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Determination of Benzoic Acid Derivatives and Lignans Compositions of the Leaves of *Sansevieria Senegambica* Baker

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ABSTRACT

The benzoic acid derivatives and lignans levels in the leaves of *Sansevieria senegambica* were determined by gas chromatography coupled with flame ionization detector. Gas chromatographic analysis revealed that the leaves have high benzoic acid derivatives (3454.91 mg kg^{-1} wet weight and 10830.43 mg kg^{-1} dry weight) and low in lignans (1.96 mg kg^{-1} wet weight and 6.14 mg kg^{-1} dry weight) contents. Five benzoic acid derivatives, mainly 4-hydroxybenzoic acid methyl ester (about 24.97% of the phenolic extract), vanillic acid methyl ester (24.94%), 4-hydroxybenzaldehyde (24.93%) and 4-hydroxybenzoic acid (25.16%) were detected. Of the eight lignans detected, galgravin (38.08%) and epieudesmin (30.90%) were the most abundant. The implication of this is that the leaves of *Sansevieria senegambica* are rich in phenolic acids, a family of compounds that has a wide range of protective functions in plants.

Key words: Lignans, benzoic acid derivatives, hydroxybenzoic acid, phytochemicals, *Sansevieria senegambica*.

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1. INTRODUCTION

Phenolics are ubiquitous plant secondary metabolites comprising a large group of biologically active compounds. On the basis of the number of phenol subunits, there are two basic groups of phenolics - simple phenols and polyphenols (Marinova *et al*., 2005). The group of simple phenols also contains the so-called “phenolic acids”, which include hydroxybenzoic and hydroxycinnamic acids (Ferreira *et al*., 2010). Phenolics protect plants against environmental and biological stress such as high-energy radiation exposure, bacterial infection or fungal attacks (Tüzen and Özdemír, 2003), cold stress, hyperthermia (Adyanthaya, 2007) and oxidative stress (Dillard and German, 2000). In addition phenolics are also important for cell structure, signalling and pigmentation (Adyanthaya, 2007). Phenolic acids and flavonoids are known to act as allelochemicals (Yoshioka *et al*., 2004). The lignans are a group of chemical compounds consisting of cinnamic acid dimers (Evans, 2005). They are one of the major classes of phytoestrogens, and also act as antioxidants.

Sansevieria senegambica belongs to the Family Agavaceae (USDA, 2016). Its dried powder is used as a grain preservative in Burkina Faso (Jarvis *et al*., 2000). In Southern Nigeria, it is used to manage diabetes mellitus, hypertension, liver problems, bronchitis, inflammation, cough, boils, gonorrhoea and snake bites (Omobuwajo *et al*., 2008); and to compound hair tonics. The weight reducing (Ikewuchi *et al*., 2011), hepatoprotective (Ikewuchi and Ikewuchi, 2011), hypocholesterolemic (Ikewuchi, 2012), hypoglycaemic (Ikewuchi, 2010; Ikewuchi and Ikewuchi, 2012) and anti-anaemic (Ikewuchi *et al*., 2013) activities of the leaves and rhizomes have been reported. Earlier, studies reported the presence of alkaloid, allicin, glycoside and saponin (Ikewuchi *et al*., 2011); and flavonoids (Ikewuchi and Ikewuchi,

2012), phytosterols and tannins (Ikewuchi and Ikewuchi, 2011) in the leaves and rhizomes. There is however, no report of the presence of benzoic acid derivatives and lignans. Therefore, the present study investigated the benzoic acid derivatives and lignans profiles of the leaves of *Sansevieria senegambica*, by gas chromatography.

2. MATERIALS AND METHODS

2.1 Plant samples and reagents

Samples of fresh *S. senegambica* plants were procured from a horticultural garden at the University of Port Harcourt's Abuja campus, and from behind the Ofrima complex, University of Port Harcourt, in Port Harcourt, Nigeria. The plants were cleaned of soil and the leaves were removed, stored in a refrigerator for subsequent analyses. All reagents used were of analytical grade purity.

2.2 Calibration, identification and quantification

Standard solutions were prepared in methanol for benzoic acid derivatives and acetone for lignans. The linearity of the dependence of response on concentration was verified by regression analysis. Identification was based on comparison of retention times and spectral data with standards. Quantification was performed by establishing calibration curves for each compound determined, using the standards.

2.3 Determination of benzoic acid derivatives' composition

The extraction was carried out according to the method of Ndoumou *et al*. (1996). The sample was extracted with methanol, and after removing the pigments with petroleum ether, was re-extracted with ethyl acetate, and dried. The resultant extract of soluble phenolic compounds was dissolved in re-distilled hexane and kept in the vials before gas chromatographic analysis. Chromatographic analyses were carried out on an HP 6890 (Hewlett Packard, Wilmington, DE, USA), GC apparatus, fitted with a flame ionization detector, and powered with HP Chemstation Rev. A09.01[1206] software, to quantify and identify compounds. The column was a capillary HP 1 Column (30 m × 0.25 mm × 0.25 µm film thickness). The inlet and detection temperatures were 250 and 320 °C. Split injection was adopted with a split ratio of 20:1. Nitrogen was used as the carrier gas, at a pressure of 206.8 kPa. The hydrogen and compressed air pressures were 193.1 kPa and 220.6 kPa. The oven was programmed as follows: initial temperature at 60 °C for 5 min, first ramping at 15 °C/min for 15 min, maintained for 1 min, followed by a second ramping at 10 °C/min for 4 min.

2.4 Determination of the lignin composition

The extraction was carried out according to the method of Chapman *et al*. (2006). The sample was extracted with methanol, and a hexane/dichloromethane mixture. The concentrated extract was dissolved in acetone for gas chromatographic analysis. Gas chromatographic analysis was performed with HP 6890, GC apparatus with a flame ionization detector, and powered by HP Chemstation Rev A09.01[1206] software. The column was ZP-5 (30 m × 0.32 mm × 0.25 µm film thickness). One microliter of sample was injected. The conditions for the GC were initial oven temperature of 40 °C, injector 250 °C, transfer line 280 °C, a solvent delay of 2.00 min, temperature ramped at 10 °C/min to a final temperature of 230 °C, and held for 1.00 min.

2.5 Derivation of compositions per dry weight from the composition per wet weight

The compositions per dry weight of the determined parameters were derived from the compositions per wet weight,

using the following formula, adapted from Health Canada Official Methods (1999).

$$Composition\ per\ dry\ weight\ (\%) = \frac{Composition\ per\ wet\ weight}{Dry\ matter\ content(\%)} x\ 100 \quad [1]$$

2.6 Data analysis

Comparisons were based on simple percentages.

3. RESULTS AND DISCUSSION

Table 1 shows the benzoic acid derivatives' composition of the leaves of *Sansevieria senegambica*. The leaves have very high levels of benzoic acid derivatives. 4-Hydroxybenzoic acid methyl ester (about 24.97%), vanillic acid methyl ester (24.94%), 4-hydroxybenzaldehyde (24.93%), 4-hydroxybenzoic acid (25.16%) and chlorogenic acid were detected. As shown in Table 2, *Sansevieria senegambica* leaves have low lignan content. The main lignans were galgravin (38.08%) and epieudesmin (30.90%); others detected include dehydroabietic acid (2.59%), retusin (4.81%), 2-allyl-5-ethoxy-4-methoxyphenol (5.46%), sakuranin (4.73%), (9E,12E,15E)-9,12,15-octadecatrien-1-ol (4.0 2%) and apigenin-4',7-dimethyl ether (9.56%).

The esters of 4-hydroxybenzoic acid, also called parabens, are widely used as antimicrobial agents. They are stable, effective over a wide pH range, and active against a large number of microbes (Valkova *et al*., 2001). Chlorogenic acid is a powerful antioxidant (Ben Best, 2016). It has cardio-protective, hypoglycaemic, antihypertensive, anti-obesity, hypolipidaemic, hepato-protective, antibacterial, antiviral, anti-inflammatory, anticancer, immunostimulatory activities (Lafay *et al*., 2006; Cho *et al*., 2010; Zhao *et al*., 2011; Farah, 2012; Meng *et al*., 2013; Li *et al*., 2014).

Table 1: The benzoic acid derivatives composition of the leaves of *Sansevieria Senegambica*

Compounds	**Composition (mg kg^{-1})**	
	/Wet weight	**/Dry weight**
4-Hydroxybenzoic acid methyl ester	862.791	2704.675
Vanillic acid methyl ester	861.531	2700.724
4-Hydroxybenzaldehyde	861.270	2699.906
4-Hydroxybenzoic acid	869.229	2724.854
Chlorogenic acid	0.075	0.235
Total benzoic acid derivatives	3454.909	10830.435

Table 2: Lignans composition of the leaves of *Sansevieria senegambica*

Compounds	Composition (mg kg^{-1})	
	/Wet weight	/Dry weight
Dehydroabietic acid	0.05075	0.15910
Retusin	0.09427	0.29553
Galgravin	0.74627	2.33940
Epieudesmin	0.60548	1.89807
Sakuranin	0.09260	0.29027
2-Allyl-5-ethoxy-4-methoxyphenol	0.10700	0.33543
(9E,12E,15E)-9,12,15-Octadecatrien-1-ol	0.07879	0.24700
Apigenin-4',7-dimethyl ether	0.18739	0.58742
Total lignans	1.95969	6.14323

4. CONCLUSION

The present study showed that the leaves of *Sansevieria senegambica* have high contents of phenolic acids. This means that they can readily serve as rich sources of phenolic acids.

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