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Biochemical and sensory characterization of an aphrodisiac drink based on *Ficus exasperata* Vahl (Moraceae) and *Cardiospermum grandiflorum* Sw (Sapindaceae), carried out in the region of Man (West of Côte d'Ivoire)

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Key words: *Ficus exasperata*, *Cardiospermum grandiflorum*, Biochemestry, Man, Côte d'Ivoire

Abstract

The present study on the formulation of an aphrodisiac herbal tea based on plants from the Man region (West of Côte d'Ivoire) was undertaken in order to contributing to the enhancement of local medicinal plants. For that, tests in tubes as well as chromatographic analyzes on thin layers were carried out for the detection of phytochemical compounds. Colorimetric tests of Folin-Ciocalteu and aluminum chloride allowed the determination of the respective contents of total polyphenols and flavonoids. As for the contents of alkaloids, mucilage, reducing sugars, lipids and protein, they were determined by gravimetric tests. The evaluation of the anti-radical power is determined by the power of the extracts to inhibit the DPPH (2,2-diphenyl-1-picrylhydrazyl) radical. The results showed the presence of certain phytocompounds at respective levels of F. exasperata and C. grandiflorum, 103.1 ± 5.1 mg/g and 93.4 ± 4.7 mg/g of vegetable powder for sugars total, 51.1±2.6 mg/g and 60.0±3.1 mg/g lipids, 20.4±0.78 and 17.07±0.40 mgEAG/g, 4.2±0 .15 and 3.7±0.08 mgEQ/g and 2.8±0.7 of alkaloid in F. exasperata. The respective IC50 of the DDPH for F. exasperata and C. grandiflorum are 64.60±3.23µg/mL and 87.45±4.37 µg/mL. The presence of compounds such as polyphenols, alkaloids and terpenes are compounds whose vasorelaxative power has been established and are therefore favorable to better blood circulation, which is the basis of erectile potential

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Introduction

Plants have always been used to treat and cure all kinds of illnesses. Advances in biotechnology, biochemistry and the search for new biologically active natural products are generating ever-increasing interest in natural resources (Baldé, 2018). Several factors are at the origin of this renewed interest such as the lower cost of these traditional medicines, the relative availability particularly in remote regions, distrust of synthetic products or quite simply the desire to consume "organic" ' (Bounihi, 2016).

It is in this context that the search for plants with aphrodisiac properties appears as an alternative solution to combat erectile dysfunction which affects more than 60% of men (Cardenas, 2014). Sexual abilities in men vary depending on age, physiological and psychological states. They reach their peak stage between the ages of twenty-five and thirty-five, and slowly decrease beyond this age range.

Seisen et *al.* (2012), believe that the decline in sexual activity has been considered as a natural evolution forming part of physiological aging and therefore an age-related inevitability. However, many pathologies can influence human sexual life and activity from time to time. This is the case of sexual impotence, defined as the repeated inability of a man to initiate and maintain an erection during sexual intercourse (Kaye, 2003 ; Jackson, 2004). It therefore represents a concern for nearly 30 to 50% of people aged between 40 and 70 years old. It is estimated that around 322 million men could be affected by sexual impotence in the year 2025 (Seftel, 2007). Many medications are used to treat sexual dysfunction, but their high cost is a limiting factor. Faced with all these situations, some people from time to time turn their attention to traditional medicine, which provides them with treatments at lower cost. These treatments are based on medicinal plants including *Cardiospermum grandiflorum* Sw (Sapindaceae) and *Ficus exasperata* Vahl (Moraceae) two plants presumed to be aphrodisiacs known respectively under the names poudeh and gniindeh in Yacouba country (Man region, Ivory Coast) used in local pharmacopoeia in the treatment of erectile dysfunction. Our objective is therefore to contribute to the valorization of these local medicinal plants. To achieve this, it was more specifically about:

Carry out the physicochemical study of plant extracts of *Ficus exasperata* and *Cardiospermum grandiflorum*; formulate a herbal tea based on these and evaluate the aphrodisiac effect of this herbal tea.

Apart from the introduction and the conclusion, this work includes three parts including, a general one which concerns a literature review on pathology and plants, followed by the description of the material and the methods used and finally the presentation of the results and their discussions.

Material and methods

Plants

The plant material consists of the leaves of *Ficus exasperata* and the aerial part consists of leaves and stems of *Cardiospermum grandiflorum* collected in « Kassiapleu » in the department of Man in the west of Côte d'Ivoire. The specimens were identified at the Herbarium of the National Floristic Center located at the Felix Houphouët-Boigny University of Abidjan in Côte d'Ivoire. All samples were collected during the dry season in January.

Chemical equipment

The chemical equipment is composed of solvent including distilled water produced within the Central and Analysis Laboratory of the University of Man, 70% ethyl alcohol, hexane, chloroform, toluene, methanol, ethyl acetate, dichloromethane, dichloromethane purchased from Carlo Erba in France. Petroleum ether at VWR Chemicals, reagents including 2,2-diphenyl-1-picrylhydrazyl (DPPH), Folin-Ciocalteu reagent, Fehling's liquor, sulfuric acid, copper sulfate, reagent Lieberman-Buchard, Dragendorff reagent, folin reagent, sodium hydroxide, hydrochloric acid, acetic hydroxide, sodium carbonate, ammonia, ammonia hydroxide, were purchased from Sigma- Aldrich, USA. All solutions were freshly prepared in distilled water.

Technical equipment

It is composed of a hot plate with magnetic stirring (Argo-Lab M2-A) for the preparation of extracts, a muffle furnace (Nabertherm GmbH) for the calcination of powder extracts, an X-ray fluorescence spectrometer (HORIBA MESA- 50) for the determination of minerals, an oven (Argo-Lab TCN 115) for drying and incubation of extracts, a spectrophotometer (ONDA) for reading absorbances, water bath (VWR) and a centrifuge

Treatment of plant material

After collecting the samples, they were cleaned and dried in the open air at the Central and Analysis Laboratory of the University of Man (LCA-U-Man), then crushed using an electric grinder and sifted to obtain powders which were stored in glass jars for later uses.

Preparation of extracts

The extraction method is that described by Mbaïhougadobé *et al.* (2017) with slight modifications. 50 g samples of *Ficus exasperata* and *Cardiospermum grandiflorum* pouder were added respectively to 500 mL of distilled water and 500 mL of a water/ethanol mixture in equal proportions hot in an Erlenmeyer flask and stirred at 700 rpm for 4 hours. The mixtures are then filtered using a funnel topped with cotton wool. The filtrates were dried in an oven at 40°C until dry extracts were obtained (Sonibare *et al.*, 2017). The extraction yield of the different plant species is given by the formula:

$$r = \frac{me}{ms} * 100$$

me: mass of the extract; ms: mass of the powder

r= yield

Physical parameters

Humidity level

A quantity of 10 g of dry matter powder was placed in a dry and clean container, placed in an oven at 105°C for 24 hours. It is removed from the oven and weighed after cooling. The humidity level is then evaluated by the expression:

$$Th = \frac{(P3 - P1)}{P2 - P1} * 100$$

With P1: weight of the empty container

P2: weight of all the vegetable powder and the container

P3: weight of the entire vegetable powder and container after steaming (Radha *et al.*, 2021).

Ash rate and the volatile dry matter rate

In a porcelain container, a quantity equal to the mass resulting from the steaming was placed in a branded muffle furnace at 550°C for 1 hour. weighed after cooling, the ash content is then evaluated by the expression:

$$Tc = \frac{(P3 - P1)}{P2 - P1} * 100$$

With Tc: ash rate

P1: weight of the empty container

P2: weight of all the vegetable powder and the container

P3: weight of all the vegetable powder and the container after calcination

The volatile dry matter rate being the complement of the ash rate is given by the expression:

$$Tv = 100 - Tc$$

With Tv: volatile dry matter rate (Radha *et al.*, 2021)

Mineralogical analysis

X-rays were used to irradiate the sample with sufficient energy to collide with the inner shell electrons of the sample atoms. Electrons from the outer layers then pass into vacant positions in the inner layer and characteristic X-rays are emitted. This is X-ray fluorescence (XRF). In X-ray analysis (XRF), the energies of the X-rays emitted by the sample are measured using a Si (Li) detector and are processed by a pulse height analyzer. nEXT system software works with Windows operating system. It defines the composition of the sample elements. The energy of the peak gives the identification of the element and the number of X-rays counted in the peak gives the amount of element present in the sample (Jyothsna *et al.*, 2020). The experimental part of the study was carried out using the X-ray inflorescence spectrometer (HORIBA MESA-50).

Phytochemical study

Sterols and Terpenes

The presence of terpenoids and steroids was determined by a method described by Ahmed *et al.* (2019) with slight modifications. To 2 mL of extract

were added 8 mL of ac*et*ic acid, then a few drops of concentrated sulfuric acid (H_2SO_4). The emergence of a pink or pinkish brown color/ring indicates the existence of terpenoids, while a blue or bluish green color for the presence of steroids and the combination of pink and blue/bluish green colors confirmed the presence of both terpenoids and steroids.

Glycosides

To 6 mL of extract are added 10 mL of chloroform. After stirring, the chloroform phase is separated and a 10% ammonia solution is added to it. The pink color indicates the presence of glycosides. (Abdelhamed *et al*., 2019).

Flavonoids

A few drops of a 1% NH3 solution are added to the aqueous extract of each plant sample in a test tube. A yellow color is observed if flavonoid compounds are present (Krishnaiah *et al*., 2009).

Coumarins

In à test tube which contains 1 g of crude extract, 10 mL of *et*hanol was added and then filtered. Then, 1,5 mL of 10% NaOH was added to the filtrate. The yellow color indicates the presence of coumarins (Zivic *et al*., 2019).

Anthraquinones

20 mL of toluene was added to 6 g of the organ powder sample in a conical flask and soaked for 10 min and then filtered. 10 mL of 10% ammonia solution was added to the filtrate and shaken vigorously for 30 seconds and a pink, purple or red color indicated the presence of anthraquinones in the ammonia phase (Rahman *et al*., 2017)

Phlobatannins

10 mL of aqueous extract of each plant sample is boiled with 1% hydrochloric acid HCl in a test tube in a water bath. The appearance of a red precipitate indicates the presence of phlobatannins in the sample (Abdul *et al*., 2013)

Reducing sugars

A quantity of 0.5 g of sample was introduced into 5 mL of distilled water. Then 1 mL of *et*hanol mixed with plant extract. 1 mL of Fehling A solution and 1 mL of Fehling B solution in a test tube were brought to a boil and then poured into the aqueous *et*hanol extract. Observation of a color reaction shows a positive result (Abdul *et al.,* 2013).

Saponosides

Introduce a volume of 2 mL of each extract into a test tube and adjust it to 5 mL with distilled water. Shake the tubes for 15 seconds lengthwise then leave for 20 minutes. The result is positive if the height of the moss is greater than 1 cm (Zivic *et al*., 2019).

Proteins

In a test tube, an aliquot quantity of crude extract is taken up in 2 mL of 20% (m/v) aqueous NaOH to which are added 2 to 3 drops of a 2% (m/v) aqueous solution of CuSO4. The appearance of a purple color, some*et*imes with a reddish tint, indicates a positive reaction (Ladiguina *et al*., 1983)

Alkaloids

1 g of plant powder is extracted in 20 mL of 70% *et*hanol, then filtered. A few drops of Dragendorff's reagent were added to a test tube containing the extract. The appearance of an orange-red or reddish-brown precipitate indicates a positive test (Békro *et al*., 2007)

CCM detection

The extract samples were deposited using fine capillary pip*et*tes on a chromatoplate (Merck TLC silica gel 60 F254). These plates were then placed in a chromatographic tank containing an eluent system. After elution, they were removed and the solvent front was marked. After drying, the phytocompounds were revealed at UV 365 nm and using specific developers: the Liebermann-Buchard reagent for the d*et*ection of sterols and terpenes, the Neu reagent for the d*et*ection of flavonoids, the Dragendorff for the d*et*ection of alkaloids, Folin's reagent for the d*et*ection of polyphenols (Lagnika, 2005). Chromatograms were marked and r*et*ention factors were calculated and recorded. The resulting chromatograms were photographed. Toluene/chloroform/*et*hanol (5:5:2, v/v/v) produces the best spot separation.

Folin-Ciocalteu reagent

After spraying the plate, then heating at 100°C for 10 min, the blue spots observed in the visible area attest to the presence of polyphenols (Lagnika, 2005)

Liebermann-Buchard reagent

After spraying, the plate is heated to 100°C for around ten minutes. Depending on the type of compound tested, spots of various colors are observed at UV 366 nm: red (oleanane and ursanne type triterpenes); orange-yellow (lupane-type triterpenes); yellow and yellow green (steroids) (Lagnika, 2005)

Neu's reagent

After spraying and drying the reaction is positive when fluorescence of different colors is observed at 366 nm. The flavonoids are revealed in the form of yellow and brown spots immediately or after 15 min in the visible. Under UV at 366 nm, we note the appearance of intense orange, red, yellow, blue and green fluorescence characteristic of flavonoids (Lagnika, 2005)

Dragendorff's reagent

After spraying, all the orange or red colors observed in the visible correspond to alkaloids (Benkiki, 2006).

Total polyphenols (Colorimetric method)

Total phenolic content was determined using the Folin-Ciocalteu (FC) reagent method with slight modifications. The polyphenol concentration of the plant sample was determined using a gallic acid calibration curve taken as a standard. Aqueous solutions (0.5mL) of standard gallic acid at concentrations of 12.5, 25, 50µg/mL were added into 2.5mL of 10% FC reagent and 2.5mL of solution of Na2CO3 (5%) and kept in an oven at a temperature of 40°C for 40 min. The absorbance was measured at 750 nm using a UV-visible spectrophotometer. Samples were prepared in triplicate for each analysis and average values were taken. The same procedure was followed for a single concentration of plant sample (1mg/mL). The total content of phenolic compounds was determined as mg gallic acid equivalent g dry tissue extract (mgEAG/g plant powder) using the formula: TPC= (X x V)/m; where TPC is the total phenolic composition content, X is the gallic acid concentration in mg/mL; V is the volume of extract used in mL and m is the mass of the tissue extract in grams (Rashid *et al*., 2019).

Flavonoids (Colorimetric method)

The aluminum chloride colorimetric method was used for the determination of the total flavonoid content of the samples. For the determination of total flavonoids, quercetin was used to plot the standard calibration curve. The quercetin stock solution was prepared by dissolving 1 mg of quercetin in 10 mL of distilled water, and then the quercetin standard solutions were prepared by serial dilutions using the distilled water (12,5; 25; 50 100 µg/mL). A quantity of 1 mL of solutions or extracts of Diluted standard quercetin was mixed separately with 2 mL of 2% aluminum chloride. After mixing, the solution was incubated for 90 minutes in an oven at a temperature of 35°C. The absorbance of the reaction mixtures is measured against the blank at a wavelength of 434 nm with a UV-Vis Spectrophotometer (VWR). The concentration of total flavonoid content in the test samples was calculated from the calibration plot (y= 0,0199x, R^2 = 0,9975) and expressed as mg quercetin equivalent (mgEQ/g powder of dried plant material. All assays were carried out in triplicate (Suman *et al*., 2014).

Total sugars (Gravimetric method)

Total carbohydrates were quantified by the method of Munson and Walker (1940). This consists of hydrolyzing the sample containing the sugars with a 0,2 N HCl solution. Once the hydrolysis is complete, it is neutralized with a NaOH solution. Then, a quantity of Fehling reagent equivalent to the volume of extract is transferred into the reaction mixture. The mass of the Cu2O precipitate makes it possible to determine the total sugar content (Appendix III).

Total lipids were extracted from samples homogenized in chloroform-methanol-water (1:2:1, v/v/v) as described by Folch, Lees and Sloane Stanley (1957) and determined gravimetrically.

Alkaloidos (Gravimetric method)

In an Erlenmeyer flask containing 2,5 g of plant extract, were stirred with a mixture of 100ml of 10% acetic acid in ethanol, covered and left to stand for 4 hours. After filtration, the extracts were concentrated in a water bath to the original volume. Concentrated ammonium hydroxyl was added dropwise to the extract until precipitation appeared, washed with diluted ammonium hydroxyl and then filtered through filter paper. The residue obtained after drying in an oven is the alkaloid (Niangaly, 2020)

Formulation of herbal tea based on F. exasperata and C. grandiflorum

Extraction method

100g of sample from each plant were homogenized in 1 L of water then brought to the boil for 30 min. the herbal tea was obtained by filtration on a traditional filter. The formulation of the herbal tea was carried out by mixing equivalent volumes (v/v) of the two filtrates obtained at the end of the extraction of the different herbal teas. These filtrates were subjected to sensory analysis.

Sensory analysis of the formulated herbal tea

The analyzes were carried out on the basis of the criteria of availability of the tasters, motivation, sensitivity, ability to understand the rating scales and their ability to work in a team.

Firstly, these 10 tasters were trained in sensory analysis techniques in general, that is to say with pure products, and secondly more specifically in the tasting of the different herbal teas to be analyzed. The study methodology was based on research and quantification of the intensity of appropriate sensory descriptors applied to "herbal teas". The idea was to assign a score to each of the products tested, based on the intensity of the descriptors measured (color, fluidity, taste, erection and general appreciation). A graduated scale from 1 to 10 made it possible to quantify the different descriptors with 1 corresponding to a very low intensity and 10 to a very high intensity.

Statistical analyzes

For each of the products, 3 test trials were carried out. The sensory profile was produced using Excel 2016 software. The other results were statistically analyzed by the variance method (ANOVA) using STATISTICA software (Stat., Soft, Inc., 1995). The comparison of the means of three tests is carried out using the LSD (Least Significant Difference) test. This method of analysis consists of looking for means that are significantly different from each other at $p<0,05$.

Results

Physico-chemical study of plant extracts of Ficus exasperata and Cardiospermum grandiflorum

Extraction rate

Aqueous extraction (infusion) of *F. exasperata* produced a better result than hydroalcoholic extraction (infusion) of *C. grandiflorum*. The extraction rate of *F. exasperata* is 10.4±.19% compared to 8.8±2.5% for *C. grandiflorum* (Table 1).

Table 1. Extraction rate of plant species studied

Espèce végétale	Taux d'extraction(%)
F. exasperata	10,4±1,9
C. grandiflorum	8,8±2,5

Physico-chemical parameters

Analysis of the physical parameters of the plant samples shows that the leaves of *F. exasperata* have an ash content twice as high (16,0±0,8%) as the aerial part of *C. grandiflorum* (8,0± 0,5%). The humidity level displays an identical value for both plants (12,0±0,6%± (Fig. 1).

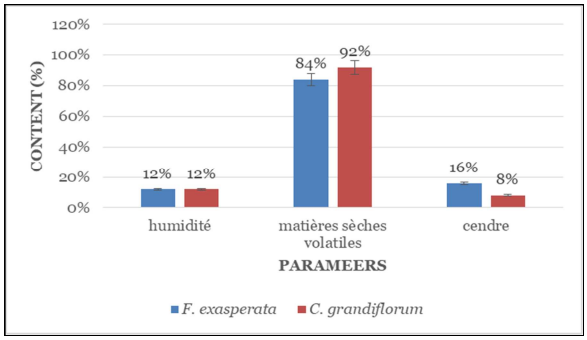
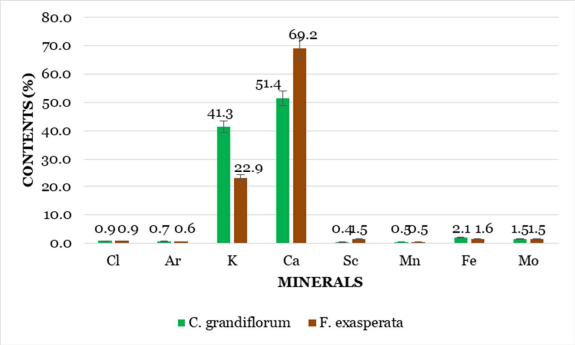


Fig. 1. Physical parameters of *F. exasperata* and *C. grandiflorum*

Mineralogical composition

Mineralogical composition of the plants studied is dominated by Calcium and potassium, with respective contents of 69,2% and 22,9% for F. exasperata compared to 51,4% and 41,3% for *C. grandiflorum*.

Other minerals such as chlorine, iron, molybdenum, manganese were also detected at low levels of 2,1% to 0,4%. (Fig. 2).



Cl: Chlorine; Ar: Argon; K: Potassium; Ca: Calcium; Sc: Scandium; Mn: Manganese; Fe: Iron; Mo: Molybdenum

Fig. 2. Mineralogical composition of *C. grandiflorum* and *F. exasperata*

Phytochemical study

Screening of nutritional compound

The primary phytochemical screening of the different plant samples shows the presence of nutritional compounds in them, including reducing sugars and lipids. As for proteins, they were not detected in either of the two plants studied (*Ficus exasperata or Cardiospermum grandiflorum*) (Table 2).

Table 2. Detection of the nutritional composition of *C. grandiflorum* and F. *exasperata*

Plants	Compounds		
	Reducing sugars	Lipids	Proteins
C. grandiflorum	+	+	-
F. exasperata	+	+	-

Table 3. Composition of secondary metabolites of *C. grandiflorum* and *F. exasperata*

Compounds	Plants	
	F. exasperata	*C. grandiflorum*
Stéroïds	+	+
Terpenoïds	+	+
Coumarin	+	+
Flavonoids	+	+
Alcaloïds	+	-
Glycosids	-	-
Anthraquinons	-	-
Phlobatanins	-	-
Saponins	-	+

+ : presence - : absence

Table 4. Revelation of secondary metabolites by TLC

Révélateurs	Plantes	Frontal repor (rf)				Coloring	Identification
		rf1	rf2	rf3	rf4		
Folin	*F. exasperata*	0	0,64	0,73	1	Blue	Polyphénols
	C. grandiflorum	0,6	0,71	1			
Neu	*F. exasperata*	0,11				Yellow	Flavonoïd
	C. grandiflorum	0,06					
	F. exasperata	0,2				Green	
	C. grandiflorum	0,15					
	F. exasperata	0,48	0,98			Red	
	C. grandiflorum	0,45	0,76	0,98			
Dragendorff	*F. exasperata*	0				Orange	Alcaloïds
	C. grandiflorum						
Lieberman-Buchard	*F. exasperata*	0,63	0,98			Red	orting oleananne type terpenes
	C.grandiflorum	0,44	0,53	0,61	0,98		

Screening for secondary metabolites

Phytochemical screening revealed the presence of steroids, terpenoids, coumarins, flavonoids in each of the plants. Saponins and alkaloids were detected respectively in *C. grandiflorum* and *F. exasperata*, while glycosides, anthraquinones and phlobatannins were absent in the two plants studied (Table 3).

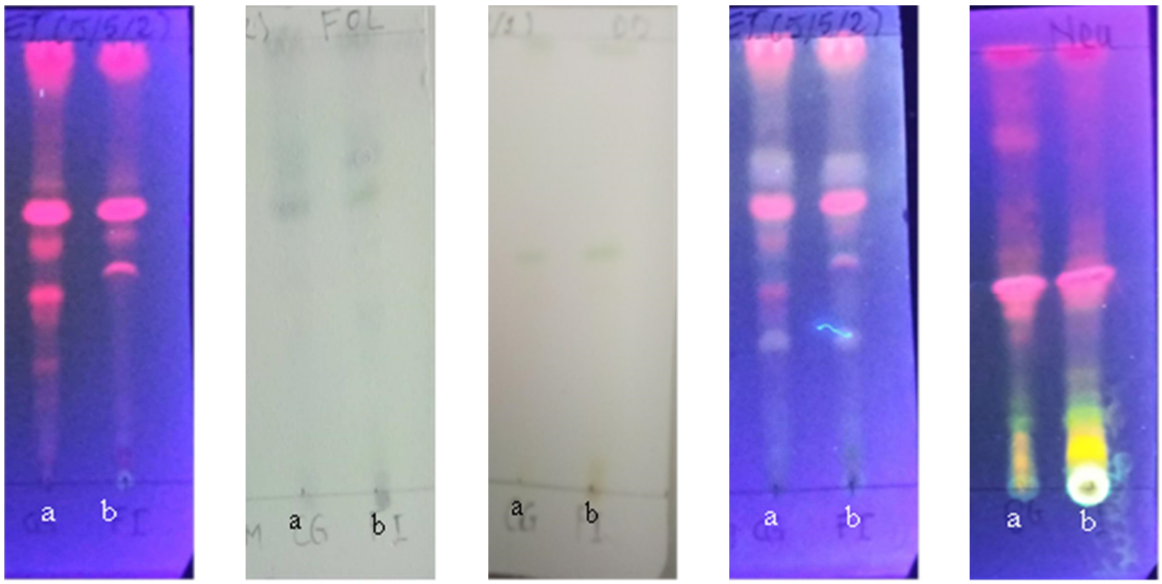
Phytochemical Screening by TLC

Phytochemical screening by TLC allowed the detection of phytochemical compounds such as polyphenols, flavonoids, alkaloids and terpenes.

The analysis results of the chromatograms (Fig. 3) are summarized in Table 4. The chromatographic profile on the left is that of *C. grandiflorum* and that on the right is for *F. exasperata*.

Nutritional compound

The contents of nutritional compounds expressed in mg/g of vegetable powder of *F. exasperata* and *C. grandiflorum* are respectively 103,1±5,15 mg/g and 93,4±4,67 mg/g for total sugars mg/g, 51,1±2,5 mg/g and 60,0±3,0mg/g of lipids, as shown in Fig. 4.



UV 365 | Folin (10%) | Dragendorff | Lieberman-Buchard | Neu

a: *C. grandiflorum*, b: *F. exasperata*

Fig. 3. Chromatograms of *F. exasperata* and *C. grandiflorum* extracts

Secondary metabolites

The quantification of metabolites reveals that the total polyphenol contents of *F. exasperata* leaves and the aerial part (leaves + stem) of *C. grandiflorum* are respectively (20,4 ±0,78 and 17,07±0 ;40) mg EAG/g of dry matter powder obtained from the gallic acid calibration curve (y = 0,0099x with R^2 = 0,999. These contents are much higher than those of the flavonoids obtained from the gallic acid calibration curve quercetin calibration (y = 0,0199x with R^2 = 0,9975 and whose respective values are only (4,19 ± 0,15 and 3,71 ± 0,08) mg EQT/g of dry matter powder As for the content of alkaloids in the leaves of *F. exasperata*, it is 2,8±0,7 as shown in Table 5.

Table 5. Dosage of secondary metabolites

Plantes	Totals Polyphénols (mg EAG/g)	Flavonoïd (mg EQT/g)	Alcaloïd (mg/g)
F. exasperata	20,4 ±0,78	4,19 ± 0,15	2.8±0.7
C. grandiflorum	17,07±0,40	3,71±0,08	-

Evaluation of the aphrodisiac effect of the formulated herbal tea

Fig. 5 presents the sensory profile of the aphrodisiac herbal tea based on *F. exasperata* and *C. grandiflorum*. Overall, the herbal tea is very popular with an average of -6,5/10.

Medium intensity brown in color, it has a slightly bitter taste and medium fluidity. Its erectile power is estimated at 4,5/10

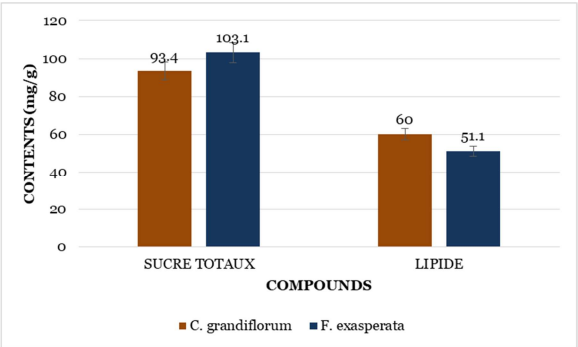


Fig. 4. Nutritional compound contents of *F. exasperata* and *C. gandiflorum*

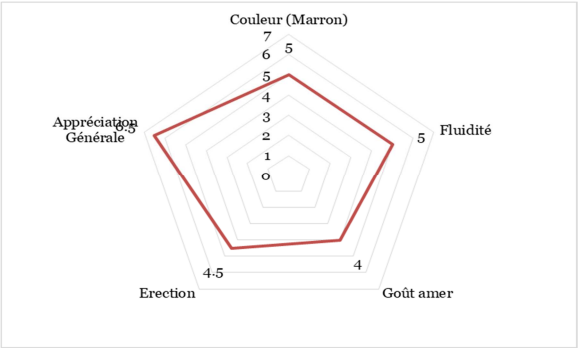


Fig. 5. Sensory profile of aphrodisiac herbal tea

Discussion

The extraction rate of *F. exasperata* (10,4±1,9%) is higher than that of C. grandiflorum (8,8±2.5%). Indeed, the latter is approximately half of that

reported by Houngnimassoun *et al.* (2017) of around 16,35% on the in vitro strongylicidal effects of the aqueous extract of *F. exasperata* leaves. This difference can be explained by the difficulty in filtering the *C. grandiflorum* extract due to its viscosity. Furthermore, that of *F. exasperata* confirms the results reported by Amonkan *et al.* (2010) of 14,27 ± 3,26% on the aqueous extract of this same plant.

The ash rate, which is the measure of inorganic matter in the samples, is twice as high in the leaves of *F. exasperata* (16,0±0.8%) as in *C. grandiflorum* (8,0±0, 5%). These values show that *F. exasperata* leaves are good sources of minerals in occurrence of potassium (69,2%) and calcium (22,9%) but relatively poor in iron (1,6%) and manganese (0,5%) necessary for the well-being of the body. This value is approximate to 12,19 ± 0,1% reported by Muiba *et* al. (2014) in Nigeria highlighting high levels of potassium (3,36 ± 0,04 g/100g of powder), calcium (1,13 ± 0,02 g/100g) and low iron content (122,95 ± 3,31 mg/Kg) and manganese (220 ,31 ± 13,07 mg/Kg). However, some of these minerals are subject to divergent results such as the presence of Molybdenum, Argon, chlorine. These discrepancies may be linked to the nature of the soil.

Lipid contents are relatively low in the leaves of *F. exasperata* and *C. grandiflorum*. They have respective values of 51,1±2,5 and 6,0±3,0 mg/g, but have rather high contents of total sugars, 103,1±5,15 mg/g and 93,4± 4,67 mg/g. These results are consistent with those of the work of Muiba *et al.* (2014) who reported contents of around 42 mg/g of lipids, 69,1 mg/g and 728,1 mg/g total sugars in aqueous extracts of *Ficus exasperata* leaves. The poor source of lipids in these leaves is typical of most leafy vege*t*ables. This is an advantage because, consumed in many medicinal preparations; they would not increase fat consumption, excessive fat consumption being implicated in cardiovascular disorders such as atherosclerosis and cancer (Sonibare *et al*., 2006). Many authors, including Muiba *et al.* (2014), Sonibare *et al.* (2017) reported the presence of proteins in aqueous extracts of *F. exasperata* and the presence of which was not d*et*ected in any of our plants studied. This absence could be explained by the nature of the soil or by the experimental protocol. These being common factors in our plant samples. The high level of carbohydrates could be a source of energy necessary for the proper functioning of the body.

Also, the phytochemical screening revealing the presence of alkaloids, flavonoids, coumarin, steroids and terpenoids confirms the phytochemical study carried out by Amonkan *et al.* (2010) on the evaluation of the effect of the aqueous extract of *F. exasperata* on blood pressure and contractile activity of the heart in mammals. These authors highlighted the presence of these chemical compound except coumarins, steroids and terpenoids which were not tested during their work. In addition, the phytochemical screening carried out on the m*et*hanolic extract of *Turraea heterophylla* (*Et*h) commonly called Gouro tooth cure by Boua *et al.* (2013) made it possible to identify sterols, terpenes, alkaloids, coumarins, reducing sugars, polyphenols, steroid saponosides and proteins. To this plant commonly used by healers to treat erectile disorders in Ivory Coast, the authors linked vasorelaxation to penile erection through an experimental approach which consisted of studying its effects on the contractile activity of the artery, isolated guinea pig aorta. The results showed that the m*et*hanolic extract of Turraea h*et*erophylla induced vasorelaxation favorable to b*et*ter blood circulation, which is the basis of the erectile potential which would be linked to the action of certain suspected secondary m*et*abolites such as terpenes and alkaloids d*et*ected in Turraea h*et*erophylla. The presence of these compounds in our plants could explain their uses for the treatment of erectile dysfunction.

The contents of total polyphenols, flavonoids of *F. exasperata* are higher than those of *C. grandiflorum* in our study and an alkaloid content higher than (48,8 mg/100g of powder) reported by Muiba *et al.* (2014). High levels of polyphenols would contribute significantly to the prevention and risk of diseases such as cancer and heart disease reported by Rodrigo *et al.* (2011).

At the same time, they can help modify the rheological properties of soils by acting as binding agents in soil aggregates. Its oil r*et*ention capacity could allow its use combined with other products to capture oil and many fatty substances in water when they are found there. In addition, the good oil r*et*ention capacity could improve the texture of certain food products (Mariel *et al.,* 2017).

The results of the antioxidant activity showed a higher activity of the aqueous extract of the leaves of *F. exasperata* than that of the hydro-*et*hanolic extract of the aerial part of *C. grandiflorum* recording the highest IC_{50} (87,45± 4,37µg/mL). The high IC_{50} corroborates the results of the work of Konan *et al.* (2021) on the essential oil of the same plant with an IC_{50}, 48 times higher than that of ascorbic acid.

Conclusion

The phytochemical study carried out on the leaves of *Ficus exasperata* and the aerial part (leaves + stem) of *Cardiospermum grandiflorum*, showed significant levels of potassium and calcium. The phytochemical screening revealed the presence of reducing sugars, lipids, steroids, terpenoids, coumarin and flavonoid in each of the plants while alkaloids were only revealed in *F. exasperata* like saponins. Glycosides, anthraquinones, phlobatannins, and proteins tested negative in each plant sample. The contents of polyphenols, flavonoids and sugars are higher in *F. exasperata* than in *C. grandiflorum*. The contents of alkaloids (2,8 ± 0,7 mg/g) and mucilage (40 ± 2 mg/g) were measured in *F. exasperata* and *C. grandiflorum*, respectively. The anti-radical activity of the aqueous extract of *F. exasperata* was found to be greater than that of the hydro*et*hanolic extract of *C. grandiflorum* with respective IC_{50} of 64,60±3,2 µg/mL compared to approximately 87,45 ± 4,37µg/mL. The suspected aphrodisiac power of the extracts has been attributed to the polyphenols, alkaloids and terpenoids d*et*ected in these plants. These results could allow the valorization of these plants in the region. Thus, they would constitute an income alternative and make it possible to resolve a social problem represented by the breakdown of the family unit.

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