck, Darmstadt, Germany).

Preparation of medicinal Teas and Metal Determination

Most of the studies of medicinal teas in the literature use acid digestion of plant substances for preparation of the samples, this procedure complicates the comparison of the data obtained with the real tea product of preparation for traditional medicine. For this study the analytical samples are drawn from real tea, therefore the results directly report quantities in real tea. Another novelty in this study is the analysis of the elemental content of compound tea - prepared from more than one species. In the literature, studies of medicinal teas only involve the analysis of teas prepared with one species. Thirteen medicinal teas were made from sixteen species listed (Table No. 1).

The medicinal teas were prepared in triplicate and analyzed the same day. Determinations of their metal contents were made according to methodology described in the literature (Amarante et al., 2011), with modifications to match the formulations obtained from the Community (Table No. 3). For the preparation of Cidreira tea, for example, according to the Community's indication, a handful of leaves was used, around five leaves, this ammount was converted into mass (g) which totaled 2,937g.

In this work medicinal tea is used as a generic term (best translation of chá) for beverages prepared either by infusion or by decoction of plant substances (leaves, roots or bark) using water. In fact, most of the traditional preparations mentioned here use decoction. Extraction for analysis was made using measured amounts of dry plant substance, calculated to be the repeatable equivalent of the less precise amounts given in traditional recipes, standardized for liquid quantities of 200 mL. Extraneous contribution of trace metals was avoided by using pure deionized water in formulation.

Table No. 3
Remedial Application, mass of plant material and volume of water used for preparation.

Tea	Popular use	Part used	Mass (g)	Water volume (mL)
Cidreira	Hypertension/Headache	Leaf	2.937 ± 0.02	200
Pariri	Anemia	Leaf	0.4445 ± 0.04	200
Elixir paregórico/Urubucacá	Abdominal pain/Diarrhea	Leaf	0.8220 ± 0.03/ 0.3501 ± 0.03	200
Sucuuba	Bronchitis/Asthma	Stems	12.758 ± 0.75	200
Pata de Vaca	High Cholesterol	Leaf	2.2324 ± 0.45	200
Hortelã/Marupazinho	Abdominal pain/Diarrhea	Leaf	0.5453 ± 0.05/ 4.8758 ± 0.12	200
Escada de Jabuti	Diabetes	Stem	11.7405 ± 0.52	200
Lombrigueira	Worms/Worm	Leaf	2.4321 ± 0.12	200
Hortelã/Marupazinho/Açaí	Abdominal pain/Diarrhea	Roots	0.3662 ± 0.03 /1.6689 ± 0.09 /4.8656 ± 0.45	200
Elixir Paregórico/Salva do Marajó	Abdominal pain/Diarrhea	Leaf	1.8109 ± 0.05/ 0.4891 ± 0.02	200
Jucá	Anti-inflammatory	Stem	4.6686 ± 0.22	200
Jucá	Anti-inflammatory	Leaf	2.1417 ± 0.28	200
Quebra pedra/Babosa/Sucuriju	Kidney stones	Leaf	0.3257 ± 0.01 /4.2653 ± 0.52 /2.2838 ± 0.12	200

Median ± standard deviation (*n* = 3)

Of the total, 7 medicinal teas, are prepared with only 1 species, and 6 combined 2 or more species, prepared with leaves, stems and roots by decoction, according to the traditional recipes.

Statistical analysis

Least square linear regression methods were used to join and fit sections of range curves to straight lines for instrument calibration and measurement. Linear ranges were composed accepting only sections with a minimum coefficient of determination (R^2) = 0.99. The limits of detection (LOD) and quantification (LOQ) (in µg/L) were estimated considering the IUPAC recommendation, where LOD = (3s)/S, LOQ = (10s)/S, where s is the standard deviation of 10 measurements of a blank solution and S represents the slope of the analytical curve used for quantification. Addition and recovery tests on samples of medicinal tea were performed in accordance with National Health Surveillance Agency (ANVISA) procedures (Brazil, 2005).

RESULTS AND DISCUSSION

Preliminary Survey about the medicinal teas used in the folk medicine in the Community

Interviews with residents revealed that prescribing teas to adults, for treatment of each disease or symptom, is based on the knowledge bearer's experience or learning transmitted orally between generations. Teas are indicated for treatment of diseases in all age-groups, including infants. In the latter case, the most common ailment treated is abdominal pain, for which teas are given between normal feeds, in volumes of 50 to 100 mL, during the symptomatic period.

Teas are usually administered in quantities of one to three cups per day, a cup being approximately 200 mL; and some treatments were reported to last for weeks or months. About 2 liters of tea daily are prescribed as follows; *L. alba* for hypertension, *B. forficata* for hypercholesterolemia, *P. niruri*, *A. vera* and *M. lindleyana* for prevention of kidney stones and *H. sucuuba* for bronchitis. Until the end of the treatment, patients usually replace water intake exclusively by tea consumption.

Teas are taken with no sugar or any other sweeteners, because the locals believe that the sweetness cuts the active ingredient, and that the cure is in the bitterness.

Metal analysis in medicinal tea consumed in the Community

The results presented are expressed in terms of µg per 200 mL serving of tea; a form that reflects the way the teas are consumed by the Community. Data for analytical curves are shown in Table No. 4. Linearity was induced over the evaluated concentration ranges, and the limits of detection permitted determination of metals in decoctions. LOD and LOQ are presented in µg L^{-1} to optimize comparison with analyses of the teas, which are stated by mass (µg) per volume (200 mL) of decoction (Table No. 5), the usual measure for studies of the mineral content of medicinal plant teas.

Table No. 4
Data concerning calibration curves Ca, Cu, Fe, Mg, Mn and Zn in deionized water of high purity and detection and quantification limit

Element	Linear range (mg L^{-1})	R^2	LOD (µg L^{-1})	LOQ (µg L^{-1})
K	1.0 – 5.0	0.999	14.95	31.14
Na	1.0 – 5.0	0.991	13.60	28.10
Ca	1.0 – 4.0	0.995	10.34	33.18
Mg	0.1 – 0.4	0.995	19.89	101.85
Cu	1.0 – 4.5	0.998	2.41	18.81
Mn	1.5 – 3.5	0.999	4.87	25.41
Zn	0.5 – 1.4	0.991	1.70	5.60
Fe	3.0 – 9.0	0.998	1.68	4.87

Addition and recovery test ranges were: 93-98% (K), 91 – 93% (Na), 98 – 101% (Mg), 99-103% (Cu), 96 – 101% (Mn), 97 – 101% (Zn) and 101 – 105% (Fe), therefore meeting the acceptance criteria (80-120%) for the method (Brazil, 2005).

It can be inferred from the measured quantities of metals in the samples analyzed (Table No. 5) that none of the teas, as commonly used, would result in nutrient ingestion outside the limits recommended by the referenced health authorities, for persons older than seven months. Nevertheless, most of the tea samples had amounts of Mn in a 200 mL serving that would be higher than the 3 µg/day recommended for infants under six months old. Only teas made from *L. alba; F. chica; P. callosum* and *A. trilobata; B. guianensis; C. ramosa; L. laxiflora, P. niruri, A. vera* and *M. lindleyana did* not exceed the recommended Mn amounts for infants.

Table No. 5A
Metal content in a standard volume of a cup of medicinal tea (μg of the metal/200 mL) compared Health Authority Reference Values *, **, *.**

Tea	K	Na	Ca	Mg
Cidreira	673.4 ± 2.31	3092.1 ± 4,14	804.6± 3.25	172± 0.16
Pariri	489.9 ± 3.22	541.77 ± 2.66	141. ± 1.54	57.6±0.23
Elixir paregórico / Urubucacá	396.2 ± 3.23	511.9 ± 2.17	186 ± 0.73	182± 0.36
Sucuuba	414.5 ± 4.14	551.9 ± 1.56	4756 ± 1.04	2640±1.28
Pata de Vaca	1970.9 ± 6.31	2696.8 ± 1.28	3070 ± 2.37	570 ±0.24
Hortelã / Marupazinho	647.7 ± 2.26	670.1 ± 1.18	1654 ± 0.94	624 ± 0.37
Escada de Jabuti	526.2 ± 3.23	947.3 ± 1.07	1776 ± 0.62	730 ± 0.99
Lombrigueira	283.2 ± 2.16	207.1 ± 3.65	57 ± 1.66	21.5±0.033
Hortelã / Marupazinho / Açaí	688.7 ± 1.12	730.5 ± 2.12	445.4± 1.27	64 ± 2.17
Elixir Paregórico / Salva do Marajó	390.3 ± 3.25	1224.5 ± 2.61	1546 ± 2.63	558 ± 0.66
Jucá (casca)	161.3 ± 1.97	198.2 ± 2.17	84,8 ± 0.7	23.8 ± 0.33
Jucá (folhas)	429.5 ± 4.13	1224 ± 2.35	3915 ± 2.64	520 ± 0.96
Quebra pedra / Babosa / Sucuriju	1092.5 ± 5.31	644 ± 1.61	1094 ± 1.72	702 ± 1.23
Recommended Daily Intake – Reference Values				
Adults	2300 mg*	2000 mg**	1000 mg***	260 mg***
Infants (0-6 months)	500 mg*	400 mg	300 mg***	36 mg***

Median ± standard deviation (n = 3)
ND < Limit of detection (LOD)
*** Washington Institute of Medicine (Institute of Medicine 2004)**
**** World Health Organization (WHO/FAO 2007)**
***** ANVISA (Brasil 2005)**

Table No. 5B
Metal content in a standard volume of a cup of medicinal tea (μg of the metal/200 mL) compared Health Authority Reference Values *, **, *.**

Tea	Cu	Mn	Zn	Fe
Cidreira	4.2 ± 0.004	2.6 ± 0.008	1.2±0.001	2.4 ± 0.005
Pariri	ND	ND	ND	2.8 ± 0.001
Elixir paregórico / Urubucacá	ND	1 ± 0.002	3.8±0.001	1.6 ± 0.001
Sucuuba	ND	182.8±0.010	1.8±0.001	11.4±0.003
Pata de Vaca	ND	36 ± 0.002	ND	25.6± 0.010
Hortelã / Marupazinho	ND	3.6 ± 0.001	4.4±0.002	11.2± 0.009
Escada de Jabuti	1 ± 0.001	21.4 ± 0.012	5.2±0.002	13.4± 0.004
Lombrigueira	ND	ND	ND	45.5± 0.006
Hortelã / Marupazinho / Açaí	ND	12 ± 0.009	11±0.003	9.6 ± 0.008
Elixir Paregórico / Salva do Marajó	ND	11 ± 0.009	4 ±0.001	6.6 ± 0.005
Jucá (casca)	ND	ND	8.4±0.003	2 ± 0.001
Jucá (folhas)	1.4 ± 0,001	129 ± 0.012	15.8±0.002	9.4 ± 0.008
Quebra pedra / Babosa / Sucuriju	ND	12.2 ± 0.009	27 ± 0.005	18.8± 0.003
Recommended Daily Intake – Reference Values				
Adults	0.9 mg***	2.3 mg***	7 mg***	14 mg***
Infants (0-6 months)	0.2 mg***	0.003 mg***	2.8 mg***	0.27 mg***

Median ± standard deviation (n = 3)
ND < Limit of detection (LOD)
*** Washington Institute of Medicine (Institute of Medicine 2004)**
**** World Health Organization (WHO/FAO 2007)**
***** ANVISA (Brasil 2005)**

The highest concentrations of metals found in teas made by traditional decoction were as follows: *B. forficata* - K, *L. alba* - Na and Cu, *L. ferrea* - Zn, *C. ramosa* - Fe and *H. sucuuba* - Ca, Mg and Mn.

In general, Cu presented the lowest microelement concentration, a result possibly associated with the preparation of the decoctions, or other factor such as soil or water content. According to Szymczycha-Madeja *et al.* (2012) temperatures above 60℃ tend to reduce the transfer rate of Cu from the leaves, due to the insolubility of the phenolic complexes associated with copper.

The medicinal teas and the community

Mn is an essential element for humans playing an important role in formation of amino acids and activation of some enzymes and coenzymes. Mn deficiency is related to bone deformities, poor growth, impaired reproduction and blood clotting (Soetan *et al*., 2010). However, Mn excess can have adverse effects on the nervous and respiratory systems (Amarante, 2011), particularly in children and infants (Erikson *et al*., 2008). Four teas: *Mentha* sp. and *E. bulbosa*; *Mentha* sp, *E. oleracea* and *E. bulbosa*; *P. callosum* and *H. mutabilis* are indicated for abdominal pain, primarily for children and infants in the 0-6 months age group. However, three of them had Mn levels above the recommended daily intake for infants in a serving of 200 mL.

Compared to reference standards, single servings of the teas with the highest concentrations of the surveyed metals apparently possess relatively low capability to correct metal deficiency in adult metabolism. However, they could be an important supplementary source of these metals.

Jucá (*L. ferrea*) leaf tea (anti-inflammatory) had higher levels of all surveyed elements when compared with tea made from bark (anti-inflammatory), even with the smaller mass of leaves used in preparation. This result may indicate that the analyzed elements accumulate in the leaves, rather than the bark. A similar tendency was reported by Ugulu *et al*. (2016) in a study of the micronutrients in *Ficus carica* by ICP-OES. In this case, concentrations of Fe, Mg and Zn were also higher in tea leaf tea than in bark tea. Rocha *et al*. (2018) researching the mineral content in teas from leaves and bark of *Hymenaea martiana* Hayne, by ICP OES, similarly found that decoction of leaves produced higher levels of K, Mg, Mn and Na. Note that both *L. ferrea* leaves and bark reportedly have high phenolic content (Silva *et al*., 2011), mainly flavonoids. Such organic compounds are conceivably related to the observed anti-inflammatory property of Jucá tea (González-Gallego *et al*., 2014).

Coutoubea ramosa is used for skin care in Surinam (country bordering the north of Brazil) to treat pimples (Mans & Grant, 2017). The Community of this research uses Lombrigueira leaf tea (*C. ramosa*), which had the highest Fe content found per serving, as an anti-helminthic. Literature reports the importance of Fe for controlling intestinal hemorrhaging caused by intestinal parasites (Maspes & Tamigaki, 1979) and Fe deficiency is related to anemia, retarded growth in children, and other physical and mental health problems (Nasiri et al., 2009). There is little chemical study of *C. ramosa*, but literature points out the toxicity of the species to cattle, suggesting that its use as a therapeutic tea, could have risk for human health; therefore, additional studies are needed to support safe use of this plant in herbal medicine (Tokarnia & Döbereiner, 1981).

Reis *et al*. (2010) analyzed *Lipia alba* leaves by ICP OES, using a wet acid digestion method, for three macronutrients Ca, Mg and P, with Mg being the metal of highest content. In decoction of *L. alba* leaves, the present study found Mg to be in the lowest concentration among all the macronutrients analyzed, while Na was the highest. Excessive consumption of Na is a nutritional factor related to high blood pressure (Mente *et al*., 2014) but, comparing the quantity of this metal in *L. alba* tea with the maximum daily amount, it is noticed that 2 liters of the beverage contains only 1.54% of the maximum allowed daily dose for humans, therefore carrying no apparent risk of exceeding recommended Na intake.

The questionnaire responses indicated that consumption of *L. alba* leaf tea significantly increases urine flow, suggesting it has a diuretic property. Diuretics are the second most commonly prescribed class of antihypertensive medication (Roush & Sica, 2016). Drugs with this characteristic act in the kidneys, increase diuresis and promote the elimination of electrolytes such as sodium (Guyton & Hall, 2011).

Quebra Pedra, the tea which consists of a mixture of *P. niruri*, *A. vera* and *M. lindleyana* has been used traditionally to prevent kidney stones. Any real therapeutic effect might be due to the high water intake, implicit in the 2L per day prescription and relatively high concentrations of Ca and K. Increasing water intake is formally indicated (Pak *et al*., 1980) among therapeutic measures adopted to combat the growth of stone forming crystals.

Some authors consider that the mineral composition, volume and type of fluid ingested by patients can influence the reduction or growth kidney stones (Reis-Santos, 1987; Curhan *et al*., 1993). Controlling Ca, K and Mg appears to play an important role in the treatment of kidney stones. Quebra Pedra concentrations of macroelements occur in the following order: Ca>K>Mg>Na, with the values of Ca and K being amongst the highest analyzed. Many authors consider Ca to be a promoter of kidney stones formation, but Curhan *et al*. (1993) reported that males with high intake of calcium in the diet were 34% less likely to form crystals in the kidneys compared to patients with low calcium intake. They later confirmed this condition for women (Curhan *et al*., 1997).

According to Institute of Medicine in Washington studies, intake of K in the diet reduces the risk of renal stone formation (Institute of Medicine, 2004). Potassium citrate salt is a drug widely used in the treatment of this disease (Gomes *et al*., 2005) and Mg is well-known for inhibiting the nucleation and growth of calcium oxalate crystals (Carmen *et al*., 2005; Silva *et al*., 2010).

Clinical studies of *P. niruri* tea demonstrated a decrease in the formation of kidney stones in Wistar rats that drank tea, when compared to a control group (Melo *et al*., 1991). The authors concluded that the decrease might be due to diuresis, although the effect is possibly related to substances inhibiting crystallization.

The tea made from *F. chica* leaf (anti-anemia) had Fe in quantity unable to reduce Fe deficiency anemia. This result is similar to that reported by Magalhães *et al*. (2009) using FAAS. The authors found that the dried leaves of the species showed a high level of Fe (115.5 µg g^{-1}) but the extraction of this element by decoction was very low (4.5%), which led them to recommend additional studies to confirm the biological activity attributed to the plant, and evaluate the effects of other compounds known to be present, which might contribute to the treatment of anemia. In contrast, Martins *et al*. (2009) reported Fe content, by F AAS, in leaf tea of the species at 8 mg per 200 mL. This higher level of Fe might be related to the method of tea preparation, which used dry leaves in four times the mass used to prepare 200 mL of beverage for the present study.

Sucuuba tea (*H. sucuuba*) indicated for the treatment of joint pain and asthmatic bronchitis, had the highest levels of Ca and Mg analyzed in this study. High levels of Ca and Mg, 354 and 259 mg g^{-1} respectively, have also been seen in latex of the species analyzed by ICP-MS (Silva *et al*., 2003).

Hypomagnesemia is the electrolyte abnormality most frequently found in hospitalized patients with chronic diseases, including bronchitis (Saris *et al*., 2000), in addition to being associated with other disorders such as hypocalcemia. The Mg^{+2} ion is closely involved with muscle contraction processes, and insufficiency of this element, in the bodies of patients with chronic airflow problems, can lead to respiratory deterioration inducing decreased muscle strength (Cerci Neto *et al*., 2006; Thomas & Mathanraj, 2018). However, recovery of the magnesium electrolyte concentration in muscle cells can improve tissue strength (Fernandes & Bezerra, 2006).

Interviewed Community healers said that water intake is replaced by Sucuuba tea for a whole day, during bronchial crises. Ingestion of 2 liters of the beverage contains approximately 10% of the daily amount of Mg required for an adult, probably a significant supplement. Furthermore, this tea reportedly has anti-inflammatory potential (Soares *et al*., 2016), reinforcing the Community indication of its use for treatment of bronchial inflammation.

CONCLUSIONS

It was observed that the Community teas are only used intentionally for medicinal purposes. Nevertheless, these home remedies could be acting as mineral supplements in the Community staple diet.

In isolation, the ingestion of tea is probably insufficient to reduce deficiencies of the evaluated metals in the body, or act in the treatment of associated diseases. Yet, in addition to consideration of the metals, Community knowledge bearers, supported by evidence from the literature, suggest that there are active (organic) substances in some of the teas, or associated practices, such as increasing water intake, that might contribute to treatment of illnesses.

Homemade remedies given to treat diarrhea and abdominal pains are mostly aimed at children, including infants. For the 0-6 months age group, applying simple equivalence to health authority recommendations, safe amounts for daily consumption would be 166.7 mL of *Mentha* sp and *Eleutherine bulbosa* tea, 50 mL of *Mentha* sp, *Euterpe oleracea* and *Eleutherine bulbosa* tea, or 54.5 mL of *Piper callosum* and *Hyptis mutabilis* tea. Thus caution is recommended with respect to the quantities of tea given to infants, and further studies are necessary to evaluate the bioavailability and absorption of the metals present in these beverages, with regard to safe human consumption.

The consumption of medicinal teas from seven months of age is not likely to bring risk of intoxication by any of the studied elements, even when consumed daily in 2 L quantities.

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