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(Research Article)

Exploration of the mineral compounds contained in the aerial organs of *Phyllanthus amarus* schumach and Thonn

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Abstract

Medicinal plants are increasingly used by sub-Saharan populations for their health security. The chemical composition of *Phyllanthus amarus* organs can enhance the use of this broad-spectrum plant species against pathogens.

P. amarus stems contain moisture ranging from 67.8% to 75.2%, chlorides, phosphates, nitrites and nitrates. The same aerial organs contain no sulfate or calcium.

The ash content of *P. amarus* stems varies between 43 and 45%, an important proportion for exploring the mineral elements contained in organic matter and likely to serve as intermediary compounds in the synthesis of secondary metabolites.

Keywords: *Phyllanthus amarus;* Medicinal plants; Mineral elements; Ash

1. Introduction

Humans have always relied on nature for their basic needs. For practical reasons of accessibility, plants have formed the basis of all known traditional medicines. The oldest of these comes from Mesopotamia and dates back to 2600 BC. It records the use of some 1,000 plant-derived remedies, many of which are still used today to treat ailments ranging from coughs and colds to parasitic and inflammatory infections [1].

Malaria is a real threat to public health in sub-Saharan Africa. Its resurgence increased around the 1980s as a result of Plasmodium's resistance to chloroquine [2]. The use of other, more effective antimalarial molecules (sulfadoxine-pyrimethamine combination and mefloquine) proved indispensable [3]. Today, the therapeutic arsenal against malaria in Africa is limited [4].

In addition to malaria, diabetes is another pandemic in some low- and middle-income African countries. According to the WHO, diabetes will be the seventh leading cause of death worldwide by 2030. In 2004, 3.4 million people died as a result of high fasting blood sugar levels. Over 80% of these deaths occurred in low- and middle-income countries [5]. Around 3.5 million people were being treated for diabetes in 2014, representing 5.3% of the world's population. And this number is increasing by almost 3% every year. More than four hundred and twenty-two million adults worldwide currently have diabetes [6].

The statistics for these two diseases are alarming. Considering, on the one hand, that certain microbial strains are showing resistance to synthetic drugs, and on the other hand, the damage that can be caused by the misuse of available

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medicinal plants [7], it is important to explore the mineral ions contained in a medicinal plant that may justify certain biological activities [8].

2. Material and methods

2.1. Biological material

The biological material, consisting of *Phyllanthus amarus* stems, was collected in the Kisenso municipality, in the Bikanga district and in the commune of Ngaliema, in the Binza district in Kinshasa whose geographical coordinates are : Latitude: 4°19′39″ South, longitude: 15°18′48″ East and altitude above sea level: 281 m [9].

2.2. Methods

2.2.1. Drugs

Phytochemical analyses were carried out at the phytochemistry laboratory of the Faculty of Science at the Université Pédagogique Nationale of Kinshasa. Stems separated from twigs and roots were oven- dried and then ground using a mortar and pestle. Analyses were carried out on the powders obtained.

2.2.2. Determination of moisture content

The samples were first weighed fresh to obtain the initial weight (Fresh Weight). The samples were then placed in the Mermmert study at 40 °c (± 0.1). Weighing was carried out every 48 hours until a constant weight was reached. Dry matter content and moisture content were calculated using the following formulas:

$$\frac{\text{P1x100}}{p} = \text{\% dry matter}$$

$$\text{and \% moisture } = \frac{(\text{P} - \text{P1})\text{x100}}{p}$$

Where P denotes the fresh weight of the sample and P1 the dry weight of the sample.

2.2.3. Mineral compounds development

Ash making

- Place a quantity of *Phyllanthus amarus* stems in a mortar.
- Grind the stems
- Place the resulting powder on the hot plate until ash is obtained.

Ash content

Total ash was determined using the method described by Degroote in Itoma [10].

- Principle

Incinerate a known quantity of sample on a hot plate until gray ash is obtained and deduce the ash content.

- Procedure

Using a spatula a few grams of *Phyllanthus amarus* stem powder are deposited (P1) into a pre-weighed Pyrex beaker (P0). The beaker and its contents are then placed on the hot plate for at least 2 hours, until greyish ash is obtained (P2).

Expressions of results

Ash = (P2-P0) x 100 / (P1-P0)

P0 = weight of empty beaker
P1 = weight of sample
P2= weight of beaker + ash

2.2.4. Detection of mineral compounds

Chloride ions

Take a few grams of *Phyllathus amarus* ash and put them in a beaker containing a quantity of distilled water. Stir until the mixture is homogeneous. Filter the mixture; divide the filtrate between 4 different test tubes. Then acidify with 2 drops of nitric acid and add 2 drops of silver nitrate to trigger the reaction. If the silver chloride precipitates, the reaction is positive.

Sulfate ions

After obtaining the filtrate, acidify with chloridric acid and add a few drops of 0.1M cobalt II chloride. If copper II sulfate precipitates, the reaction is positive.

Phosphate ions

Prepare 2.65 g of ammonium chloride in 50ml of distilled water mixed with hot saturated solution of magnesium sulfate solution equal in volume; add a few drops of ammonia in different test tubes. If the ammonioco-magnesium phospate precipitates, the reaction is positive. The test kit for colorimetric determination of phosphate ions was used to support the reaction test as follows:

- Pour a sample of the filtrate into a container
- Add 6 drops of PO4-1, close the container and mix
- Add 6 drops of PO4-2, close the container and mix
- Open the container after 10 minutes and place it in position B of the dial indicator
- Slide the dial indicator until the colors match in the inspection hole.

Nitrate and nitrite ions

- Place 3 cc of the filtrate to be analyzed in a test tube.
- Add diphenylamine reagent (place one crystal of diphenylamine in 1 cc of concentrated sulfuric acid). If a precipitate forms, the reaction is positive.

The nitrate and nitrite strip test kit was used to support the reaction test, using the following procedure:

- Place a quantity of ash in a beaker
- Add distilled water
- Shake vigorously
- Place open filter paper in suspension
- Place the Nitrate test stick in the suspension that has passed through the filter.
- After waiting one minute, compare the color of the test stick with the reference colors on the case

Calcium ions

- Place 3 cc of the filtrate to be analyzed in a test tube
- Add a few millilitres of ammonium oxalate to the filtrate. If a white precipitate of calcium oxalate forms, the reaction is positive.

3. Results and discussion

The results of our moisture and dry matter analyses are shown in Figures 1 and 2. Table 1 summarizes the reactions used to identify ions.

3.1. Moisture and ash content

Figure 1 shows the moisture content of *P. amarus* stems harvested at Binza and Kisenso.

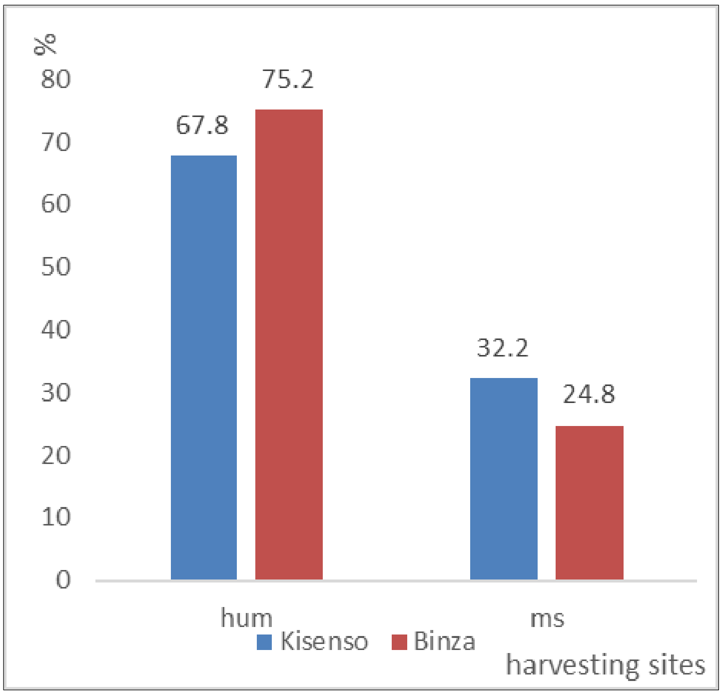

Figure 1 Moisture and dry matter content of *P. amarus*

This graph shows that the moisture content of samples from Kisenso is 67.8%, while those from Binza have a moisture content of 75.2%.

As for dry matter, the graph shows that samples harvested in Kisenso have a dry matter content of 32.2%, while those harvested in Binza have a dry matter content of 24.8%.

Figure 2 shows the ash content of *P. amarus* stems harvested at the two sites.

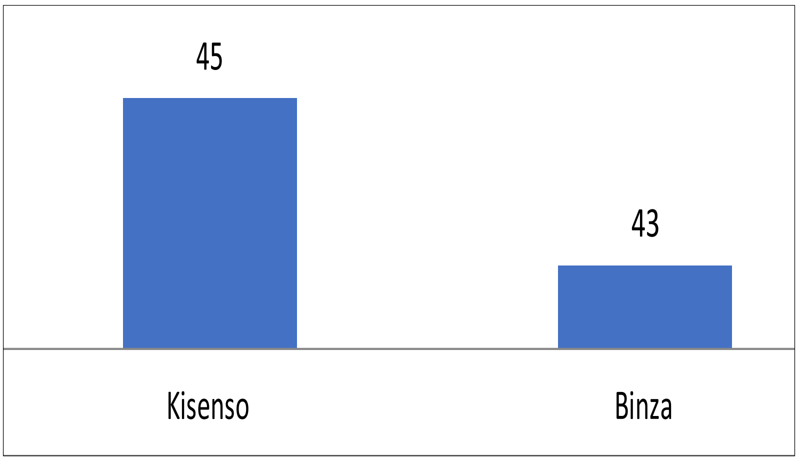

Figure 2 Ash content of *P. amarus* stems

This graph shows that the ash content of samples harvested at Kisenso is 45%, while that of samples harvested at Binza is 43%.

3.2. Mineral elements

Table 1 The results of mineral analysis of *P. amarus* stems. Table 1: Mineral element tests on *P. amarus* stems

	Binza				**Kisenso**			
	1st testing	**2nd testing**	**3rt testing**	**4th testing**	**1st testing**	**2nd testing**	**3rt testing**	**4th testing**
Chloride ions	+	+	+	+	+	+	+	+
Sulfate ions	-	-	-	-	-	-	-	-
Phosphates ions	+	+	+	+	+	+	+	+
Nitrates ions	+	+	+	+	+	+	+	+
Nitrites ions	+	+	+	+	+	+	+	+
Calciums ions	-	-	-	-	-	-	-	-

+ = present - = absent

This table shows that

- Chlorides, phosphates, nitrites and nitrates are present in samples from Binza and Kisenso.
- Sulfates and calcium are absent in the Binza and Kisenso samples.

4. Conclusion

The aim of this study was to explore the mineral elements present in the *Phyllanthus amarus* stem, a very familiar medicinal plant growing wildly in our immediate environment. Given the broad spectrum of action of this plant species, it is imperative to know the ion composition of its specific organs in order to guide its prescription against pathologies. It is with this in mind that this plant can be useful in combating health insecurity and promoting the use of specific organs of medicinal plants in phytotherapy.

With a moisture content ranging from 67.8% to 75.2%, *Phyllanthus amarus* stems contain chlorides, phosphates, nitrites and nitrates. The same aerial organs contain no sulfate or calcium.

The ash content of *P. amarus* stems varies between 43 and 45%, which is an important proportion for exploring the mineral elements contained in organic matter.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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