Introduction

Throughout centuries and generations, humans have empirically used the virtues of natural resources to tackle their daily issues including the struggle against physiological and infectious diseases (IDs) (Dahiru, 2013). With the advent of modern microbiology in the 1865s, the challenge against IDs became much more oriented and opened ways to development of regimens of antimicrobial agents that obviously reduced the rates of deaths and increased life expectancy in many populations across the globe. The discovery of resistance phenotype in micro-organisms noticed soon after re-tabled, however, the issues of IDs that remain a permanent challenge in all health systems, associated with the interplay between drug use and
microbial drug tolerance (Iserin et al., 2001; Fotsing Kwetche et al., 2012; Tamil Selvan, 2013).

Some developed nations can afford the most recent conventional drugs, health facilities and healthcare workers why others, basically in developing countries do not have access to the minimum they need (Andersson and Hughes, 2011; Fotsing Kwetche et al., 2012; Mondal et al., 2012; Anochie et al., 2013). Further, antimicrobial resistance is a global phenomenon. Its fast growth is alarming among populations with limited resources in developing countries (Andersson and Hughes, 2011; Nguendo Yongsi, 2011; Tamil Selvan, 2013). Microbial resistance is associated with social determinants like basic education, average living standard, technological advances, and human resources for health. These factors are directly linked with inadequate use of available modern drugs in human medicine, veterinary medicine and crop production. Beyond the fast resistance growth, it is estimated that 10-20% of hospital admissions are due to the side effects of conventional drugs. Moving back to original but modernized and scientifically supported practices like the use of resources from plants (versatile resource worldwide) appeared as a reliable option for many. According to some reports (Iserin et al., 2001; WHO, 2003) in addition, some traditional drugs are more effective than conventional ones and can be used in resource limited settings. Estimating that 50% of all deaths in tropical countries are caused by infectious diseases and that more than 80% of people in Africa rely on traditional medicine, the WHO encouraged the production of improved traditional drugs (ITDs) that would be available and cost effective in specific contexts. In general, plants are rich in large varieties of bioactive components like essential oils, alkaloids, terpenoids, flavonoids, tannins, coumarins, phenolic compounds and heterosides acknowledged as potent substances against infectious agents. Many attempts are underway in understanding the scientific bases of antimicrobial phytotherapy and identifying associated bioactive components with their respective roles in the overall effectiveness of crude extracts (Igbinoso et al., 2009; Chougouou Kengne et al., 2012; Chougouou Kengne et al., 2013). A wide range of secondary metabolites are currently known in many plants with varying concentrations, depending upon the climate under which they are grown, the plant part and the soil composition (Chougouou Kengne et al., 2012; Kuate Tokam et al., 2013).

The present study targeted the phytochemical screening and antimicrobial potentials of extracts from Hyphaene thebaica (H. thebaica) harvested in Haraza (Republic of Chad - Central Africa). This work was conducted in the framework of the ongoing research program on medicinal plants put in place by health institutions in many African countries. It aimed at determining through macro-dilution the minimal inhibitory concentrations (MICs), the minimal lethal concentrations (MLC-minimal bactericidal and fungicidal concentrations-) of extracts from the flowers and stem of this plant. The inhibitory zone diameters associated with the MICs and MBCs were also assessed for a few strains with and without DMSO. Antimicrobial activity was tested on a total of nine bacterial and one dimorphic fungal strains belonging to microbial species often incriminated in IDs (either as true pathogens or as opportunistic organisms). The goal was to broaden the field of investigations in order to contribute to the development of new IDs treatment alternatives with potential sources for new conventional drugs.

Material and Methods

a. Plant identification and work sites

The plant identification was conducted by botanists in Chad and confirmed at the National Herbarium in Cameroon under the collection number 25255/SRFCam. The 8-10 years-old plant pats were harvested in October, 2013. Thereafter, the phytochemical screening was conducted in the Laboratories of chemistry of the Faculty of Medicine and Biomedical Sciences, Higher Teacher’s Training College, Yaoundé-Cameroon, and the antimicrobial tests performed in the Laboratory of Microbiology (Université des Montagnes, Bangangté-Cameroon).

Extractions were carried out on dried flowers and stem with methanol and ethyl acetate. 7 Kg and 5 Kg of the powdered product (flower and stem, respectively) were macerated in 15 L of each of the two solvents for 72 h. Filtration with whatman paper No 1 followed. The filtrates obtained were further concentrated in a Rota-Vapor (HEIDOLPH, HEIZBAB®) at 45°C and 200 bars to generate the crude residues used in the chemical screening.

b. Phytochemical screening

The aqueous test solution was prepared by dissolving (stirring to homogenization with a
magnetic agitator) 1 g of each crude extract in 20 mL of distilled water.

1. Test for Alkaloids (Mayer’s, Hager’s and Wagner’s tests)

2 mL of the test solutions were transferred into three test tubes. 2 mL of distilled water were also put in three other test tubes (negative controls). Respectively, a few drops of Mayer’s, Hager’s and Wagner’s reagents were added in the first group of tubes that contained the extracts, and in the three negative control tubes. The presence of alkaloids was evidenced by the development of precipitates in the 3 tubes that contained the test solutions, unlike the 3 control tubes (Djeussi et al., 2013).

2. Test for Coumarins (Alkaline reagent test)

In a test tube, 2 mL of NaOH was added to 2 mL of the test solution in each case. Development of a greenish yellow or blue fluorescence indicated a positive test for coumarins (Alzoreky and Nakahara, 2003).

2. Test for flavonoids

General tests

When a few drops of FeCl₃ were added to 2 mL of the extract in a test tube, development of an intense green color was evidence of the presence of flavonoids.

To 2 mL of the test solution 3 mL of NaOH was added. If a yellow color developed and discolored upon addition of HCl, that indicated the presence of flavonoids in the extract (Alzoreky and Nakahara, 2003).

Specific Test (Anthocyanins)

To 2 mL of each crude sample, 2 mL of H₂SO₄ was added. A pink-red color that turned into purple blue with addition of ammonia indicated the presence of anthocyanins (Ayoola et al., 2008).

3. Test for glycosides

About 1 mL of chloroform and 1 mL of 10% ammonia were respectively added to 2 mL of the extracts in the test tubes. A pink-red color indicated a positive test.

4. Mucilages

Two tubes were used in each case. 2 mL of each extract were transferred in the first and 2 mL of distilled water in the second. In each of these tubes, 3 mL of 95% ethanol were added. A flake formation confirmed the presence of mucilages (Sofowora, 1993).

5. Polyphenols

Two tubes were used in this experiment: the test and the control. 2 mL of each extract were transferred into test tubes and 2 mL of distilled water in the control tubes. Development of a whitish precipitate upon addition of lead acetate indicated the presence of total phenols. - When 2 mL of the test solution were mixed with 1 mL of acetic acid, development of a reddish color indicated the presence of polyphenols.

6. Saponosids test (frothing test)

2 mL of each test solution were introduced in a test tube containing 2 mL of distilled water. The tube was stopped and shaken vigorously for about 15 seconds. Allowed to stand for 15 min, persistent frothing indicated the presence of saponosids (Sofowora, 1993).

7. Test for terpenoids (Chloroform test)

2 mL of chloroform were mixed with 2 mL of the test solutions. To this mixture, 2 mL of concentrated H₂SO₄ were added and heated for 120 s in a water bath (≈65°C). A reddish brown color that developed at the interface was evidence of the presence of terpenoids (Mahesh and Satish, 2008).

8. Test for quinones

When 2 mL of the test solution were mixed with 2 mL of concentrated H₂SO₄, color changing into red was evidence of the presence of quinones. In each of the above cases, positive tests were semi-quantified based on the intensity of the test indicator.

c. In vitro antimicrobial susceptibility assays

Test micro-organisms

The micro-organisms used in this investigation were selected on the basis of their clinical and pharmacological importance. They included six Gram-negative bacterial strains (E. coli ATCC 25922, E. coli ATCC 35218, Pseudomonas aeruginosa QC 76110, Salmonella Enteritidis, Serratia odorifera and Vibrio cholera O1); two Gram-positive cocci (S. aureus QC 1625 and S.
aureus ATCC 1026™); one Gram-positive bacillus
(Enterococcus faecalis ATCC 29212), and a
dimorphic fungal specie, Candida albicans.

Minimal Inhibitory Concentration (MIC)

Prior to the MIC tests, all microbial strains were
seeded on Mueller Hinton agar (Liofilchem) and
incubated at 37°C for 24 h aerobically. From the
resulting overnight pure culture, a bacterial
suspension equal to 0.5 McFarland (10⁶-10⁸
cells/mL) was prepared and adjusted to the final
density required for susceptibility tests according to
the “Comité de l’Antibiogramme de la Société
Française de Microbiologie, CA-SFM (2014)”. A
similar procedure was followed to prepare, from a
fresh culture on Sabouraud agar (Liofilchem), the
2x10⁵ cells/mL suspension density used to assess
the antifungal activity with conventional techniques.
The test was conducted by macro-dilution in Mueller
Hinton broth (MHB) as performed in Kuate Tokam
et al., (2013) with slight modifications. Briefly, the
original (stock) solution was prepared at 400
mg/mL. In each of a series of twelve test tubes, 2
mL of MHB was dispensed. From this preparation, a
serial dilution was performed (from the stock
solution) to obtain extract concentrations that
ranged from 200 mg/mL through 0.1 mg/mL. In
addition, two controls were prepared with MHB
without extract (positive control for growth and the
negative control for broth sterility). This procedure
was repeated for all microbial strains (C. albicans
was tested in Sabouraud broth).

In each tube (except the broth sterility control), 15
µL of the above bacterial (or fungal) preparation
were added. The preparations were incubated at
37°C for 24 h for bacteria and 30°C for C. albicans
in aerobic environments. When incubation was
completed, the tubes were centrifuged at 5000 rpm
for five minutes. The MICs were read from the first
tube in which no microbial precipitate (whitish) was
observed at the bottom upon centrifugation
(absence of growth), and confirmed by the broth
turbidity recorded prior to centrifugation. This
procedure was repeated three times for each strain
for test reproducibility.

Minimal Lethal Concentration (MLC)

The tubes in which no visible microbial growth was
obtained were re-homogenized. 10-15 µL of the
resulting suspension were reseeded on appropriate
agar (Mueller Hinton agar for bacteria and
Sabouraud agar for C. albicans). These cultures
were allowed to incubate aerobically overnight at
37°C and 30°C, respectively. Upon completion of
incubation the MLC (MBCs for bacteria and MFC for
C. albicans) were recorded from the first dilution in
which no visible growth was obtained on the agar
plate.

Microbial growth inhibition zone diameters

The inhibitory zone diameters were determined by
the disc diffusion technique on MHA (Liofilchem)
according to Hayes and Markovic (2002) with slight
modifications. Briefly, the bacterial suspension
prepared as described above was further diluted
(1/10) to the final density required for susceptibility
test by standard agar diffusion technique with swabs.

On the seeded agar plate, ten sterile paper discs (6
mm diameter each) were deposited for the tests.
Out of these ten paper discs, 15 µL of the extract at
the MIC concentration were dispensed on four (one
received sterile distilled water) on one hand; 15 µL
of the extract at the MIC concentration with 10%
(v/v) DMSO (Merk) was dispensed on four and one
was inoculated with DMSO. The same procedure
was followed at the MBCs for all bacterial strains
tested. These preparations were, thereafter,
icubated aerobically at 37°C for 18-24 h. After
incubation, the zone of inhibition around each disc
was recorded and computerized in terms of means
and standard deviations.

Results

Phytochemical screening of the crude extracts

The solvents used displayed various effectiveness
in the extraction process. The results obtained in
this semi-quantitative assay were recorded,
summarized and presented in table 1.

When present in the plant, the bioactive compounds
targeted were indiscriminately detected in
approximately similar amounts in the flowers and
stem. It also appeared from the tabled data that
extraction with methanol was more effective than
with ethyl acetate in either part. Overall in fact,
about 80% and 70% of the chemical categories
were identified in the flowers and stem,
respectively, when methanol was used for
extraction, against 50% and 60% with ethyl acetate.
Coumarins and mucilages could not be detected
from any of the crude extracts, regardless of the
technique used. Acetic acid was also efficient in
characterizing polyphenols only in the methanol
extract from the flowers.
Table 1: Characterization of chemicals in the methanol and ethyl acetate crude extracts

<table>
<thead>
<tr>
<th>Chemical category</th>
<th>Reagent</th>
<th>Flowers</th>
<th>Stem</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>METHF</td>
<td>ETACF</td>
</tr>
<tr>
<td>Alkaloids</td>
<td>Valser-Mayer</td>
<td>+++</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Hager</td>
<td>+++</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Wagner</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>Coumarins</td>
<td>NaOH</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Flavonoids</td>
<td>FeCl₃ 1%</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td></td>
<td>NaOH + HCl</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td>Anthocyanin</td>
<td>H₂SO₄ + NH₄OH</td>
<td>+++</td>
<td>-</td>
</tr>
<tr>
<td>(spF)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glycoside</td>
<td>10% Chloroform + NH₄</td>
<td>++</td>
<td>-</td>
</tr>
<tr>
<td>Mucilage</td>
<td>Ethanol 95%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Polyphenols</td>
<td>Acetate lead</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Acetic acid</td>
<td>+++</td>
<td>-</td>
</tr>
<tr>
<td>Quinones</td>
<td>H₂SO₄</td>
<td>+++</td>
<td>-</td>
</tr>
<tr>
<td>Saponosids</td>
<td>Nr</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td>Terpenoids</td>
<td>Chloroform + H₂SO₄</td>
<td>+++</td>
<td>+</td>
</tr>
</tbody>
</table>

METH₁: Extract with Methanol; ETAC₁: Extracts with Ethyl acetate; spF: specific flavoinoids; Nr: no particular reagent

**In vitro biological activity**

Assessment of the antimicrobial potentials of the crude extracts generated series of data that were computerized and summarized accordingly.

<table>
<thead>
<tr>
<th>Micro-organism</th>
<th>MIC (mg/mL)</th>
<th>MLC (mg/mL)</th>
<th>MLC/MIC</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>E. coli</em> ATCC 25922</td>
<td>6.25</td>
<td>50</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>&gt;200</td>
<td>8</td>
</tr>
<tr>
<td><em>E. coli</em> ATCC 35218</td>
<td>3.13</td>
<td>25</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>3.13</td>
<td>100</td>
<td>32</td>
</tr>
<tr>
<td><em>S. aureus</em> QC 1625</td>
<td>3.13</td>
<td>&gt;200</td>
<td>&gt;64</td>
</tr>
<tr>
<td></td>
<td>6.25</td>
<td>&gt;200</td>
<td>&gt;32</td>
</tr>
<tr>
<td><em>P. aeruginosa</em> QC 76110</td>
<td>6.25</td>
<td>12.5</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>200</td>
<td>4</td>
</tr>
<tr>
<td><em>E. fæcalis</em> ATCC 29212</td>
<td>3.13</td>
<td>50</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>&gt;200</td>
<td>&gt;8</td>
</tr>
<tr>
<td><em>S. aureus</em> ATCC 1026™</td>
<td>25</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3.13</td>
<td>100</td>
<td>32</td>
</tr>
<tr>
<td><em>V. cholerae</em> O1</td>
<td>50</td>
<td>50</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>200</td>
<td>4</td>
</tr>
<tr>
<td><em>S. Enteritidis</em></td>
<td>3.13</td>
<td>25</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>&gt;200</td>
<td>&gt;8</td>
</tr>
<tr>
<td><em>S. odorifera</em></td>
<td>0.1</td>
<td>&gt;200</td>
<td>&gt;2000</td>
</tr>
<tr>
<td></td>
<td>0.1</td>
<td>&gt;200</td>
<td>&gt;2000</td>
</tr>
<tr>
<td><em>C. albicans</em></td>
<td>3.13</td>
<td>100</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>3.13</td>
<td>100</td>
<td>32</td>
</tr>
</tbody>
</table>

* > : Larger than ; *- : First line: flower-derived; - second line: stem-derived
With the exception of \textit{V. cholerae} in which they were equal, the overall picture is that the MLCs were very large compared to the MICs. The largest MIC indexes were obtained with \textit{S. odorifera} and \textit{S. aureus} QC 1625 in which no extract concentration within the range considered (regardless of the origin) could have a lethal effect. No lethal effect could also be obtained on \textit{E. fecalis} ATCC 29212 and \textit{S. Enteritidis} with the extract from the stem. On \textit{E. coli} ATCC35218, O1-\textit{V. cholerae}, \textit{S. odorifera} and \textit{C. albicans}, growth inhibition was recorded at similar concentration for both crude extracts.

When bacterial growth inhibition was assessed on MH agar the inhibitory zone diameters generated by the diffusion of extracts from the flower and stem (with and without addition of DMSO) were recorded and displayed as presented in Table 3. As expected, the diameters at the MBCs were larger than those recorded at the MICs in all cases. They differed slightly with the extract used on the same bacterial strain. But overall, addition of DMSO was followed by an increase in the zone of inhibition in most cases. The largest increase was observed with \textit{E. coli} ATTCC 35218. In \textit{V. cholerae}, its addition in the flower-derived extract did not produce any obvious additional effect.

### Table 3: Inhibitory zone diameters with and without DMSO

<table>
<thead>
<tr>
<th>Microorganism</th>
<th>Mean Inhibition zone diameter ± SD (mm)*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Without DMSO</td>
</tr>
<tr>
<td></td>
<td>MIC</td>
</tr>
<tr>
<td>\textit{E. coli} ATCC 25922</td>
<td>8±1.4</td>
</tr>
<tr>
<td>\textit{E. coli} ATCC 35218</td>
<td>10.3±0.9</td>
</tr>
<tr>
<td>\textit{S. aureus} ATCC 1026™</td>
<td>7.5±0.5</td>
</tr>
<tr>
<td>\textit{P. aeruginosa} QC 76110</td>
<td>9±0.0</td>
</tr>
<tr>
<td>\textit{V. cholerae} 01</td>
<td>8±0.8</td>
</tr>
<tr>
<td>\textit{V. cholerae} 01</td>
<td>8±0.8</td>
</tr>
<tr>
<td>\textit{V. cholerae} 01</td>
<td>10±0.0</td>
</tr>
</tbody>
</table>

* - upper line: flower-derived; - lower line: stem-derived

### Discussion

The present investigation provided substantial pieces of information that corroborate the use of \textit{Hyphaene thebaica} (\textit{H. thebaica}) by traditional health practitioners. \textit{H. thebaica} is rich in hosts of secondary metabolites that were previously identified in other plant resources (Mahesh and Satish, 2008; Djeussi et al., 2013; Kuate Tokam et al., 2013) and known for their role in protecting against and preventing human diseases. Overall, 80% of the targeted bioactive compounds were detected in the plant regardless of the part from which the crude extract was obtained, the solvent or the screening technique used. However, optimal use of the plant potential appeared to rely on methanol for extraction. This is consistent with the findings of the earlier authors who reported that appropriate choice of the solvent is important in optimizing the extraction product composition (Wendakoon et al., 2012). The bioactive phyto-compounds detected (and semi-quantified) in \textit{H. thebaica} roughly included alkaloids, flavonoids, glycosides, terpenoids, saponosids, polyphenols and quinones. Flavonoids and alkaloids were described as antibacterial, antiviral and anticancer agents (Ayoola et al., 2006; Ayoola et al., 2008; Savithramma et al., 2011), among other potentials they possess. Extracts from \textit{H. thebaica} could also play a key role in the control of haemostasis and the related vasoconstriction with regard to the presence of saponins and terpenoids (Dandjesso et al., 2012). Saponosids can act and reduce blood cholesterol, blood sugar or cause weight loss. Further, they can be used as detergent, pesticide, molluscicide, anifungal, or as anticancer agents (Rathore et al., 2012).

In general, plant extract may act on microorganism through different mechanisms, some of which include complexation of the cell envelop constituents (and the associated disruption of the normal cell metabolic processes), and inhibition of the quorum sensing mechanism (Khan et al., 2009; Szabo et al., 2010). Both have paramount importance in the infectious process (microbes require convenient inoculums to cause disease in their hosts). Although the individual role of each
constituent is yet to be fully investigated through, it is known that flavonoids attach to extra-cellular and membrane-borne proteins, cause their inactivation while quinones interfere with bacterial survival by inactivation through attachment to nucleophilic amino acids within protein molecules. It is not clear, however, whether in vivo the bioactive compounds play neutral, additional, synergistic or antagonistic roles. A quantitative study is necessary to determine both the content and activity of each of the chemicals detected, and perhaps, would be useful in understanding better why one extract is more effective than the other. *P. aeruginosa*, *S. odrifera* and *E. coli* are representative of a large group of Gram-negative bacteria that are commonly incriminated in deadly opportunistic nosocomial and community acquired infections. Their role in the infectious process can be regarded in at least two ways: their virulence that is associated with rapid growth (15-20 min/generation) and the resistance traits they may express or disseminate through genetic mobile elements. Both factors are likely to prolong the course of infection with the related extra financial charges (Yorita-Christensen et al., 2009). Professional Gram-negative bacilli like *V. cholerae* or *S. Enteritidis* are occasionally incriminated (because they are not as frequent as the formers in nature). They can cause outbreaks or severe food-borne infections in areas with low hygiene standard (Tamatcho Kweyang et al., 2012; Kouitcheu Mabeku et al., 2013). In the present study the strains tested were susceptible at relatively low extract concentration.

Strains of *S. aureus* are incriminated in suppurative infections, superficial lesions (like boils and impetigo), throat sore, pneumonia, mastitis, phlebitis, meningitis, food poisoning, and urinary tract infections (Wendakoon et al., 2012; Sen and Amla, 2012; Daniel et al., 2012; Djeussi et al., 2013). Strains used in the present investigation were also found susceptible at relatively low concentrations.

These antimicrobial tests revealed very slight differences in the activity of both extracts, consistent with result obtained in the chemical screening. The differences may be suggesting that other active constituents (beyond the identified ones) were likely present in the extract. Activity recorded in the present investigation is evidence that the crude extracts could be used in therapeutic, in accordance with the use made if the plant by traditional practitioners in human IDs management. This assertion can be reinforced by the relatively reduced values of MICs recorded (the highest MIC observed was 50 mg/mL).

Earlier surveys (Aboada and Efuwape, 2001; Mohanta et al., 2007; Sen and Amla, 2012) reported that saponins could inhibit growth in *C. albicans*. Accordingly, growth inhibition of *C. albicans* (at reduced MIC) could be explained by the high saponin amount in the crude extract. Related conclusions could also be drawn as far as other active secondary metabolites are concerned. From these findings, however, it cannot be ruled out that one component or the other was actually responsible for the antimicrobial effect observed (for the reasons stated above). Wendakoon et al. (2012) reported differential effectiveness of plant extract on Gram-positive and Gram-negative bacteria. In the current investigation, the action appeared to be strain-specific rather than Gram-group specific and, like in Kuate Tokam et al. (2013), addition of DMSO further potentialized the activity of the extracts.

The use of extracts from this plant, therefore, appears as a reliable alternative that can be capitalized in resource-limited communities were conventional drugs are either lacking or, available but beyond the purchasing power of most people. Further concentrating the extract would produce even more satisfactory results. This requires proper orientation of the local heath policy and will be possible through standardized extraction techniques and solvents that should be specified according to the targeted bioactive compounds (once detected) in the natural resources of interest. One of the paramount virtues of plant extracts is that they contain a host of chemical compounds that have potentials to act and protect against many human conditions, unlike modern drugs and food additives, generally more focus.

**Conclusion**

*Hyphaene thebaica* provides a precious available and sustainable source for medicine in the short run for indigenous populations and a reliable source for new conventional drugs. This promising future with *H. thebaica* and other natural resources relies on a strong political will, financial support, trained and motivated human resources that will explore the diversity of their potentials for human welfare.

**Acknowledgments**

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