

Aspect of the Chemical Constituents of the Synonymous *Aloe vera* (L.) Burm.f. and *Aloe barbadensis* Miller

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Abstract: The common medicinal *Aloe* had been known for quite a long time, as *Aloe barbadensis* by most formularies and reference books, until it was reduced to the synonymy of *Aloe vera*. Despite this, both taxa continued to be used as a matter of choice by different workers, as if they are distinct species, leading to confusion in the literature. The present study investigated aspects of the chemical constituents of young and old plants of the synonymous species, using standard procedures. This was to ascertain whether the findings would lend support to the view that both taxa are one species. Young and old *Aloe barbadensis* and *A. vera* leaves tested positive to alkaloids, flavonoids, tannins, cardiac glycosides anthraquinones, saponins and negative to phlobatannins. Quantitative mineral assay showed the presence in varying levels, of micronutrients chromium, zinc and manganese and macronutrients calcium, potassium; and magnesium in both taxa. The findings in this study lend support to the view that both taxa are synonymous.

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1. Introduction

Although chemical characters may be employed at all levels of the taxonomic hierarchy, they should not be regarded as *a priori* more important than other characters either for purposes of analysis or synthesis (Davis and Heywood, 1967). For quite a long time, most formularies and reference books regarded *Aloe barbadensis* as the correct species name for the common medicinal *Aloe*. While this remained the official name, the plant was still popularly known as *Aloe vera*. However, Newton (1979) argued that the scientific name should be *Aloe vera*. His argument was predicated on the fact that since Burman had used this name for what Linnaeus had previously described as a variety *vera* of *Aloe perfoliata*, Burman had priority over Miller's later use of the name *A. barbadensis* (Newton, 1979). Based on this reasoning, *A. barbadensis* was reduced to the synonymy of *Aloe vera* which is the legitimate name (Newton, 2012). In spite of this, the use of the legitimate name *Aloe vera* only appeared not to have been respected by some workers in the literature.

As an example, Wang and Strong (1995) carried out a two-year study monitoring some physical and chemical properties of field-grown *Aloe barbadensis* leaves and stated that the plant could also be named *Aloe vera*. Although Barandozi *et al.*, (2011) studied the effects of fertilizer on morphological traits in *Aloe vera*, the workers stated that Curacao *Aloe* is also *Aloe barbadensis*. Boudreau and Beland (2006) evaluated the biological and toxicological properties of *Aloe barbadensis* and *Aloe vera*. The authors used both scientific names as if they were distinct species. Also

Foster *et al.*, (2011) stated that *Aloe vera* was commonly known as *Aloe barbadensis* despite its legitimate name being *A. vera*.

The literature has examples of plant species previously declared as synonyms but with fresh evidences later recognized as distinct species. Davis and Heywood (1967) reported that *Pinus engelonanii* had in the past been treated as a synonym of *P. ponderosa* but with scientific evidence that the turpentine composition of both species were very different, they were thereafter regarded as distinct species. Despite the treatment of *Aloe barbadensis* being a synonym of *A. vera* and as some workers still use and regard the species as if they are distinct, there is the need to study their chemical constituents.

In Southwestern Nigeria both names *Aloe vera* and *A. barbadensis* are differentially used based on their morphological sizes. Generally plants called *Aloe vera* are smaller in size than *A. barbadensis*, both of medicinal importance. Their uses include the treatment of burns, constipation wound healing and in soap preparation for antiseptic as well as cosmetic purposes.

The present work was undertaken to study the chemical constituents of the plants referred to as *Aloe barbadensis* and *A. vera*. This was with a view to ascertaining whether the study would serve as a support or otherwise for their treatment as synonyms.

2. Materials and Methods

Collection of plant materials

Matured *Aloe vera* plant grown on soil for 3 years, and a potted younger species of 1½ years old

were collected from private gardens in the University of Ibadan Nigeria. *Aloe barbadensis* grown on soil for 2 years was collected from the Centre for Environment, Renewable Natural Resources Management, Research and Development (CENRAD), Ibadan. Identification of the plant samples was confirmed at the University of Ibadan Herbarium (UIH).

Extraction

25g of the pulverized leaves were extracted with 500ml absolute ethanol for 8 hours, using soxhlet extractor. After extraction, the solvent was allowed to evaporate and condensed into another flask until the extract left in the soxhlet flask was about 50ml, this was then allowed to cool before further drying and weighing to know the yield. The solid crystal extract was kept in sterile labeled MacCartney bottles and stored at 4°C. The plant extracts were tested for active constituents.

Phytochemical screening

The following active constituents were tested for in line with standard procedures (Harborne, 1984; Sofowora, 2008).

Alkaloids:

The extract (0.5g) was stirred with 5ml Dilute HCl on a steam bath, 1ml of the filtrate was treated with a few drops of Meyer's reagent and another 1ml portion was treated similarly with Dragendorff's reagent and finally another 1ml portion with Wagner's reagent. The formation of characteristic precipitates was observed.

Flavonoids:

Five millilitres (5ml.) of ethanol extract was treated with four drops of concentrated HCl after which 0.5gm of magnesium turnings was added. Development of pink or magenta-red colour within three minutes indicated the presence of flavonoids.

Tannins:

Five hundred milligrams (500mg) of dried extract was mixed with 10ml of distilled water and heated on water bath. The mixture was filtered and ferric chloride (FeCl_3) was added to the filtrate. Appearance of blue-black green or blue-green colouration showed the presence of tannins.

Cardiac glycosides

Keller – Kelliani's Test: The extract (0.5g) was dissolved in 2ml of glacial acetic acid containing one drop of ferric chloride solution. This was then underlaid with 1ml of concentrated sulphuric acid (H_2SO_4). Formation of a light brown ring indicated the presence of cardiac glycoside.

Anthraquinones

Five grammes (5g) of the extract was shaken with 10ml of benzene. The solution was filtered and 5ml of 10% ammonium hydroxide (NH_4OH) solution was added to the filtrate. A positive reaction was indicated by a pink, red and violet colour appearing in the lower phase.

Saponins

The extract (0.2g) was shaken with 5ml of distilled water and then heated to boil. Persistent frothing showed the presence of saponins.

Phlobatannins

Five millilitres of the aqueous extract of the plant sample was boiled with 1% hydrochloric acid (HCl). The presence of phlobatannins was indicated by deposition of a red precipitate.

Reducing sugar

Half a gram (0.5g) of the extract was dissolved in distilled water; two drops of Fehling's solution was added and warmed in a water-bath. The disappearance of the blue colour of Fehling's solution and the appearance of red precipitate indicated the presence of reducing sugar.

Mineral assay of leaves

To digest the plant material, 2g of the leaf was weighed into a dry digestion tube and 5ml of 2:1 nitric perchloric acid was added to it. A small glass funnel was inserted to act as a reflux condenser and left for a few hours at 50% or overnight with no heat. Tubes were placed in heating block and digested for one hour at 150°C. The temperature was raised to 230°C and the tubes rotated so that the nitric acid was driven off as uniformly as possible in case of any "cold spots". The time when all tubes had reached the dense white fume stage was noted and digestion was continued for another 30 minutes. Tubes were removed from the digestion block and cooled at about 100°C. 1ml of 1:1 HCl was added to dispel the last trace of oxides of nitrogen and then heated to white fuming stage. It was then cooled just to handle and 5ml of water was added, then mixed thoroughly in order to be certain that sparingly soluble perchloric salts were dissolved. It was allowed to stand until silica had settled and about 10ml of the digest was taken by means of a pipette for analysis which was read on the Atomic absorption spectrophotometer.

3. Results

Phytochemical screening

As shown in Table 1, *Aloe barbadensis*, young and matured shoots of *Aloe vera* tested positive to alkaloids, flavonoids, tannins, cardiac glycosides, anthraquinones, saponins and reducing sugar but tested negative to phlobatannins.

Test 1: Phytochemical screening of two *Aloe* species

Secondary metabolites	<i>Aloe barbadensis</i>	<i>Aloe vera</i> (young)	<i>Aloe vera</i> (matured)
Alkaloids	+	+	+
Flavonoids	+	+	+
Tannins	+	+	+
Cardiac glycosides	+	+	+
Anthraquinones	+	+	+
Phlobatannins	-	-	-
Saponins	+	+	+
Reducing sugar	+	+	+

Legend: + = Present - = Absent

Mineral analysis

The quantitative analysis of the mineral elements, chromium, calcium, zinc, magnesium, manganese and potassium are shown in Table 2. All the six elements were found in *A. barbadensis* and *A. vera* (young) but chromium and zinc were not

detectable in matured *Aloe vera* plant. Comparatively, the values of zinc, calcium and magnesium were higher in *Aloe barbadensis* than *A. vera* which had higher levels of manganese and potassium than *A. barbadensis*.

Table 2: Quantitative analysis of six minerals of *Aloe* species

<i>Aloe</i> species	Mg/kg					
	Cr	Ca	Zn	Mg	Mn	K
<i>Aloe barbadensis</i>	63.25	1488	18.15	927.07	11.95	492.20
<i>Aloe vera</i> (young)	11.00	963	4.80	229.58	5.05	510.60
<i>Aloe vera</i> (matured)	Nd	752.5	Nd	115.83	21.55	72.45

Nd: Not detectable

4. Discussion

As phytochemicals, secondary metabolites are the by-products of primary metabolism in plants (Richter, 1978.). Although certain functions have been ascribed to some phytochemicals (Boilley *et al.*, 1998), in the view of Stace (1989), secondary metabolites appear to perform non-universally vital functions and therefore are less widespread in plants. He opined that this restricted occurrence in plants renders secondary metabolites valuable as taxonomic information. Apart from this attribute, secondary metabolites are very important because of their pharmacological activities which make them useful components of most herbal preparations.

In the present study, alkaloids, flavonoids, tannins, cardiac glycosides, anthraquinones, saponins and reducing sugars were detected in *Aloe vera* and *A. barbadensis*. Alkaloids are known to have activities on the autonomic nervous system, blood vessels, respiratory system and gastrointestinal tract (Omotayo and Omoyemi, 2009). Flavonoids have been reported by Lee *et al.*, (2007) to have anti-inflammatory, anti-cancer and anti-viral properties. Riviere *et al.*, (2009) reported that tannins possess general antimicrobial and antioxidant activities. Cardiac glycosides are plant steroids having stimulating action on the heart muscle hence are cardio-tonic (Ajayi, 2006). According to Evans (1989), anthraquinones act on gastrointestinal tract to increase the peristalsis action, hence useful as

a purgative drug. Saponins lower cholesterol level and have anti-diabetic, anti-carcinogenic properties (Edward, 2011). Reducing sugars act as antioxidants (Richard, 2006).

The quantitative mineral assay of the two *Aloe* species revealed the presence in varying levels, of chromium, calcium, zinc, magnesium, manganese and potassium. Calcium, magnesium and potassium are inorganic macronutrients which constitute the major part of the buffer ions in human body fluids. Calcium is essential for proper utilization of Vitamins A, D and C and speeds all healing processes in the human body (Pamplona-Roger, 1998). Magnesium helps in the utilization of Vitamins B and E and functions with other minerals like calcium, sodium and potassium in maintaining body fluid and electrolyte balance (Bakhru, 1999). Also potassium and sodium promote the regulation of osmotic pressure, to maintain water balance within the body.

Chromium zinc and manganese are micronutrients of relatively high importance. Chromium is involved in maintaining appropriate blood glucose levels and zinc is important because all the enzymes in human body require it for their functioning (Bakhru, 1999). Also, manganese activates numerous enzymes and has a role in protein, carbohydrate and fat metabolism.

The occurrence of the same types of phytochemicals, macro and micronutrients, and the

absence of phlobatannins in both *Aloe vera* and *A. barbadensis* studied, lends support to their being officially regarded as synonyms despite some morphological differences which may be due to habitat factors. However the variations in the quantities of macro and micronutrients may be attributed to age of the plants, environmental and growth factors.

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