**Comparative study of phenolic compound content and assessment of antioxidant activity of *Uvaria chamae* and *Jatropha curcas* extracts used in the management of sickle cell disease in Benin.**

**Abstract**

Despite therapeutic advances in the management of sickle cell disease, the high cost of conventional treatments and limited access to specialized care push many populations, especially those with low incomes, to turn to traditional medicine. The objective of this study is to measure the phenolic compounds present in the extracts of the plant species under study and then to evaluate their antioxidant power. The major chemical groups were evaluated by phytochemical sorting. The dosage of phenolic compounds and the evaluation of the antiradical power were determined respectively by the Folin-Ciocalteu method, the DPPH method and FRAP. The results of our work show the presence and relative abundance of the different chemical groups in the plant species. These are mainly tannins, flavonoids, alkaloids, anthocyanins, coumarins, steroids, triterpenes, leuco anthocyanins and saponins. Cardiac glycosides and anthraquinones are absent in *Jatropha curcas* leaves, but present in *Uvaria chamae* roots. Mucilages, present in *Jatropha curcas* leaves, but absent in *Uvaria chamae* roots. Phenolic compounds assay reveals that *Jatropha curcas* leaves are richer in total polyphenols (73.95 mg EAG/100 mg) than *Uvaria chamae* roots (41.78 mg EAG/100 mg). In contrast, *Uvaria chamae* has a higher content of total flavonoids (25.41 mg EQ/100 mg) and condensed tannins (72.44 mg EC/100 mg) than *Jatropha curcas* (19.47 mg EQ/100 mg and 54.23 mg EC/100 mg, respectively). Regarding antioxidant activity, *Uvaria chamae* has the lowest IC₅₀ (3.28 mg/ml), indicating a better antiradical capacity of its root extracts. These results confirm that *Uvaria chamae* and *Jatropha curcas* have a diversity of secondary metabolites explaining their biological activities and would play a major role in the management of sickle cell disease by neutralization of free radicals.

**Key words**: *Uvaria chamae*, *Jatropha curcas*, sickle cell disease, phenolic compounds, antioxidant activity, traditional medicine.

**Introduction**

Sickle cell disease, also called sickle cell anemia, is a genetic hemoglobin disease transmitted in an autosomal recessive manner (Mattioni *et al*., 2016). A real public health problem, it is the most common genetic disease in the world with approximately 300,000 births per year, two-thirds of which occur in Africa (Hsu *et al*., 2018). In Benin, the estimated prevalence of sickle cell disease (hemoglobin S) is 22.3% and that of hemoglobin C is 10.21% with approximately 4% of the Beninese population affected by homozygosity of hemoglobin SS and double heterozygosity of hemoglobin SC (Zohoun *et al*., 2020). It is the result of a point mutation occurring on the β-globin gene that causes the production of an abnormal hemoglobin (Hb), hemoglobin S (HbS) (Connes, 2020). In deoxygenated conditions, HbS polymerizes, which leads to the sickling of red blood cells. The latter become rigid, sticky, take the shape of a crescent or sickle and have difficulty circulating in the blood. Blockages can occur anywhere in the body, leading to various health problems that vary from one person to another (hemolytic anemia, vaso-occlusive crisis). Indeed, the pain of vaso-occlusive crises is usually repeated, sometimes severe, unbearable, long-lasting and makes sickle cell disease a very disabling condition. Hematopoietic stem cell transplantation is the only curative therapeutic approach while gene therapy is in full development with the new Crisper Cas9 technology (Kangah, 2022). However, these highly specialized therapies require appropriate infrastructure, qualified personnel with high financial resources. Vaso-occlusive crises require frequent hospitalizations, leading to increased household health expenses, restriction of parents' professional activities and a financial loss for families (Mbassi *et al*., 2017).

Despite therapeutic advances, the high cost of conventional treatments and limited access to specialized care push many populations, especially low-income ones, to turn to traditional medicine for the management of sickle cell disease. Today, according to the World Health Organization (WHO), nearly 80% of the population uses traditional medicine for primary health care (Mignanwandé *et al*., 2020). Medicinal plants are full of new pharmacologically active compounds that constitute a potential source of natural antioxidants (Atanasov *et al*., 2015). Among the medicinal plants used in Benin, *Uvaria chamae* (Annonaceae) and *Jatropha curcas* (Euphorbiaceae) occupy a notable place. *Uvaria chamae* is frequently used in the traditional management of gastroenteritis, typhoid fever, wounds (Koudokpon *et al*., 2018); (Legba *et al*., 2020). For its part, *Jatropha curcas* L., a plant belonging to the Euphorbiaceae family, is commonly used for its anti-inflammatory, antifungal and antiviral properties. Its leaves and seeds are used to treat skin infections, wounds and gastrointestinal conditions (Osman *et al*., 2017). However, the specific efficacy of these plants against sickle cell disease has not been sufficiently studied. The plants under study could influence oxidative stress, hemolysis, anemia and sickling of red blood cells, which are biological markers associated with the pathophysiology of sickle cell disease. This raises the problem of phytochemical composition and phenolic compound content, which depend on the biological activities of these plants. The objective of this study is to measure the phenolic compounds present in the extracts of *Uvaria chamae* roots and *Jatropha curcas* leaves and then to evaluate their antioxidant power.

**2. Materials and methods**

**2.1. Chemicals**

The chemicals and reagents used in this work, such as 2,2-diphenyl-1-picrylhydrazyl (DPPH), Folin-Ciocalteu reagent, ascorbic acid, potassium hexacyanoferrate, trichloroacetic acid, gallic acid, ascorbic acid, quercetin, sodium carbonate (Na2CO3), dimethyl sulfoxide (DMSO), aluminum chloride (AlCl3), methanol solvent, acetonitrile, and acetic acid, were purchased from Sigma-Aldrich.

**2.2. Plant materials**

The plant material consisted of fresh leafy stems of *Jatropha curcas*, harvested in Adjagbo in the commune of Abomey-Calavi and fresh roots of *Uvaria chamae* harvested in Sèmè Kpodji, identified at the National Herbarium of Benin (HNB) (Table I). These different plant species were washed, cut and dried at a temperature in the laboratory under air conditioning (20°C ± 2) for two weeks then pulverized using an electric grinder (MARLEX Electronique Excella). The powders obtained are stored in plant packaging bags (Double PM kraft bag) before extraction.

**a**

**b**

**Figure 1 :** Plate showing the different species of plants studied: Leafy stem of *Jatropha curcas* (a), Cut roots of *Uvaria chamae* (b) ;

**Table I** provides information on the scientific names of our different plants, their identification number in the national herbarium, as well as their vernacular names.

**2.3. Preparation of the hydroethanolic extract**

The extract was prepared according to the method previously described by (Kpètèhoto *et al*., 2019). The powder of the plant material (200 g) was extracted by maceration under stirring for 48 h at room temperature (20 ° C ± 2) with 2000 ml of the ethanol-water mixture (50 : 50) using a mechanical stirrer (IKA KS 260 basic). The extraction was done twice on the same starting plant material. The macerates obtained were filtered with cotton then on Whatman paper (No. 1001-150 Grade 1,150 mm Ø, Lot of 100). The filtrates obtained were dried under reduced pressure using a rotary evaporator (BUCHI Rotavapor R-100). The extracts obtained were stored at 4 ° C for phytochemical and biological analyses.

**2.4. Yield**

The yield of the extract was calculated according to the formula below:

Yield (R) = ME/MV\*100 with

ME: Mass of extract;

MV: Mass of plant material

**2.5. Phytochemical screening**

Phytochemical analysis based on differential reactions (coloration and precipitation) of the main groups of chemical compounds contained in the hydroethanolic extracts was carried out according to the method of the method of (Houghton & Raman, 2012) reviewed and adapted to the conditions of the Laboratory of Biochemistry and Natural Bioactive Substances (LBSNB), Faculty of Science and Technology. The characterization tests are based partly on qualitative analysis, either on the formation of insoluble complexes using precipitation reactions, or on the formation of colored complexes, using coloring reactions.

**2.6. Phenolic compounds determination**

**2.6.1. Total polyphenols**

The polyphenol contents of the different hydroethanolic extracts were estimated according to the Folin-Ciocalteu method (Li *et al*., 2007) with a slight modification (Agidew *et al*., 2021). It is based on the reduction in alkaline media of phosphotungsten (WO42-) and phosphomolybdenum (MO42-) of the Folin reagent by the oxidizable groups of the phenolic compounds. Each extract tested was prepared at 1 mg/ml with the methanol solvent. 200 μl diluted sample was added to 1 ml of Folin-Ciocalteu reagent diluted 1/10. After 4 minutes, 800 μl of saturated sodium carbonate (75 g/l) was added. After 2 hours of incubation at room temperature, the absorbance was measured at 765 nm. The standard calibration curve was plotted using gallic acid (y = 0.043 x − 0.051; R2 = 0.994). The average of three readings was used and the results expressed as mg gallic acid equivalent (GAE)/100 mg extract (Sharmin *et al*., 2018); (Li *et al*., 2007).

**2.6.2. Total flavonoids**

Total flavonoids were quantified by the spectrophotometric method with aluminum trichloride (AlCl3) (Shraim *et al*., 2021). It allows the evaluation of all the compounds reacting with aluminum trichloride (AlCl3) by the formation of a very stable complex, between aluminum chloride and the oxygen atoms present on carbons 4 and 5 of the flavonoids. The sample was prepared by dissolving the extract in methanol (1 mg ml−1). Then, 1 ml of sample was added to 1 ml of the AlCl3 solution (2% in methanol). After 10 minutes of reaction, the absorbance was read at 430 nm against a blank consisting of a mixture of 1 ml of the extract solution and 1 ml of methanol without AlCl3. Quercetin was used as a reference compound to produce the standard curve (y = 0.325x − 0.363; R2 = 0.995). The experiment was performed in triplicate and the results were expressed as mg quercetin equivalent (mg QE)/100 mg of the extract.

**2.6.3. Condensed tannins**

The condensed tannin contents were determined by the method using sulfuric vanillin with catechin as a reference molecule reviewed and adapted to laboratory conditions (Galgano *et al*., 2021). This method is based on the ability of vanillin to react with tannic units in the presence of acid. This method is based on the ability of vanillin to react with tannic units in the presence of acid. The stock solution of each extract was prepared at a concentration of 1 mg ml−1 in methanol. Then, 400 ml of this stock solution was taken, then added to 3 ml of vanillin (4%) and 1,500 ml of hydrochloric acid (HCl). A mixture of methanol and acid was used as a blank. The sample mixture is kept at 30 °C for 20 minutes in a dark room. The absorbance is read at 500 nm. Results were expressed as milligram equivalent of catechin/100 milligram of dry plant material (mg EC/100 mg) using a standard curve (y = 0.0067x – 0.058; R2 = 0.980).

**2.7. Antioxidant potential**

**2.7.1. DPPH free radical scavenging test**

The antioxidant activity of each hydroethanolic extract was evaluated by the method described previously (Dadan *et al*., 2018). The principle of this method is based on the ability of the extracts to trap the DPPH (2,2-diphenyl-1-picrylhydrazyl) radical. The stock solution of the extract was prepared at 1 mg/ml. Then, a serial dilution of 50% was carried out to obtain eight concentration ranges (1000 to 7.8 μmg/ml). Then, 1.5 ml of a freshly prepared methanolic solution of DPPH (2%) was mixed with 0.75 ml of the extract solution. After 15 minutes of incubation in the dark, at room temperature, the absorbance of the mixture was read at 517 nm using a spectrophotometer (UV-1600 PC). Blank composed of a mixture of 1.5 ml of methanol and 0.75 ml of extract solution. The positive control used was quercetin. All analyses were carried out in triplets. The percentage of inhibition of the DPPH radical was calculated according to the following formula :

IPDPPH (%) =$\frac{Abs cont-Abs ech}{Abs cont }$× 100 where

PI = percentage of inhibition; Abs = absorbance; cont = blank; Ech = sample.

**2.7.2. Ferric iron reducing power (FRAP)**

The evaluation of the antiradical power by the FRAP method was carried out as the work described previously (Saeed *et al*., 2012); (Amoussa *et al*., 2015). The principle of this method was based on the ability of the extract to reduce the ferric ion (Fe3+) present in the potassium ferricyanide complex [K3Fe(CN) 6] to ferrous ion (Fe2+) by an antioxidant. The reaction resulted in the change from the yellow color of the ferric cast iron (Fe3+) to the blue-green color of the ferrous cast iron (Fe2+). The intensity of this color was measured spectrophotometrically at 700 nm. Briefly, a volume of 2 mL of sample (100 μg/mL) was mixed with 2 mL of phosphate buffer (0.2 M, pH 6.6) and 2 mL of aqueous solution (1%) of potassium hexacyanoferrate [K3Fe (CN)6]. The mixture was incubated at 50 °C for 20 min, followed by the addition of 2 mL of trichloroacetic acid (10%). Then, the mixture was centrifuged at 3000 rpm for 10 min to collect the upper layer of the solution. A volume of 2 mL of supernatant was then mixed with the same volume of distilled water and 0.4 mL of freshly prepared aqueous solution of FeCl3 (0.1%) was added. After 10 min of reaction, the absorbance was read at 700 nm. The reducing power is deduced from the calibration curve established with ascorbic acid. The reducing power is expressed in ascorbic acid equivalent (AAE).

**2.8. Statistical analyses**

Data were presented as mean ± standard deviation. Graphical representation of data was performed using Graph Pad Prism 5.0 software (Microsoft, USA). The difference was considered statistically significant when the p ˂ 0.05.

**3. Results and discussions**

**3.1. Extraction yield**

**Table II**: Extraction yield of the plants studied

The analysis of the table informs us that *Jatropha curcas* has a higher yield (11.65%) than *Uvaria chamae* (9.15%).

**3.1. Phytochemical screening**

Phytochemical screening allows to identify the groups or families of secondary metabolites present in the tested plant species (Table III).

**Table III** highlights the different major groups of metabolites detected in *Jatropha curcas* powder and *Uvaria chamae* powder. These are mainly tannins, flavonoids, alkaloids, anthocyanins, coumarins, steroids, triterpenes, anthocyanins, leuco anthocyanins and saponins. Cardiac glycosides and anthraquinones are absent from Jatrophacurcas leaves, but present in *Uvaria chamae* roots. Mucilages are present in *Jatropha curcas* leaves, but absent in Uvariachamae roots.

**3.2. Phenolic compound content**

The results of the phenolic compounds contained in our different plant extracts are recorded in Table IV. The analysis of this table informs us that the leaves of *Jatropha curcas* are richer in total polyphenols (73.95 mg EAG/100 mg) than the roots of *Uvaria chamae* 41.78 mg EAG/100 mg). On the other hand, *Uvaria chamae* has a higher content of total flavonoids (25.41 mg EQ/100 mg) and condensed tannins (72.44 mg EC/100 mg) than *Jatropha curcas* (19.47 mg EQ/100 mg and 54.23 mg EC/100 mg).

**3.3. Antioxidant power by the DPPH method**

The evaluation of the anti-radical activity was done in order to know the percentage of inhibition of DPPH. Figure 2 reports the anti-radical activities by the DPPH method.

**Figure 2** : Antioxidant power by DPPH method

The curves in Figure 2 show the evolution of inhibition percentages as a function of concentrations of the hydroethanol extract of Jatrophacurcas, Uvariachamae and the reference molecules quercetin and ascorbic acid, following a geometric progression of reason two. In this study, the DPPH radical-scavenging activities of both extracts increased progressively in a dose-concentration-dependent manner (0.0078 -1 mg/ml). Antioxidant activity ranged from 13.014 to 79.97% for Jatrophacurcas and from 14.03 to 85.70% for *Uvaria chamae*. At 0.0312 mg/ml, the inhibition percentages of our two extracts are roughly equal, with an average of 44.205%, comparable to ascorbic acid. In the 0.0625 - 0.5 mg/ml range both extracts showed significant activity, with percentage inhibition above 50%(60.52≤IP%≤79.97) for Jatrophacurcas and (68.32≤IP%≤85.37) for *Uvaria chamae* in comparison to ascorbic acid (57.014≤IP%≤86.19) and to quercetin (76.066 ≤ IP%≤ 99.41). Between 0.5 and 1 mg/ml, antiradical activity remained stationary. In summary, quercetin shows a higher percentage of inhibition at all concentrations. The three curves (ascorbic acid, *Uvaria chamae* and *Jatropha curcas*) are close and reach an inhibition of around 80-85% at the highest concentrations.This suggests that both extracts have antioxidant activity comparable to that of ascorbic acid. At low concentrations ≤ 0.0625 mg/ml, *Uvaria chamae* appears slightly more active than *Jatropha curcas*. Ascorbic acid has a faster effect than the extracts, but they catch up at higher concentrations. These results were used to calculate the IC50s of *Jatropha curcas*, *Uvaria chamae* and the reference molecules.

**3.4. 50% inhibitory concentrations of extracts and standards**

The results in Table IV show a 50% variation in inhibitory concentrations from one fraction to another. The DPPH anti-radical results show that *Uvaria chamae* root extract is more or less active against *Jatropha curcas* leaf extract, with lower IC50s that are more or less close to the standards.

Figure 3 below shows the FRAP results for free radical scavenging activity of *Jatropha curca*s and *Uvaria chamae* ethanolic extract.

**Figure 3** : the FRAP results for free radical scavenging activity of *Jatropha curcas* ethanolic extract and *Uvaria chamae*

The FRAP antioxidant power results show that both *Jatropha curcas* leaf and *Uvaria chamae* root extracts exhibit significant ferric ion reduction activity. At 100 µg/ml, the reduction rate was 79µmol AAE/g for Jatrophacurcas leaves and 85.479µmol AAE/g for Uvariachamae roots.

**4. Discussion**

**4.1 Validity of results**

Before any harvest, each of our plant species was authenticated at the national herbarium. The organs of the plant, namely fresh leaves for *Jatropha curcas* and fresh roots for *Uvaria chamae*, harvested, were treated under the required conditions in order to avoid any external contamination. The hydroethanolic extraction with the rotavapor used in this work constitutes one of the best extraction techniques. The standard screening tests (differential precipitation coloring) carried out by the method described by (Houghton & Raman, 2012), best meet this type of analysis. The methods used to quantify the main groups of chemical compounds are among the recent and reliable methods that reveal almost all of the compounds sought. As for the determination of the antiradical power of the extract, in order to avoid any bias, two methods, DPPH and FRAP were used. They constitute two complementary methods that reflect the reliability of the results obtained. Considering the relevance of the methods used and the repeatability of the tests, these results discussed below are considered valid.

**4.2. Achieving objectives and comparing results**

**4.2.1. Extraction efficiency**

The efficiency of extraction of secondary metabolites from medicinal plants is attributable to other factors such as drying time, filtration method of the ground material, ethanol percentage of the extraction solvent, maceration time (Kone *et al*., 2017). The extraction yield may vary depending on the polarity of the solvent, extraction method and environmental conditions of the plant.

In the present study, the yield of the hydroethanolic extract of *Jatropha curcas* leaves and *Uvaria chamae* roots gave 11.65% and 9.15%, respectively. It should be noted that the use of a v/v mixture of solvent is often recommended to obtain a balance between polar compounds (which are better extracted by water) and apolar compounds (which are better extracted by ethanol). Ethanol, combined with water in a 50/50 ratio, promotes the extraction of bioactive compounds such as flavonoids and phenols, which have been associated with antioxidant and antimicrobial properties. In a comparative approach, a study conducted by (Ahmad *et al*., 2013), hydroethanolic extraction of *Jatropha curcas* leaves gave a yield of 10.5%, which is slightly lower than that obtained in the present study (11.65%). This higher yield could be attributed to differences in the concentration of ethanol used, maceration duration, or environmental conditions of leaf growth. Our results are similar to those of (Singh *et al*., 2014), who state that this solvent combination allows a more complete extraction of bioactive compounds compared to the use of water or ethanol alone. The yield of 9.15% for the hydroethanolic extract of the roots of *Uvaria chamae* is significantly higher than that obtained by (Kaboré *et al*., 2024) regardless of the organic solvents such as hexane, dichloromethane, ethyl acetate and butanol, which demonstrates the efficiency of the extraction solvent used in this study.

**4.2.2. Standard screening**

The different chemical components of plant extracts can be influenced by several factors regarding chemical compositions. Indeed, according to (Sofowora, 1996) the geographical location, the organ harvested, the period, the time and the storage conditions affect the composition of a plant in secondary metabolites. The phytochemical screening of *Jatropha curcas* leaves contains tannins, flavonoids, alkaloids, anthocyanins, triterpenes, steroids, coumarins, leucoanthocyanins and saponins. These results confirm the work of (Bolanle *et al*., 2018); (Nwamarah *et al*., 2015); (Imam *et al*., 2016); (Asuk *et al*., 2015); (Jumare *et al*., 2023) which partly led to the same phytochemical screening results on *Jatropha curcas*. In addition to all these secondary metabolites mentioned above, *Uvaria chamae* roots contain cardiac glycosides and anthraquinones. These results are similar to those of (Avaligbe *et al*., 2012); (Okwu & Iroabuchi, 2009); (Emeka *et al*., 2015); (Dougnon *et al*., 2022). The absence of cardiac glycosides and anthraquinones in *Jatropha curcas* leaves could be explained by certain factors such as soil type, plant origin and harvest period (Nounagnon *et al*., 2018). The flavonoids present in the plant are polyphenolic pigments responsible for the coloring of flowers and fruits. They have many therapeutic virtues and are particularly active in maintaining good blood circulation.The two plants show similarities in terms of secondary metabolites. Phytochemicals identified in Jatrophacurcas leaves and *Uvaria chamae* roots confirm their therapeutic potential, widely documented in the literature (Bossou *et al*., 2020) ; (Sharma *et al*., 2013); (Abu *et al*., 2018).

**4.2.3. Determination of secondary metabolites**

In the present work, in perfect continuity with the establishment of the phytochemical map of the plant species *Jatropha curcas* and *Uvaria chamae*, the dosage of secondary molecules namely total tannins, total flavonoids and total phenolics in each hydroethanolic extract was carried out. These results show that *Jatropha curcas* contains total polyphenols, total flavonoids and total tannins at respective doses of 73.95 mg Eq ac.Galic/100 mg; 19.47 mg EqQuer/100 mg and 54.23 mg EqCat/100 mg. Other researchers have also determined the content of total polyphenols and total flavonoids from different parts of *Jatropha curcas*. For comparison, the concentration range of total phenolics (38.70 – 48.95 mg Eqac.Galic/100 mg) and total flavonoids (12.03 – 13.9947mg Eq Quer/100 mg) obtained by (Zengin *et al*.., 2021) is lower than the value obtained in this study. This difference may be related to the harvest site, the physiological age of the plant or the time of harvest. Interestingly, several studies have also demonstrated that extraction techniques play a crucial role in the yield of phenolic content of plant extracts (Sultana *et al*., 2009); (Pietrzak *et al*., 2014).

The determination of phenolic compounds from *Uvaria chamae* roots yielded 41.78 mg Eqac.Galic/100 mg of total polyphenols; 25.41 mg EqQuer/100 mg of total flavonoids and 72.44 mg EqCat/100 mg of condensed tannins. The values ​​obtained in this study are significantly higher than those of (Nwakaego *et al*., 2019) which had respectively 0.69 mg Eqac.Galic/100 mg of total polyphenols; 0.32mg Eq Cat/100 mg of condensed tannins and 0.0013mg EqQuer/100 mg of total flavonoids. This difference may be related to the choice of extraction solvent, the harvest site, the harvest time or the extraction method used. The work of (Kone *et al*., 2015) in relation to the dosages of phenolic compounds gave respectively 2.41 mg Eq ac.Galic/100 mg of total polyphenols; 0.95mg Eq Cat/100 mg of condensed tannins; 0.12mg Eq Quer/100 mg of total flavonoids on the one hand for the ethanolic extract of *Uvaria chamae* roots and on the other hand 0.89mg Eq ac.Galic/100 mg of total polyphenols; 0.62 mg Eq Cat/100 mg of condensed tannins; 0.68 mg Eq Quer/100 mg of total flavonoids for the aqueous extract of the same plant species. The range of concentrations of total phenolic compounds obtained by Kone *et al*. (2015) is much lower than that obtained in this study. These results would demonstrate the effectiveness of the v/v extraction solvent used in this study. According to (Singh *et al*., 2014), this solvent combination allows a more complete extraction of bioactive compounds compared to the use of water or ethanol alone. The use of a v/v mixture of solvents is often recommended to obtain a balance between polar compounds (which are better extracted by water) and nonpolar compounds (which are better extracted by ethanol). This type of solvent is known to be effective in the extraction of secondary metabolites such as flavonoids, alkaloids and saponins, which are widely present in different organs of the plant species. Ethanol, combined with water in a proportion of 50/50, favors the extraction of bioactive compounds such as flavonoids and phenols, which have been associated with pharmacological properties. The synthesis of the dosage of phenolic compounds in *Jatropha curcas* leaves and Uvariachamae roots shows a fairly high content of phenols, thus supporting their multiple uses in phytotherapy for their reported pharmacological properties. The analyses reveal that *Jatropha curcas* leaves and *Uvaria chamae* roots contain significant contents of polyphenols. This richness in phenolic compounds confirms the therapeutic value of *Jatropha curcas* and *Uvaria chamae* in traditional medicine and their importance for the discovery of new improved traditional medicines.

**4.2.4. Antioxidant power of extracts and IC50**

Since ancient times, many plants have been used for the treatment and prevention of many ailments and diseases and have shown a huge resource for the development of new drugs. Medicinal plants used in folk medicine are particularly interesting for the study of their antioxidant effects. Some authors have reported that the therapeutic benefit of medicinal plants is generally attributed to their antioxidant properties and that oxidative stress is an important feature of these diseases (Javanmardi, 2003). Several methods have been used to determine the antioxidant activity of plants. Thus, our study involved two different methods to evaluate the antioxidant activity of our plant species namely DPPH scavenging activity and ferric reducing power/antioxidant (FRAP) analysis. Among the most widely used procedures to measure antioxidant activity capacity, DPPH radical scavenging assay is one of the most known, accurate, and frequently used to measure plant electron donating capacity (Figueroa *et al*., 2014);(Ahmad *et al*., 2013). DPPH is a stable radical commonly used to determine the antioxidant activity of various compounds. The results show that from 62.5 – 500 µg/ml both extracts showed significant activity, with an inhibition percentage greater than 50% (60.52≤IP%≤79.97) for *Jatropha curcas* and (68.32≤IP%≤85.37) for *Uvaria chamae* in comparison with ascorbic acid (57.014≤IP%≤86.19) and quercetin (76.066 ≤ IP%≤ 99.41). The results of the anti-radical power by the DPPH method show that the *Uvaria chamae* root extract has a more or less better activity against the *Jatropha curcas* leaf extract with a lower IC50 which are more or less close to the standards. In a logic of confirmation by the FRAP method, the hydroethanolic extract of the leaves of *Jatropha curcas* and the roots of *Uvaria chamae* presents a significant antiradical potential by the reduction of ferric iron to ferrous iron respectively 79 mMol EAA/g and 85.4 mMol EAA/g. These analyses inform us that the antioxidant activity of the plant extracts studied is dose-dependent. At high concentrations (≥ 0.25 mg/mL), the extracts reach a plateau (~80-85%), showing that they have significant antioxidant activity, but slightly lower than that of quercetin. The IC₅₀ (concentration required to inhibit 50% of free radicals) is lower for *Uvaria chamae* (3.28 mg/ml) than for *Jatropha curcas* (4.62 mg/ml). Our results are similar to those of (Oskoueian *et al*., 2011); (Papalia *et al*., 2017); (Huang *et al*., 2020) on the one hand for Jatrpha curcas and those of (Kone *et al*., 2015); (Thomas *et al*., 2008); (Popoola *et al*., 2021); (Bamba *et al*., 2021); (Godfrey *et al*., 2024) for *Uvaria chamae* on the other hand, which confirm the antiradical power of the different plant species studied. *Uvaria chamae* and *Jatropha curcas* have notable antioxidant activity. These results indicate that these extracts could be used in antioxidant therapy. The dose-response effect is clearly visible, confirming an increase in antioxidant activity with concentration.

**Conclusion**

Plants used in traditional medicine are particularly interesting for studying their antioxidant effects. Phytochemical screening of the plants under study shows similarities in terms of secondary metabolites such as tannins, flavonoids, saponosides, coumarins, alkaloids, triterpenes, anthocyanins and leuco anthocyanins, confirming their therapeutic potential, widely documented in the literature. In the present work, in perfect continuity with the phytochemical mapping of the plant species Jatrophacurcas and Uvariachamae, the determination of secondary molecules namely total tannins, total flavonoids and total phenolics in each hydroethanolic extract was carried out with fairly significant results in comparison with other authors ,which testify that Jatrophacurcas and Uvariachamae contain bioactive phytochemical compounds useful for restoring human and animal health. *Uvaria chamae* and *Jatropha curcas* have good antioxidant activity, similar to ascorbic acid. *Uvaria chamae* seems slightly more effective at low concentrations. These results confirm that these plants have interesting potential as natural antioxydants, useful in traditional medicine.

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**List of tables**

**Table I** : Identification numbers of the plants used.

|  |  |  |  |
| --- | --- | --- | --- |
| **National Herbarium N°** | **Name of the studied plant species** | **Local names (fon)** | **Plant organs** |
| HY 843/ HNB | *Jatropha curcas L.* | Gnikpotin wewe | Leafy stems |
| HY 988/ HNB | *Uvaria chamae P.Beauv.* | Aylaha | Roots |

**Table II**: Extraction yield of the plants studied

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Mass of plant material (MV) g** | **Mass of extract (ME) g** | **Yield (R) %** |
| ***Jatrophacurcas* (leaves)** | 1800 | 209,722 | 11,65 |
| ***Uvariachamae* (roots)** | 1800 | 164,836 | 9,15 |

**Table III** : Standard screening of *Jatropha curcas* and *Uvaria chamae*

Legend “+” = Weak presence; “-” = Absence; “++” Moderate presence; “+++”: Strong presence.

|  |  |
| --- | --- |
| **Chemical groups** | **Plant species studied** |
| ***Jatropha curcas*** | ***Uvaria chamae*** |
| Gallic tannins | **++** | **+++** |
| Catechic tannins | **++** | **+++** |
| Flavonoids | **++** | **++** |
| Anthocyanin | **++** | **+** |
| Coumarins | **+** | **++** |
| Alkaloids | **++** | **++** |
| Leucoanthocyanin | **+** | **+** |
| Mucilages | **+** | **-** |
| Steroids | **+** | **+** |
| Triterpenes | **++** | **++** |
| Saponosides | **++** | **+++** |
| Cardiac glycosides | **-** | **+** |
| Anthraquinones | **-** | **+++** |

 **Table IV** : Results of the determination of phenolic compounds

Values ​​± Standard Deviation (n= 3); EAG: Gallic Acid Equivalent; EQ: Quercetin Equivalent; EC:

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Total polyphenols (mg EAG/100mg)** | **Total flavonoids (mg EQ/100mg)** | **Condensed tannins (mg EC/100 mg)** |
| ***Jatrophacurcas* (feuille)** | 73,95 ± 0,06 | 19,47 ± 0,02 | 54,23 ± 0,04 |
| ***Uvariachamae* (racines)** | 41,78 ± 0,03 | 25,41 ± 0,1 | 72,44 ± 0,004 |

**Table V** : 50% inhibitory concentrations of extracts and standards

|  |  |
| --- | --- |
| **Extract / Fraction**  | **Inhibitory concentrations at 50% in µg/ml** |
| ***Jatrophacurcas*** | 4,62 ± 0,025 |
| ***Uvariachamae*** | 3,28 ± 0,016 |
| **Quercetin** | 2,03 ± 0,1 |
| **Ascorbic acid** | 3,05 ± 0,02 |