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Guest Articles

Phytochemical constituents and medicinal uses of *Aloe vera*

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Introduction

Aloe vera or *Aloe barbadensis* miller is a well-known perennial xerophyte which belongs to Liliaceae family. In Arabic, "Aloe" refers to "shining bitter substances," while in Latin, "Vera" means "true." Moreover, this plant is commonly known by other names such as Kumari, Burns Plant, Lily of the Desert, and Elephant's Gall. The habitat of this plant ranges from tropical to subtropical regions, with the ability to withstand high temperatures up to 40 °C. The most significant feature of this plant is its gel encased by the rind the outer layer of the leaf. This gel is rich in phytochemicals such as flavonoids, anthraquinones, polyphenols, phyto-sterols, chromones, etc. Many of them possess advanced medicinal properties used to treat conditions such as anti-diabetic, anticancer, anti-microbial, antiviral, antioxidant, antiseptic, anti-inflammatory, anti-aging, hormone modulatory, and wound healing.

Aloe vera is used in the cosmetic industry (as sunscreen, body lotion, shampoo, moisturizing cream, haircare product, etc.), food and pharmaceutical industry (e.g., drink, powder, pill, food preservative, etc.) (Fig. 1). In Asia and the US, *Aloe vera* is added to dairy products such

as ice cream and milk, not only for flavoring but also as a food preservative. In South Africa, people consume *Aloe vera* gel as food. During cheese production, the gel is added to create a prebiotic food.



Figure 1: Products of *Aloe vera*

Morphology

Aloe vera (Fig. 2) is one of the plant species that consists of crassulacean acid metabolism mechanism, (i.e., a special pathway of carbon fixation that allows them to grow under water stress conditions). The height of this cactus-like plant is 60-90 cm. Around 100-200 bisexual (or hermaphroditic) yellow-colored tubular flowers of *Aloe vera* are helically arranged as a cluster

on an erected spike as shown in Fig. 3. The length of this spike is about 90-100 cm.



Figure 2: *Aloe vera* plant



Figure 3: The matured inflorescence of *Aloe vera*

The leaf of *Aloe vera* can be divided into several layers such as rind (A), latex (B) and gel (C) as shown in Fig. 4.

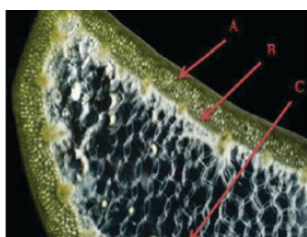


Figure 4: The light microscopic view of cross section of *Aloe vera* leaf.

The rind is the outermost protection layer which contains about 15-20 cells, and it helps in carbohydrates and protein synthesis. Yellow color bitter taste latex can be seen between the rind and the gel. The main constituents of the latex are anthraquinones and glycosides. Soft, clear, moist, transparent semi-solid gel is made up from a large parenchyma cell and 99% of it consists of water. *Aloe vera* powder and essential oil used mainly in cosmetic industry are manufactured using this gel.

Phytochemicals in *Aloe vera*

This plant contains various bioactive compounds, such as polyphenols, flavonoids, alkaloids, carotenoids,

phytosterols, saponins, and tannins, which function as phytochemicals.

The leaf contains more than 30 **anthraquinones** (*i.e.*, large structural variety of compounds among the polyketide group). Aloin A **1a** and aloin B **1b** are the most abundant compounds in this plant. Chrysophanol **2**, emodin **3**, physcione **4**, aloe-emodin **5** are other foremost anthraquinone derivatives present in it. The structures of some anthraquinones and their derivatives present in *Aloe vera* are given in Table 1 and Fig. 5.

Table 1: Some anthraquinones and their derivatives present in *Aloe vera*

Compound name	No.
Aloin A	1a
Aloin B	1b
Chrysophanol	2
Emodin	3
Physcione	4
Aloe-emodin	5
6'-O-Acetyl-aloin A	6a
6'-O-Acetyl-aloin B	6b
10-Hydroxyaloins A	7a
10-Hydroxyaloins B	7b
Aloinoside A	8a
Aloinoside B	8b
7-Hydroxyaloin A	9a
7-Hydroxyaloin B	9b
7-Hydroxy-8-O-methylaloin A	10a
7-Hydroxy-8-O-methylaloin B	10b
6'-malonylnataloin A	11a
6'-malonylnataloin B	11b
Homonataloside B	12
Elgonica dimer A	13a
Elgonica dimer B	13b
Aloindimer A-D	14a-d
Madagascine	15
Rhein	16

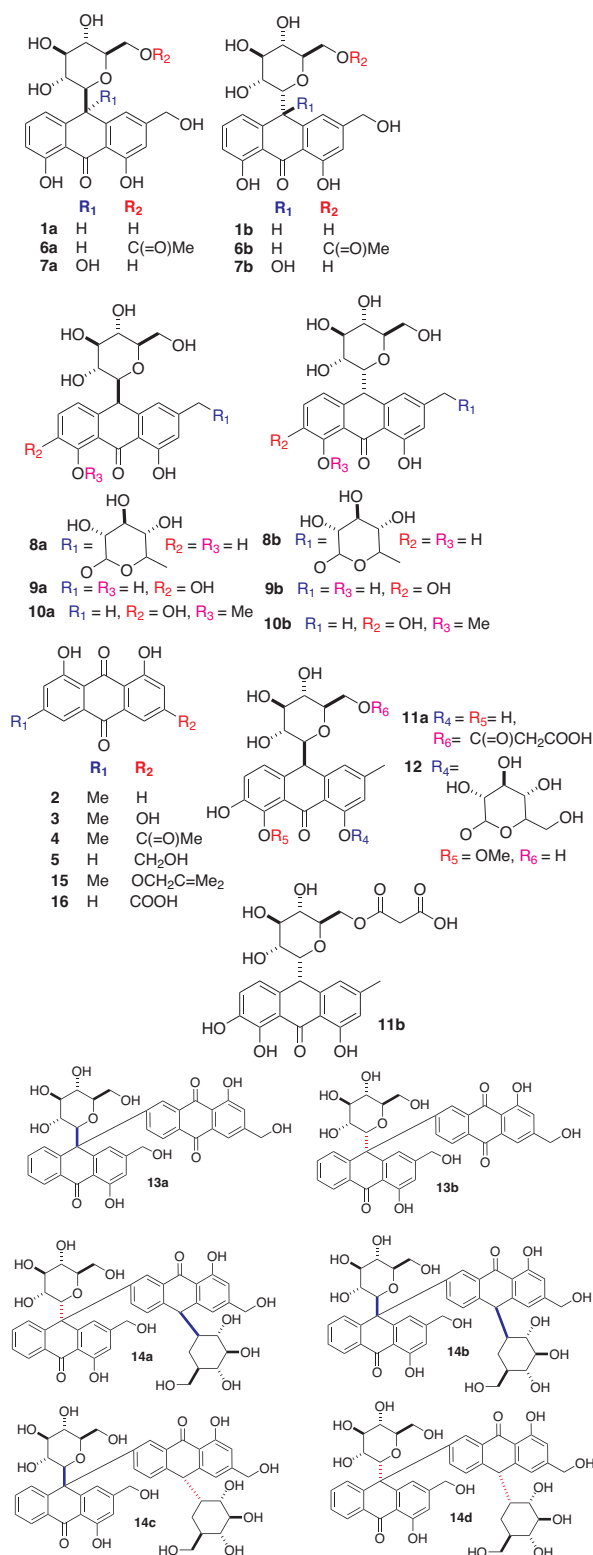


Figure 5: Structures of some anthraquinones and their derivatives

Chromones are a group of chemical compounds containing 5:6 benz-1:4-pyrone rings. Most prominent chromones present in *Aloe vera* are aloeresin A 17, aloeresin B/aloesin 18, isoaloeresin D 19 and aloeresin

E 20. Some of the chromones which are present in this plant are given in Table 2 and the structures are given in Figure 6.

Table 2: Some of the chromones present in this plant

Name	No.
Aloeresin A	17
Aloeresin B/aloesin	18
Isoaloeresin D	19
Aloeresin E	20
Neoaloesin A	21
Alcoveraside A	22a
Alcoveraside B	22b
6'-O-coumaroyl-aloesin	23
Allo-aloesin D	24

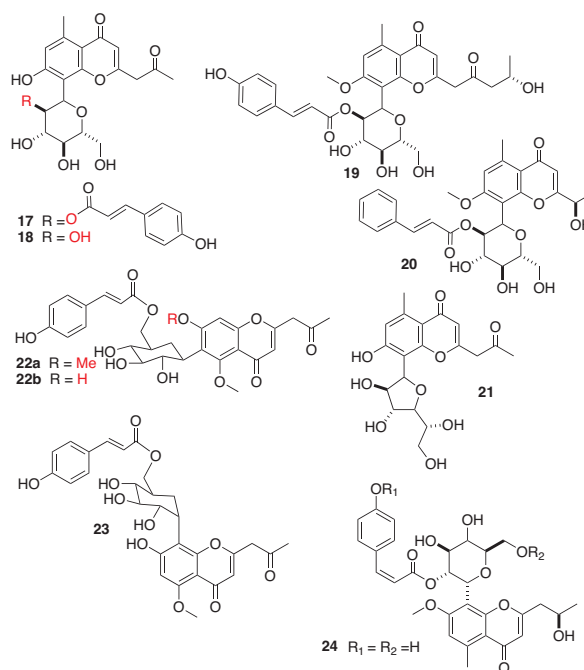


Figure 6: Structures of some anthraquinones and their derivatives

Apigenin 25, kaempferol 26, quercetin 27, epicatechin 28, D-catechin 29, rutin 30, and luteolin 31 are some of the flavonoids present in *Aloe vera* plant. Polyphenols such as chlorogenic acid 32, caffeic acid 33, caffeoyl shikimic acid 34, gallic acid 35, *p*-coumaric acid 36, coumarin 37 give immense medicinal value to the plant. Cycloartenol, lophenol, 24-ethyl-lophenol, 24-methyllophenol, and 24-methylene-cycloartanol are

phytosterols found in the gel.

Health benefits of *Aloe vera*

Aloin acts on skin and reacts against pimples. Flavonoids and polyphenols slow down the aging process while acting as antioxidants. Proline, an amino acid present in the gel, helps maintain the elasticity of the epithelial tissues in the skin. Anthraquinones in *Aloe vera* gel enhances gastrointestinal motility and the gel gives laxative effect.

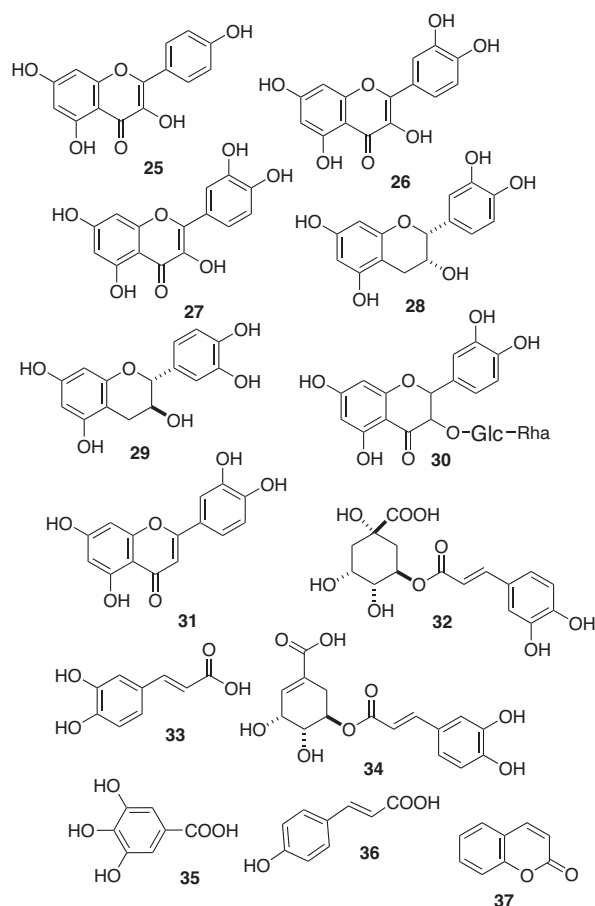


Figure 7: Some of the flavonoids and polyphenols present in *Aloe vera*

These compounds in the *Aloe vera* improve the functions of gastrointestinal system by stimulating colonic mobility, increasing electrolyte and fluid transport and accelerating the intestinal transit rate. Leaf extract of *Aloe vera* improves the transportation of poorly absorbed drugs through membranes. Thus, it can enhance the bio availability of the drugs by orally using. Lutein, acemannan, and aloe emodin present in the gel, improve the immunity of the body as well as

gives a good vision.

Aloe vera shows anti-microbial properties. Inhibition of solute transport through membranes of bacteria (such as *B. subtilis*, *E. coli*, *S. epidermidis*, and *S. sonnei*) is occurred by polyphenolic compounds present in this plant. Not only bacteria, but also fungi species such as *D. hawaiiensis* and *A. alternate* are completely inhibited by *Aloe vera*. Lupeol, salicylic acid, urea nitrogen, phenols and sulphur in this plant are antiseptic agents which inhibit fungi, bacteria and viruses. Aloe emodin and aloesin disrupt the bacterial membrane. Cinnamic acid, coumaric acid, ascorbic acid and pyrocatechol are acted against gram positive bacteria. β -sitosterol prevents the entry of the virus into the host cell.

Researchers found that *Aloe vera* gel consists of higher antioxidant value compared to those of pure α -tocopherol and butylated hydroxytoluene. Flowers of this plant have more bioactive compounds than the leaf. Gentisic acid present in flowers contains not only antioxidant properties, but also anti-inflammatory and anti-rheumatic properties. β -sitosterol is used as a treatment for breast cancer and diabetes. Sitosterol present in the leaf gel is used to treat enlarged bladder and it lowers the cardiovascular risk as well as prevents cancers. Aloe emodin acts as anti-cancer agent and inhibits lipid peroxidation. Furthermore, *Aloe vera* can be used to treat infertility and Polycystic ovary syndrome (PCOS).

According to the International *Aloe* Committee of Science Standards (IACSS) recommendations, the maximum limit of *Aloe vera* juice content in oral administration is less than 10 mg/kg, and less than 50 mg/kg for non-medicinal uses. However, prolonged or high dose consumption of *Aloe vera* can be a reason for imbalance of electrolysis in the body. *Aloe vera* is not recommended for oral use of pregnant and lactating mothers, infants and the people who suffering from abdominal pain, appendicitis and intestinal obstructions.

Conclusions

Aloe vera is a succulent plant widely recognized for its medicinal properties. Its gel contains various classes of phytochemicals, including polyphenols, flavonoids,

alkaloids, carotenoids, phytosterols, saponins, tannins, and more. These bioactive compounds are used to treat a broad range of ailments, offering antidiabetic, anticancer, antimicrobial, antiviral, antioxidant, antiseptic, anti-inflammatory, anti-aging, and wound-healing benefits. Moreover, *Aloe vera* serves as a key ingredient in the nutraceutical, pharmaceutical, and cosmeceutical industries due to its versatile therapeutic potential.

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Guest Articles

3D Printed Eco-Friendly Acoustic Panels

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Introduction

Sound pollution, one of the current environmental issues, arises from myriad sources ranging from traffic, construction, and industrial activities to aircraft/spacecraft, loud music, and other household appliances. As per the World Health Organization (WHO) standards, sound waves above 65 decibels (dB) are considered as polluted noise. Researchers have utilized many types of acoustic materials such as mineral wool, synthetic fibres, and polymer foams, especially in the building and construction industry. However, these conventional materials could act as health hazards to humans and their solid waste contributed to environmental pollution (Qui et al. 2018). Herein we report the preparation and acoustic performance of two novel composites using pineapple leaf fibres (PALF) and water hyacinth fibres (WHF) with polylactic acid (PLA).

Over the past few years, PALFs and WHFs have been studied on sound adsorption applications due to their unique characteristics such as high cellulose fiber

content, porosity, readily availability, low-cost, and environment-benignity (Putra et al. 2018; Sukhawipat et al. 2022). Polylactic acids (PLAs), also known as synthetic biopolymers or bioplastics, have recently been considered for fabricating thermoplastic filaments in 3D printing due to their low melting range, high strength, low thermal expansion, and better layer-adhesion (Yang et al 2014; Appuhamillage et al. 2018).

To the best of our knowledge, this work represents the first mechanically robust, 3D-printed acoustic panels that achieve the maximum sound absorption coefficient (α -max) > 0.5 with relatively low fiber loading. Most importantly, these panels are effective within the high-frequency sound range of 2,000 to 20,000 Hz. Our innovative approach paves the way for future developments of low-cost acoustic devices as a solution against noise pollution associated with high frequencies. Moreover, the current study provides a sustainable solution for mitigating the notorious aquatic weed, *Eichhornia crassipes* (water hyacinth).