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EVALUATION OF ANTIOXIDANT ACTIVITY OF AQUEOUS AND METHANOLIC EXTRACTS OF *MORINDA CITRIFOLIA* (NONI) LEAVES CULTIVATED IN KOUITONGUINÉ (WESTERN REGION CÔTE D'IVOIRE)

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ABSTRACT
The study was designed to investigate the phytochemical screening and antioxidant properties of *Morinda citrifolia* leaves (Noni; Rubiaceae) cropped in Man, West region of Cote d'Ivoire. Aqueous and methanolic extract obtained from *M. citrifolia* were subjected to phytochemical analysis. It proved that *M. citrifolia* contain large amount of secondary metabolite like polyphenols, flavonoids, tannins, alkaloids, saponins, cardiotonic glycosides, polyterpenes and sterols whereas quinones and coumarins were absent. Spectrophotometric analysis confirmed the presence of total polyphenols and flavonoids contents in methanolic and aqueous extracts with value of 56 mg GAE/g and 5 mg GAE/g for polyphenols and 11.06 mg GAE/g and 1.7 mg GAE/g for flavonoids respectibility. Antioxidant activity is measured by their ability to scavenge the free radicals of DPPH method. These assays confirmed the presence of antioxidants in the methanolic extract of *Morinda citrifolia.*

KEYWORDS: *Morinda citrifolia*, phytochemical screening, antioxidant activity, leaves, Man.

INTRODUCTION
In recent years, there has been an increase in interest in the biological effects of natural antioxidants included in the fight against oxidative stress generated by reactive oxygen species (ROS). These biological effects are involved in aging and in the onset and progression of several diseases such as cancer, atherosclerosis, cardiovascular accidents (stroke), osteoporosis, inflammatory diseases and neurodegenerative diseases, etc. Thus, a great deal of scientific research carried out on bioactive compounds, particularly on polyphenols (PP) which act against ROS, has fostered their use in food, cosmetic and pharmacological industries (Kebbab, 2014). These substances arouse a great deal of interest in several fields, namely that of nutrition because of their preventive or therapeutic nature to cure diseases (Manach et al., 2004). According to the World Health Organization (WHO), medicinal plants represent one of the sources of medicines used by about 80% of the african populations in primary care of their daily life (Ladoh et al., 2014).

Morinda citrifolia (Noni), belonging to the Rubiaceae family is a plant used in traditional medicine in the Tonkpi region against certain diseases. This plant is widely used to treat digestive disorders, ulcers, burns, diarrhea (Udoamaka et al., 2014; Suroowan & Mahomoodally, 2016). The leaves of young Noni plant are eaten as vegetable and used as a wrapper to heat food in foil (Morton, 1992; Dixon et al., 1999). They are applied to the burns until wilting and are then replaced with fresh leaves. The treatment is repeated until the leaves no longer dry out and the fever stops (Nicolas, 2004). After childbirth, if the child is not breathing, the midwife wraps the umbilical cord with a pair of Noni leaves to initiate breathing. If breathing is still delayed, then the midwife begins stacking Noni leaves on the child until breathing begins (Nicolas, 2004). Moreover, Noni leaves contain most of the amino acids, namely alanine, arginine, aspartic acid, cysteine, glycine, glutamic acid, histidine, leucine, isoleucine, methionine, phenylalanine, proline, serine, threonine, tryptophan, tyrosine and valine. It is also admitted the presence of anthraquinones, glycosides, phenolic compounds, sitosterol resins and ursolic acid in Noni leaves (Chunideng, 2003). In southern Vietnam the roots are commonly used in local medicine. The roots and leaves of Morinda citrifolia L. are used in Mauritius, Tangatapu,

Vietnam, the Philippines and India as an analgesic or anti-rheumatic and also for the treatment of urinary problems (Adjanohoun et al., 1983; Singh et al., 1986). The leaves, crushed with spices, help stop diarrhea and dysentery suffered by adults. The main medicinal properties of Noni are known to be antibacterial, analgesic, anticongestive, antioxidant, anti-inflammatory, astringent, emollient, laxative, sedative and hypotensive. Thus, our choice to study the Noni plant was motivated by its frequent tradtional use for culinary and medicinal purposes in the Tonkpi region in order to make a promotion of our national heritage.

Hence, this study is focused on the phytochemical sorting, the determination of phenolic compounds and the evaluation of the antioxidant activity of the aqueous and methanolic extracts of the leaves of *Morinda citrifolia*, being cropped in Man.

MATERIEL AND METHODS

1. Materiel

1.1. Plant material

The plant material studied consists of *Morinda citrifolia* leaves. These leaves were collected from the department of Agronomy and Forestry of Man Universty, region of Tonkpi, West of Côte d'Ivoire (7°19'60" N 7°25'0" W). Leaves sample were deposited at the Botany herbarium department with the voucher number of plant 1071/2021. The leaves were dried at 18°C during 5 days, crushed and packaged in sachets for analysis.

1.2. Chemical and Standard

All reagents and solvents were of analytical grade. Methanol and ethanol were purchased from Carlo Erba (Spain), Folin-Ciocalteu reagent from Panreac (USA), gallic acid and quercetin, Sigma-Aldrich (Germany), 1,1-diphenyl-2- picrylhydrazyl radical (DPPH) Carlo Erba (Spain), sodium carbonate and chloride aluminium, Merck (Germany), sodium hydroxide, Sharlau (Spain). Water was purified by a Milli-Q water purification system.

2. METHODS

2.1. Preparation of the aqueous and methanolic extract

Soluble dry matter content of the leaves was prepared according to the method described by Ano et al., (2021). For the preparation, a mass of 50 g of leaves powder was macerated in 500 mL of distilled water and in 500 mL of methanol under magnetic stirring during 24 hours. The aqueous and methanolic macerates were filtered through cotton wool and once on Whatman filter paper. The filtrate obtained were first placed in petri dishes and then dried in an oven at 50°C for 3 days to obtain the dry extract leaves of *Morinda citrifolia*.

2.2. Phytochemical screening

Phytochemical screening of *Morinda citrifolia* leaves of secondary metabolites such as polyphenols, flavonoids, sterols and terpenes, alkaloids, tannins, saponins were screened according to the method described by Bidié *et al* (2011), Koné (2009), Békro *et al* (2007) and Bagre *et al* (2007). The presence of a bioactive compound was indicated by a color change and a precipitate.

Test for polyphenols

A drop of 2% alcoholic ferric chloride solution was added to 2 mL of the extracts (aqueous and methanolic solution). The appearance of blackish-blue or more or less dark green coloring indicates a positive reaction.

Test for flavonoids

A volume of 2 mL of the extracts was dried on a sand bath. The dry residue obtained was cooled and taken up in 5 mL of hydrochloric alcohol (mixture of 10 mL of ethanol, 10 mL of distilled water and 10 mL of concentrated hydrochloric acid). Then two to three magnesium shavings were added to it. The appearance of a pink-orange or purple color after adding 3 drops of isoamyl alcohol indicates the presence of flavonoids.

TEST FOR TANNINS

Catechetical tannins

A volume of 15 mL of STIASNY reagent (10 mL of 40% formaldehyde added with 5 mL of concentrated HCl) was added to 1 g of dry extract. The mixture was kept in a water bath at 80 °C for 30 min and cooled under flowing water. The appearance of large precipitates in form of flakes indicates the presence of catechetical tannins.

Gallic tannins

The solution containing the flakes was filtered and the collected filtrate was then saturated with sodium acetate. To the mixture, 3 drops of 2ferric chloride were added to it. The appearance of an intense blue black color indicates the presence of gallic tannins.

Test for leucoanthocyanins

A volume of 2 mL of the extracts was dried on a sand bath. The dry residue obtained was cooled and taken up in 1 mL of hydrochloric alcohol and 1 mL of isoamyl alcohol. The mixtures were kept in a water bath at 80 °C for 15 min and cooled under flowing water. The appearance of a red-cherry or purplish color indicates the presence of leucoanthocyanins.

Test for sterols and polyterpenes

Liebermann's reagent was used for this demonstration. A mass of 0.1 g of dry extract of the leaves was dissolved at hot in 1 mL of acetic anhydride and collected in a test tube. Then, 0.5 mL of concentrated sulfuric acid was added. The appearance of a purple or violet ring at the interphase, turning blue and then green, indicates the presence of polyterpenes and sterols.

Test for saponins

A mass of 0.1 g of dry extract was dissolved in 10 mL of distilled water. The solutions obtained were stirred vigorously during 45 seconds. After stirring, the

solutions were allowed to stand for 15 minutes. The observation of persistent foam, greater than 1 cm in height, indicates the presence of saponins.

Test for cardiotonic glycosides
A volume of 10 mL of chloroform was added to 2 mL of the extracts. After decantation, the chloroform phases were extracted using a pipette and then divided into 2 test tubes and dried on a sand bath. The residues were taken up in 1 mL of isopropanol and 1 mL of 2% alcoholic potassium. The mixtures were heated on hot plate for 3 minutes. The appearance of a purplish red color indicates the presence of cardiotonic glycosides.

Test for quinones
A volume of 2 mL of the extracts was added to 5 mL of HCl, mixed and diluted to 1/5. The mixtures were kept in a water bath at 80 °C for 30 min and cooled under flowing water. The hydrolyzate solutions were extracted with 20 mL of chloroform. A volume of 1 mL of Borntraeger's reagent (ammonia diluted twice) was added to the chloroform phase. The appearance of an intense red or purple color indicates the presence of quinones.

Test for alkaloids
A mass of 1 g of dry extract was dissolved in 6 mL of 60° absolute ethanol. 2 drops of DRAGENDORFF reagent (aqueous solution of potassium iodobismuth) were added to the alcoholic solution thus obtained. The appearance of a precipitate or an orange color indicates the presence of alkaloids.

2.3. Polyphenols Levels
2.3.1. Total Polyphenols
Total polyphenols were determined using the method described by Singleton and Rossi (1965), as amended by Wood *et al.* (2002). A volume of 2.5 mL of Folin-Ciocalteu diluted (1/10) was added to 30 µL of extract. The mixture was held for 2 minutes in the dark at room temperature, and then 2 mL of calcium carbonate (75 $g.L^{-1}$) were added. The mixture was placed for 15 minutes in a water bath at 50°C, and then cooled quickly. The absorbance was measured at 760 nm with distilled water as blank. A calibration curve was performed with gallic acid at different concentrations (0, 0.2, 0.3, 0.6, 0.7, and 0.9 $g.L^{-1}$). Analyses were performed in triplicate and polyphenols level was expressed in mg gallic acid equivalents (GAE)/g dry matter.

2.3.2. Total flavonoids
Total flavonoids were determined by the method of Marinova et al. (2005). A volume of 0.75 mL of sodium nitrite ($NaNO_2$) to 5% (w/v) was added to 2.5 mL of extract in a 25 mL flask. The mixture was added 0.75 mL of aluminum chloride ($AlCl_3$) to 10% (m/v) and incubated for 6 minutes in the dark. After incubation, 5 mL of sodium hydroxide (NaOH 1N) were added and the volume made up to 25 mL. The mixture was stirred vigorously before being dosed with UV-Visible spectrophotometer. The reading was taken at 510 nm with distilled water as a blank. A calibration curve was performed with quercetin (0-1.5 $g.L^{-1}$) at different concentrations (0, 0.15, 0.3, 0.9, 1.2, 1.5 $g.L^{-1}$). The tests were performed in triplicate and the flavonoids content was expressed in mg quercetin equivalents (QE)/g dry matter.

2.4. Antioxidant activity
The 1,1-diphenyl-2- picrylhydrazyl radical (DPPH) was solubilized in methanol to obtain a solution with a concentration of 0.1 mg/ml. Different concentration ranges (6.25, 12.5, 25, 50, 100 and 200 µg/mL) of methanol plant extract were prepared in the same solvent. 1 mL of methanol plant extract and 1.5 mL of DPPH methanolic solution were introduced into test tubes. After shaking, the tubes were placed in a dark place for 30 min. The absorbance of the mixture was then read at 517 nm with a UV-visible spectrophotometer (Jasco V-530) against a blank consisting of 1 mL methanol and 1.5 mL DPPH. The positive reference control is quercetine. The percentage reduction (% I) of DPPH was calculated according to the following equation (Parejo *et al*., 2000):

$$I\ (\%) = \left(1 - \frac{As}{Aw}\right) \times 100$$

As: absorbance of the extract; Aw: absorbance of the white.

This parameter was used to determine the median effective reduction concentration (EC50) of DPPH, determined graphically using Graph Pad Prism.

RESULTS AND DISCUSSION
3. Results
3.1. Phytochemical screening
The results of Table 1 indicate the presence of secondary metabolites in the aqueous and methanolic extracts of *Morinda citrifolia* leaves. These are polyphenols, flavonoids, tannins (catechetical and gallic), leucoanthocyanins, sterols and terpenes, saponins, cardiotonic glycosides and alkaloids. A strong intensity of the coloring and precipate was observed in the methanolic extracts. Phytochemicals such as coumarins and quinones were not detected in the extracts leaves of *Morinda citrifolia.*

3.2. Content of phenolic compounds
3.2.1. Total Phenolics Content
Total polyphenols distribution of aqueous and methanolic extracts of *M. citrifolia* leaves are show in Figure 1. The highest rate is obtained by extracting with solvent methanol with a value of 56 mg GAE/g DM while the lowest value is obtained by aqueous solvent (5 mg GAE/g DM).

Figure 3 shows the distribution of total flavonoids content in different extracts of *M. citrifolia* leaves studied. Just as the level of total polyphenols, methanolic extract contain the highest levels of flavonoids compared

to aqueous solvent with value of 11.06 mg GAE/g and 1.7 mg GAE/g DM.

Table 1: Phytochemicals in the aqueous and methanolic leaves extracts of Morinda.

Secondary metabolites		*Morinda citrifolia* leaves	
		Aqueous extract	Methanolic extract
Polyphenols		++	+++
Flavonoids		++	+++
Tannins	Catechetical	++	+++
	Gallic	++	+++
Leucoanthocyanins		+	++
Sterols and Polyterpenes		++	++
Saponins		++	+
Cardiotonic glycosides		++	++
Coumarins		-	-
Quinones		-	-
Alcaloids		+	++

+++: strong presence, +: average presence, -: absence

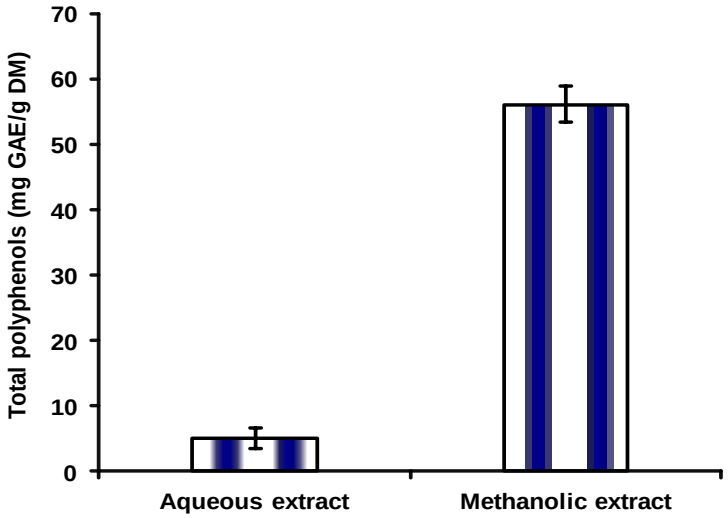

Figure 1: Polyphenolic contents of *M. citrofolia* extracts.

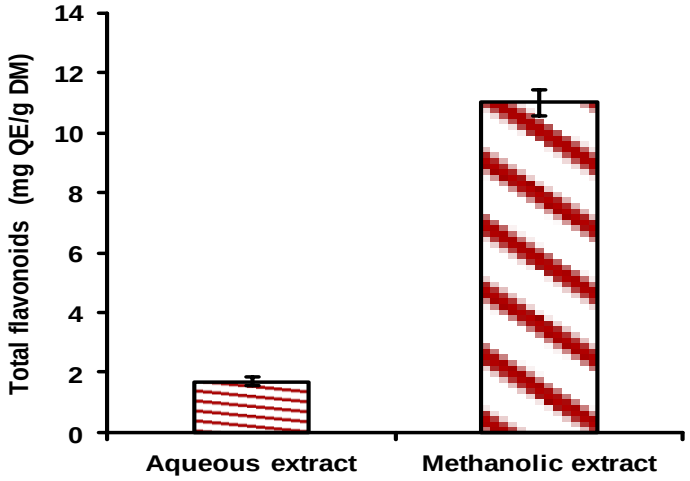

Figure 2: Flavonoids contents of *M. citrofolia* extracts.

4. Antioxidant Activity of *M. citrifolia*

The antioxidant activity of *M. citrifolia* leaves was estimated by considering the capacity of its aqueous and methanolic extracts to reduce the stable radical of DPPH, compared to quercetin (reference antioxidant). The results were expressed in graphical form (Figure 3). In general, it appears that the leaves of *M. citrifolia* reduction activity are concentration-dependent. It

decreases progressively with decreasing concentration of the methanolic extract. As far as the aqueous extract is concerned, no activity was obtained. The EC_{50} inhibitory concentration, determined graphically from the reduction percentage of DPPH, is the reliable median concentration that shows the antioxidant effectiveness of *M. citrifolia* leaves (Table 2).

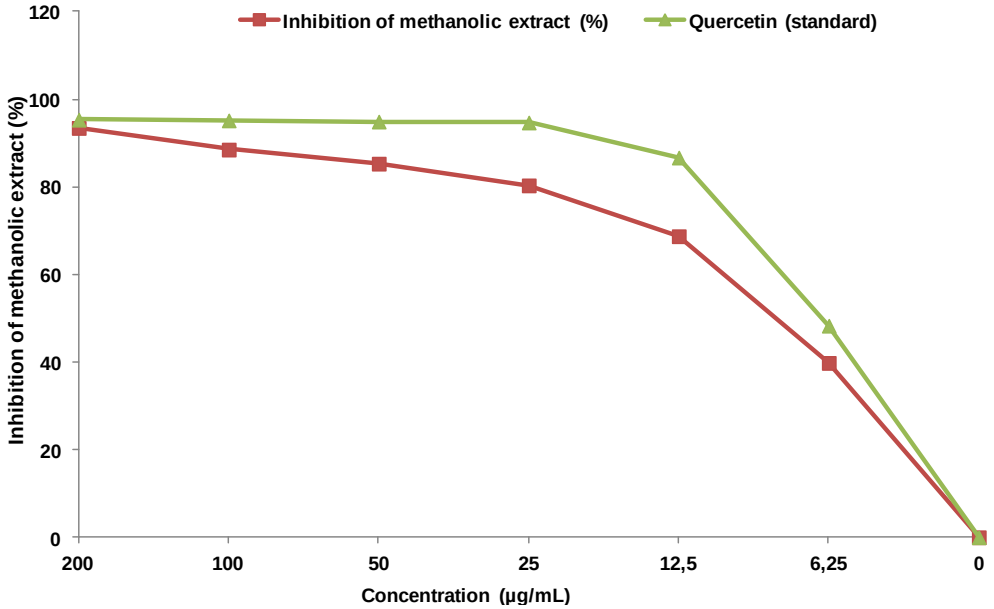

Figure 3: Inhibition of quercetin and methanolic extract.

Table 2: EC_{50} of the extracts of *M. citrifolia* leaves.

Extracts	EC_{50} (µg/mL)
Methanolic	2.30 ± 0.12
Aqueous	ND

*ND: not determined

DISCUSSION

This study was designed to investigate the phytochemical screening, phenolic compounds and antioxidant activity of two extract of *Morinda citrifolia* leaves.

Phytochemical screening revealed the presence of all major secondary metabolites such as polyphenols, flavonoids, tannins, alkaloids, saponins, cardiotonic glycosides, polyterpenes and sterols in *Morinda citrifolia* leaves whereas quinones and coumarins were absent. Results of this study are in agreement with those of Sajani and Maya, 2020; Sasikumar et al., (2012). The presence of these phytonutrients in *M. citrifolia* leaves could justify its therapeutic use. They are recognized as having antioxidant properties, which allows them to play a role in the inflammatory treatment, cardiovascular or neurodegenerative diseases (Mesia et al., 2005; Amarowicz, 2007; Phakhodee, 2012). Most of these diseases find part of their cause in the effects produced by oxidative stress (Wang and Su, 2001). For this, the leaves could intervene in the fight against this stress. As for saponins, they act like anti-hyperlipidemia, hypotensive and have cardiodepressive properties (Ogboru et al., 2015). In addition to the role of antimicrobial (Faizi et al., 2003), alkaloids play a detoxifying and antihypertensive role (Awoyinka et al, 2007). Steroids are known to be an important Cardio tonic activities posse's antimicrobial property and also used in herbal medicines and cosmetics. The presences of cardiac glycosides are known to play a major role in heart muscles by inhibiting Na^+ and K^+ pump that increase the availability of sodium ions and calcium ions to heart muscles which improves cardiac output and reduce heart distension. Thus are used in the treatment of congestive heart failure and cardiac arrhythmia (Schneider et al., 2004). Flavanoids and tannin are the group of phenolic compounds that act as primary antioxidants and posse's also antimicrobial, anti-inflammatory, antiallergic, anticancer, antineoplastic activity, and for the treatment of intestinal disorders (Gulcin et al., 2005; Rievere et al., 2009).

The results of the determination of total phenols and flavonoids showed that the methanolic extract of the leaves represents the richest extract with respectively 56 mg GAE/g of extract and 11.06 mg QE/g of extract. The radical scavenging capacity of the Noni leaves extract reduce and decolorize the 2, 2-diphenyl-1- picryhydrazyl (DPPH) into a yellow compound (Ardestani & Yazdanparast, 2007). Results are expressed as a percentage of anti-free radical activity using the EC_{50} parameter, which is defined as the concentration of the substrate that causes a 50% loss of DPPH activity (Markowicz et al., 2007). This study revealed that only the methanolic extract of the plant studied possessed anti-free radical activity. Thus, just 200 µg/mL is enough for the methanolic extract to inhibit the DPPH radical at 85.51%. DPPH scavenging activity of the extracts can be correlated to the presence of flavonoids (Turkmen et al., 2007; Bourgou et al., 2008; Miguel, 2010; Sajani and

Maya, 2020). Antioxidants are biologically synthesized as defensive mechanism having an important role in preventing or alleviating chronic diseases by reducing the oxidative damage to cellular components caused by free radicals. The present study shows that *Morinda citrifolia* leaves extract possess significant amount of phytochemicals and *in vitro* antioxidant activity. A significant linear relationship between antioxidant activity and phytochemicals, that are responsible for the *in vitro* antioxidant property of the leaves extracts.

Analyzing the results, it is clear that the methanolic extract of *Morinda citrifolia* account for the plethora of bioactive compounds. However isolation and characterization of the compounds and validating their therapeutic efficacy against different pathologies is required for clinical implementation.

CONCLUSION

This study has shown that in addition to the presence of bioactive compounds, the leaves of *M. citrifolia* have antioxidant activity. The results showed that the aqueous and methanolic extracts of *M. citrifolia* contains polyphenols, flavonoids, tannins, alkaloids, saponins, cardiotonic glycosides, polyterpenes and sterols. It also emerges from the analyzes that the methanolic extract was found to be greater antioxidant activity than the aqueous extract and even similar to that of quercetin. In combination and at useful doses, the *M. citrifolia* leaves extracts could provide an alternative to synthetic molecules and have their place in the prevention and treatment of neurodegenerative diseases.

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REFERENCES

1. Adjanohoun E.J., Aké Assi L., Eyme J., Gassita J.N., Goudote E., Gueho J., Lackaria F.S.L., Ip. D., Kalachand S.K.K., Keita A., Koudogbo Land-Reau D. & Owadally A. W., Soopramanien A., Contribution aux études ethnobotaniques et floristiques à Maurice (Iles Maurice et Rodrigues), Agence de Coopération Culturelle et Technique, Paris, 1983; 214.
2. Amarowicz R., Tannins: The new natural antioxidant. *European Journal of Lipid Sciences Technology*, 2007; 109: 549-551.
3. Amessis-Ouchemoukh N., Abou-reidah I.M., Quirantes-Piné R., Rodriguez-Pérez C., Madani K., Fernàndez-Gutièrrez A., Segura-Carretero A., Tentative characterisation of Iridoids, phenylithanoid glucosides and flavonides derivatives from *Globularia alypum* L. (Globulariaceae) leaves by LC-ESI-QTOF-MS. *Phytochemical Analysis*, 2014; 25(5): 389-98.
4. Ano A. A., Koffi N. E., Djetouan K. J., Atchibri O.-A., Phytochemical screening and evaluation of the antihypercholesterolemic activity of the cake of safou (Dacryodes edulis) in rats (Rattus norvegicus), 2021.
5. Ardestani A. & Yazdanparast R., Antioxidant and free radical scavenging potential of *Achillea santolina* extracts. *Food Chem*istry, 2007; 104: 21-29.
6. Awoyinka, O. A., Balogun, I. O., & Ogunnowo, A. A. Phytochemical screening and in vitro bioactivity of Cnidoscolus aconitifolius (Euphorbiaceae). Journal of Medicinal Plants Research, 2007; 1(3): 63-65.
7. Bagre I., Bahi C., Gnahoue G., Djaman A.J. & Guede G.F., Composition phytochimique et évaluation *in vitro* de l’activité antifongique des extraits des feuilles de *Morinda morindoides* (Baker) milne-redhead (*Rubiaceae*) sur *Aspergillus fumigatus* et *Candida albicans. Journal des Sciences Pharmacologiques et Biologiques*, 2007; 8(1): 15-23.
8. Békro Y.A., Békro J.A., Boua B.B., Tra B.F. & Ehilé E.E., Etude ethnobatanique et screning phytochimique de *Caesalpinia benthamiana* (Baill.) (Caesalpiniaceae). *Revue Sciences & Nature*, 2007; 4: 217-225.
9. Bidie P., Banga B., Yapo A.F., N’guessan J.D. & Djaman A.J., Activités antioxydantes de dix plantes médicinales de la pharmacopée ivoirienne. *Sciences & Nature*, 2011; 8(1): 1-11
10. Bourgou S., Ksouri R., Bellila A., Skandarani I., Falleh H. & Marzouk B., Phenolic composition and biological activities of Tunisian Nigella sativa L. shoots and roots. *Comptes Rendu Biologies*, 2008; 331: 48-55.
11. Chunideng T., Développement de nouveaux aliments santé à partir de graines et fruits d'origine tropicale : application à la noix du Brésil *Bertholettia excelsa* et au fruit du Cambodge *Morinda citrifolia*. Thèse de Doctorat. Institut National Polytechnique de Lorraine, 2003; 220.
12. Cybulski W.J.III, Peterjohn W.T. & Sullivan J.H., The influence of elevated ultraviolet-B radiation (UV-B) on tissue quality and decomposition of loblolly pine (*Pinus teada* L) needles. *Environmental and Experimental Botany*, 2000; 44: 231-241.
13. Dixon A.R., McMillen H. & Etkin N.L., Ferment this: The transformation of Noni, a traditional Polynesian medicine (*Morinda citrifolia*, Rubiaceae). *Economie Botany*, 1999; 53: 51-68.
14. Falleh H., Ksouri R., Chaieb K., Karray-Bouraoui N., Trabelsi N., Boulaaba M. & Abdelly C., Phenolic composition of *Cynara cardunculus* L. organs, and their biological activities. *Comptes Rendus Biologies*, 2008; 331: 372-379.
15. Faizi, S., Khan, R. A., Azher, S., Khan, S. A., Tauseef, S., & Ahmad, A. New antimicrobial alkaloids from the roots of Polyalthia longifolia var. pendula. Planta medica, 2003; 69(04): 350-355.

16. Gulcin I., Alici H.A. & Cesur M., Determination of in Vitro Antioxidant and Radical Scavenging Activities of Propofol. *Chemical Pharmaceutical Bulletin*, 2005; 53(3): 281-285.
17. Kebbab R., Etude du pouvoir antioxydant des polyphénols issus des margines d'olives de la variété Chamlal: évaluation de l'activité avant et après déglycosylation. Mémoire de Magister : Université Mouloud Mammeri de Tzi-Ouzou, 2014; 171.
18. Koné Dahafolo, Etude de la phytochimie et des activités larvicide, anticholinesterasique et antioxydante des extraits de quatre plantes du Mali: *Acacia nilotica* (Mimosaceae), *Calotropis procera* (Asclepiadaceae), *Euphorbia sudanica* (Euphorbiaceae) et *Hyptis suaveolens* (Laminaceae.). Thèse de pharmacie. Bamako, Mali., 2009; 123.
19. Kim M.C. & Pratt D.E., Thermal degradation of phenolic antioxydant. In M.T., et al. Huang Eds, Phenolic compounds in food and health (200-217). Washington : American Chemical Society, 1993.
20. Ladoh Yemeda C.F., Dibon S. D., Nyegue M.A., Djembissi Talla R.P., Lenta Ndjakou B., Mpondo E., Yinyang J. & Wansi J.D., Activité antioxydante des extraits méthanoliques de *Phragmanthera capitata* (Loranthaceae) récoltée sur *Citrus sinensis*. *Journal of applied Bioscience*, 2014; 84: 7636-7643.
21. Lee K.W., Kim Y.J., Lee H.J. & Lee C.Y., Cacao has more phenolic phytochemicals and a higher antioxidant capacity than teas and red wine. *Food chemistry*, 2003; 51: 7292-7295.
22. Manach C., Scalbert A., Morand C., Remesy C & Liliana J., Polyphenols: Food sources bioavailability. *American Society for clinical Nutrition*, 2004; 79: 727-747.
23. Marinova D., Ribarova F. & Atanassova M., Total phenolics in bulgarian Fruits and vegetables. *Journal of the University of Chemical Technology and Metallurgy*, 2005; 40(3): 255-260.
24. Markowicz Bastos D.H., Saldanha L.A., Catharino R.R., Sawaya A.C.H.F., Cunha I.B. S., Carvalho P.O. & Eberlin M.N., Phenolic Antioxidants Identified by ESI-MS from Yerba Maté (*Ilex paraguariensis*) and Green Tea (*Camelia sinensis*) Extracts. *Molecules*, 2007; 12: 423-432.
25. Mesia G.K., Tona G.L. & Penge O., Antimalarial activities and Toxicities of three plants used as traditional remedies for malaria in the Democratic Republic of Congo: *Croton mubango*, *Nauclea yobeguinii* and *Pyracantha staudti*. *Annal of Tropical Medecine Parasitology*, 2005; 99: 345-347. https://doi.org/10.1179/136485905X36325.
26. Miguel M., Antioxident activity of medicinal and aromatic plant. *Journal Flavour and Fragrance*, 2010; 25: 291-312.
27. Mohd Zin Z., Abdul-Hamid A. & Osman A., Antioxydative activity of extract from Mengkudu (*Morinda citrifolia* L.) root, fruit and leaf. *Food Chemistry Journal*, 2002; 78: 227-231.
28. Morton J.F., The Ocean-Going Noni, or Indian mulberry (*Morinda citrifolia*, Rubiaceae) and sorne of its "Colorful" relatives. *Economie Botany*, 1992; 46: 241-256.
29. Nicolas Trouillon, *Morinda citrifolia* L.: The Noni gold rush. Sciences Pharmaceutiques. Thèse soutenue publiquement à la faculté de Pharmacie de Grenoble, 2004; 113.
30. Ogboru, R. O., Okolie, P. L., & Agboje, I. Phytochemical screening and medicinal potentials of the bark of Dacryodes edulis (G. Don) HJ Lam. J Environ Anal Chem, 2015; 2(158): 2380-2391.
31. Parejo I., Codina C., Petrakis C. & Kefalas P., Evaluation of scavenging activity assessed by Co(II) /EDTA-induced luminal chemilunes-cence and DPPH (2,2-diphényl-1-pycryl-hydrazyl) free radical assay. *Journal of Pharmacological and Toxicological Methods*, 2000; 44: 507-512.
32. Phakhodee W., Distribution of naturally occurring anthraquinones, iridoidsand flavonoids from Morinda genus: chemistry and biological activity. Walailak *Journal of Science and Technology*, 2012; 9: 173-188.
33. Rievere, C., J.H. Van Nguyen, L.Pieters, B.Dejaegher, Y.V.Heyden, C.V.Minh, J.Quetin-Leclercq. Polyphenols isolated from antiradical extracts of Mallotus metcalfianus. Phytochemistry., 2009; 70: 86-94
34. Sasikumar, A. N., Perez, W. B., & Kinzy, T. G. The many roles of the eukaryotic elongation factor 1 complex. Wiley Interdisciplinary Reviews: RNA, 2012; 3(4): 543-555.
35. Sajani Jose and Maya, Phytochemical and Antioxidant Study of Morinda citrifolia. International Journal of Advanced Research in Biological Sciences, 2020; 7(4): 156-160.
36. Shen H., Tang Y., Muraoka H. & Washitani I., Charaterisatics of leaf photo synthesis and simulated individual carbon budget in primula nutansunder contrasting light and temperature conditions. *Journal of Plant Research*, 2008; 121: 191-200.
37. Schneider, T., Fetscher, C., Krege, S., & Michel, M. C. Signal transduction underlying carbachol-induced contraction of human urinary bladder. Journal of Pharmacology and Experimental Therapeutics, 2004; 309(3): 1148-1153.
38. Singh Y.N., Traditional medicine in Fiji : some herbai folk cures used by Fiji Indians. *Journal of Ethnopharmacol*, 1986; 15: 57-88.
39. Singleton, V. L., & Rossi, J. A. Colorimetry of total phenolics with phosphomolybdic-phosphotungstic acid reagents. American journal of Enology and Viticulture, 1965; 16(3): 144-158.
40. Suroowan S. & Mahomoodally M.F., A comparative ethnopharmacological analysis of traditional medicine used against respiratory tract diseases in Mauritius. *Journal of Ethnopharmacology*, 2016; 177: 61-80.
41. Turkmen N., Velioglu Y.S Sari F. & Polat G., Effect of Extraction Conditions on Measured Total

Polyphenol Contents and Antioxidant and Antibacterial Activities of Black Tea. *Molecules*, 2007; 12: 484-496.

42. Udoamaka F., Ezuruike N. & Prieto J.M., The use of plants in the traditional management of diabetes in Nigeria: Pharmacological and toxicological considerations. *Journal of Ethnopharmacology*, 2014; 155: 857-924.
43. Wang M.Y. & Su C., Cancer preventive effect of *Morinda citrifolia* (noni), *Annals New York Academy of Sciences*, 2001; 952: 161-162.
44. Wood J.E., Senthilmohan S.T. & Peskin A.V., Antioxidant activity of procyanidin-containing plant extracts at different pHs. *Food Chemistry*, 2002; 77: 155-161.
45. Zhang B.B. & Zhao K., Dietry polyphenols, oxidative stress and antioxidant anti-inflammatory effects. *Current Opinion in Food Science*, 2016; 8: 33-42.