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BIOACTIVE COMPOUNDS FROM MEDICINAL HERBS: POTENTIAL APPLICATIONS IN DERMATOLOGICAL PHARMACEUTICALS

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Abstract

For ages, people have looked to nature's abundance for healing cures, and the same is true with our skin. A wealth of bioactive chemicals, or molecules with special qualities that can improve the health and look of our skin, can be found in medicinal herbs. These powerful botanicals have enormous promise for the development of dermatological medicines in the future. They can be used for a wide range of purposes, including the treatment of acne, the reduction of wrinkles, wound healing, and irritation. Senna surattensis, Hydnora abyssinica, and Neorautanenia mitis are traditional medicinal plants with a range of applications. Our goal in this work was to identify the bioactive substances that underlie some of these actions and learn more about any possible therapeutic uses they may have.

Keywords: *Bioactive compounds, Medicinal herbs, Dermatological, Herbal extracts, Phytochemicals*

1. INTRODUCTION

The human body's biggest organ is the skin. It is comprised of connective tissue found in the dermis and epithelial tissue tracked down in the epidermis. The hypodermis is a layer of subcutaneous tissue that lies underneath the dermis. The five-layer epidermis is comprised of Langerhans cells,

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pole cells, Merkel cells, color cells, and melanocytes notwithstanding keratinocytes, or cells associated with keratinization. The storm cellar film ties it firmly to the dermis beneath. The dermis is comprised of two layers: the reticular layer (thick connective tissue) and the papillary layer (generally free connective tissue). Fibroblasts, which are responsible for delivering collagen, elastin, and glycosaminoglycans (GAGs), as well as an enormous number of veins, sensitive spots, and limbs like perspiration and sebaceous organs and hair follicles. Adipocytes, or fat cells, make fat lobules inside the free connective tissue that makes up the subcutaneous tissue.

Numerous multifaceted assignments are done by the skin. An individual's skin acts as a barrier, protecting internal organs and tissues from environmental hazards such as sunlight, ionising radiation, infrared radiation, mechanical stress, and allergic compounds. By exchanging substances and collecting upgrades, it also stays in touch with the outer world. Thermoreceptors aid in thermoregulation, the perspiration organs and epidermal border regulate water and electrolyte balance, and skin-related lymphoid tissues (SALT) fortify the resistant framework.

One of the most widely recognized cosmetic and dermatological worries is the impacts of maturing on the skin. Two frameworks impact this complicated natural association: one is outer (photoaging), achieved by ecological variables including contamination, UV radiation, and tobacco smoke, and the other is inside (genetic, requested) and results from the progression of time. These two cycles cross-over, and there is an immediate relationship between's the skin's oxidative strain and the expanded degrees of reactive oxygen species (ROS) [9]. Biochemical aggravations, (for example, the unnecessary creation of oxygen revolutionaries, which harm proteins and DNA, amino corrosive destructive racemization, and non-enzymatic glycosylation, which causes mutilated cross-connecting of collagen fibers and other essential proteins) adjust the physiological, physical, and genuine properties of the dermis and epidermis, and these progressions are related with both interior and outer cycles. These remember anomalies for the capability of the epidermal obstruction, straightening of the dermal-epidermal connection point, diminished fibroblast activity and quantity, deviant elastin fiber development (elastosis), and compromised Langerhans cell capability.Mature skin has characteristics such as telangiectasias, wrinkles, elasticity loss, colour changes, uneven pigmentation and discoloration, dryness, and

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sensitivity to irritation and slower skin repair and regeneration. The deterioration of blood vessels with age causes a reduction in blood flow, which in turn causes the skin to receive insufficient oxygen and nutrients.

1.1.Plant Extracts and Skin Care Products

The next sections focus on the common species that have been identified as having antioxidant, tyrosinase inhibitory, and antibacterial properties, all of which are important for skin care products. The models given relate to plant extracts that are local to Portugal. The Portuguese flora is abundant in many underutilized naturally occurring plants that may have medical benefits. The use of these plants' extracts has the potential to be environmentally beneficial.

- **Castanea Sativa**

Phenolic chemicals are abundant in chestnuts, especially in the fruits and leaves of the plant. But C. sativa flowers have also been shown to have antioxidant qualities by Barreira et al. Portugal is one of the major producers of chestnuts in Europe, especially Trás-os-Montes. The ideal growing conditions are found at temperatures below freezing and at elevations over 500 metres. Research on chestnut byproducts, such as leaves and shells, has revealed that they contain a wealth of phenolic chemicals that exhibit visible biological action, mainly as antioxidants.

- **Prunus Dulcis**

Prunus dulcis, or almonds, are a member of the Rosaceae family and are made up of an exterior hull and an intermediate shell that encloses an edible seed or kernel under a layer of brown skin. Almonds are a major crop in Portugal, particularly in the Algarve and Trás-os-Montes. Many diseases, especially those of the skin like eczema and acne, can be helped by eating almonds. Phenolic chemicals are abundant in the hulls, skins, and shells of almonds. The almond hull cracks open to reveal the shelled almonds when the almond reaches maturity. In an industrial operation, the seed coat, or skin, is typically taken out of the kern and thrown away. Thus, a number of studies have been carried out in recent years to assess the potential application of these industrially processed almond by-products as a source of chemicals possessing antioxidant qualities.

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- **Juglans Regia L.**

The profitable walnut tree (Juglans regia L.) produces nuts that are both delicious and in high demand. Green walnuts—along with their shells, kernels, barks, husks (epicarp), and leaves—have been utilised by the cosmetic and pharmaceutical sectors alongside dried fruits (nuts). Originally from the Near East, Juglans regia L. is now a popular tree in many parts of the Americas, Africa, and Europe. A by-product of walnut processing, green walnut husk is rich in phytochemicals but is rarely used. In addition to reducing a waste that is created in huge quantities, their valuation will raise the earnings of the walnut chain production. Various studies have exhibited the antioxidant capacity of walnut-derived products, particularly the fruits, leaves, and liqueurs derived from green fruits. The results provide more evidence that walnut skins, which are high in phenolics, effectively scavenge free radicals. In addition, Juglans regia L. extracts and pure phenolic components may be utilised as natural antioxidants in place of synthetic antioxidants as BHT (2,6-ditert-butyl-4-methylphenol).

1.2.Bioactive Compounds

The dietary components known as bioactive compounds are widely recognised for their numerous physiological, immunological, and behavioural health advantages.

Bioactive Compounds present in plants

- **Phenolic Compounds**

Naturally happening in plant items, phenolic synthetic substances are a fundamental part of the human eating routine. These substances range in structure from a direct phenolic particle to a refined high sub-atomic weight polymer. They all have a fragrant ring with at least one hydroxyl bunches appended to it. Numerous physiological qualities, including anti-inflammatory, anti-allergenic, anti-atherogenic, anti-microbial, and cardioprotective, are possessed by these substances. These substances, which belong to the most prevalent classes of phytochemicals, are crucial to the physiological and morphological processes that occur in plants. They are essential to their development and procreation. In addition to giving fruits and vegetables their colour and sensory qualities, they also offer defence against diseases and predators.

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Fruits and vegetables, and even different varieties of the same fruit or vegetable, can have vastly different total phenolic content due to differences in the complexity of these chemical groups and in the methods employed for extraction and analysis. The potential for recovery is also affected by the processing and storage conditions of these chemicals.

- **Flavonoids**

Flavonoids are low sub-atomic weight particles with a C6 - C3 - C6 structure with fifteen carbon molecules. They comprise of two fragrant rings associated basically by a three-carbon span. They are additionally separated into anthocyanin, flavones, flavanones, isoflavones, and flavonols. Since flavonoids have a high redox potential and can work as decreasing specialists, they are a critical wellspring of antioxidants. High flavonoid consumption aids in the prevention of heart disease and cancer.

- **Anthocyanins**

Anthocyanins are water-soluble vacuolar pigments that fall into the flavonoid class. Depending on their pH, they can have a purple, red, or blue appearance. All plant tissues, such as fruits, stems, leaves, flowers, and roots, contain them. Anthocyanins function as antioxidants by giving hydrogen to extremely reactive radicals, so halting the production of new radicals. These coloured compounds can be used to colour food instead of synthetic dyes. They contribute to the extra health advantages of such coloured food products since they are easily incorporated into aqueous food systems due to their water solubility.

- **Alkaloids**

Alkaloids are classified as active chemicals, primarily consisting of nitrogen, and are classified as secondary metabolites. Tryptophan, lysine, and tyrosine are among of the few amino acids that are used to make them. It is accepted that around 20% of the "types of blossoming plant" contain alkaloids, with north of 12,000 distinct groups of alkaloids tracked down in plants. Alkaloids are ordinarily tracked down in plants as natural corrosive salts, including lactic, citrus, oxalic, tartaric, tannic, and acidic acids. Only from time to time do not many week alkaloids, similar to nicotine,

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happen naturally. Glycosides of sugars like glucose, rhamnose, and galactose are additionally instances of alkaloids.

2. LITERATURE REVIEW

Ljubuncic et al. (2005) eight different medicinal plants that are employed in traditional Arab medicine in Israel were thoroughly examined. Additionally, their findings indicated that extracts from these plants exhibited various degrees of antioxidant activity, which indicates that there is potential for additional research into the utilisation of these plants as natural antioxidants.

Ponomarenko et al. (2014) specifically investigated the antioxidant capabilities of several chemicals that were produced from wood bark. Their research utilised a mix of experimental and computational approaches in order to shed light on the mechanisms that are responsible for the antioxidant activity of these chemicals. As a result, they were able to provide useful insights that can be utilised in the development of antioxidant-based therapies in the future.

Marini et al. (2012) The purpose of this study was to investigate the effects of Pycnogenol®, a natural antioxidant that is derived from the bark of French maritime pine, on the elasticity and hydration of the skin in females. According to their findings, the therapy with Pycnogenol® resulted in an improvement in both measures, which may have been caused by an increase in the expression of genes for collagen and hyaluronic acid. The findings of this study emphasise the potential of antioxidants to address concerns related to the ageing of the skin.

Nishigori et al. (2004) It concentrated on the part that reactive oxygen species (ROS) play in the development of skin cancer. Based on their findings, it appears that antioxidants may perform a preventive function against skin cancer by reducing the harmful effects of reactive oxygen species (ROS). The significance of antioxidant research in relation to the prevention of cancer and the health of the skin is highlighted by this discovery.

Belcaro et al. (2006) the usage of Pycnogenol® for the purpose of enhancing microcirculation and expediting the healing process in diabetic ulcers was examined further. The findings of their research showed promising results, which suggests that antioxidants may have therapeutic potential for wound healing and other conditions connected to microcirculation.

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3. RESEARCH METHODOLOGY

3.1.Research Design

The purpose of this research was to isolate and characterise bioactive components from a selection of medicinal herbs by employing an experimental design that was conducted in a laboratory setting. From that point forward, the extracts and unadulterated compounds were considered for their viability in contrast to a large number of diseases and catalysts, like P. falciparum, T. brucei rhodesiense, M. tuberculosis, α-amylase (AA), and α-glucosidase (AG), through the use of in-vitro models. To explain the synthetic designs of the substances, insightful techniques like atomic attractive reverberation (NMR), infrared spectroscopy (IR), mass spectrometry (MS), optical revolution, and others were used.

3.2.Data Collection

An assortment of experiments that involved the separation and characterisation of bioactive chemicals derived from medicinal plants were carried out in order to acquire the necessary data. Data from nuclear magnetic resonance (NMR) spectrometers such as the Bruker Avance and Bruker Ascend were collected, while infrared (IR) spectra were measured with an FTIR Shimadzu IRAffinity-1 equipped with MIRacle. An LCMS-2020 Shimadzu for ESI was utilised in order to acquire the MS data, and a Thermo Scientific ETD Orbitrap Fusion FSN 10314–1 was utilised in order to perform the HRSIMS data collection. In order to gather additional information, such as melting points and particular rotations, a Buchi M.560 melting point apparatus and a Jasco P-2000 polarimeter were utilised, respectively.

3.3.Ethical Consideration

For the purpose of the gathering of plants, ethical rules were adhered to, and all of the plants were obtained in a responsible manner from the verdant slopes of Mount Elgon in the Kapchorwa District of Uganda during the month of May 2021. The Department of Botany at Makerere University in Kampala was the location where the transportation, identification, and authentication procedures were carried out. A voucher or reference number was provided to each of the plants

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(N. mitis, S. surattensis, and H. abyssinica) in order to guarantee traceability and ensure that ethical norms were adhered to appropriately.

3.4.Statistical Analysis

Certain studies, particularly bioassays against viruses and enzymes, most certainly incorporated statistical analysis in order to establish the significance of observed effects. Although the specific statistical methods that were employed in the analysis are not explicitly indicated, it is likely that these experiments were conducted. For the purpose of drawing conclusions about the efficacy of the extracted bioactive compounds against the targets that were evaluated.

4. DATA ANALYSIS

In adherence to the species name "cassia," the S. surratensis ethanol remove was indicated as CEOH, and the DCM separate as CDCM. Correspondingly, the native term "kaushe" was utilized to mark the DCM and ethanol extracts of H. abyssinica, bringing about assignments KDCM and KEOH, separately. Besides, the DCM and ethanol extracts from N. mitis were named ABDCM and ABEOH, individually, using the neighborhood name "abargora." Table 1 archives the assortment, visual qualities, and rate yields of both DCM and ethanol extracts from the three plants — S. surrattensis-CAQ, H. abyssinica-KAQ, and N. mitis-ABAQ — in examination with their water extracts. Dissimilar to the DCM extracts, the ethanol extracts of S. surrattensis and H. abyssinica displayed higher rate yields, recording 11.7% and 10.4%, separately. On the other hand, N. mitis showed a lower biomass recuperation of 1.1% from ethanol, rather than 1.6% from DCM.

Table 1: Actual appearance and rate yield of DCM and ethanol extracts from S. surratensis, H. abyssinica and N. mitis

Extract	Colour	Dehydrated plant matter (g)	Concentration of Extract (g)	Yield (%)
CDCM	Forest green	395	10.0	2.6
CEOH	Mossy Green	365	45.0	11.7

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KDCM	Rusty Red	995	9.0	1.1
KEOH	Mahogany Brown	960	100.0	10.4
ABDCM	Espresso Brown	995	16.0	1.6
ABOH	Deep Chocolate Brown	980	9.0	1.1

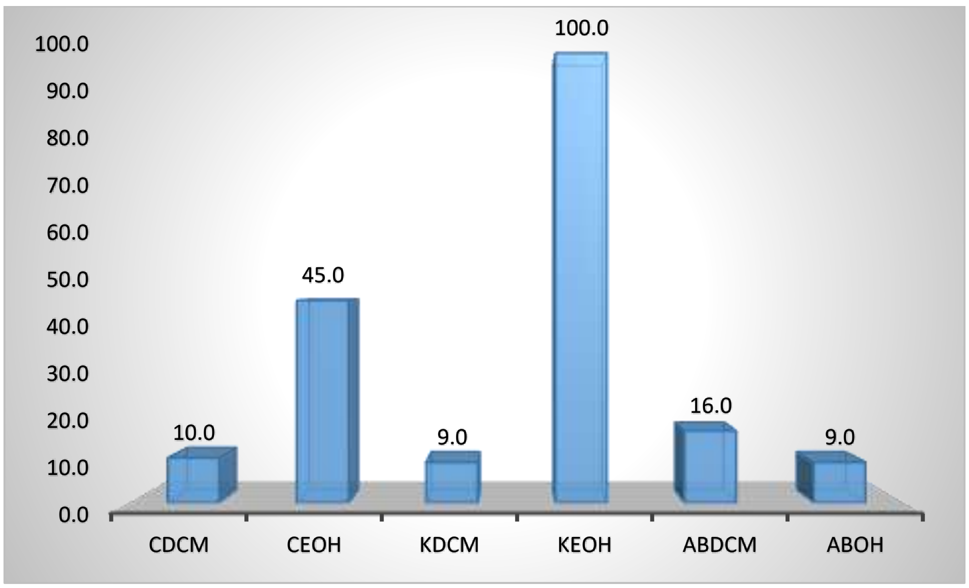

Figure 1: Amount of Extract of DCM and ethanol extracts from S. surratensis, H. abyssinica and N. mitis

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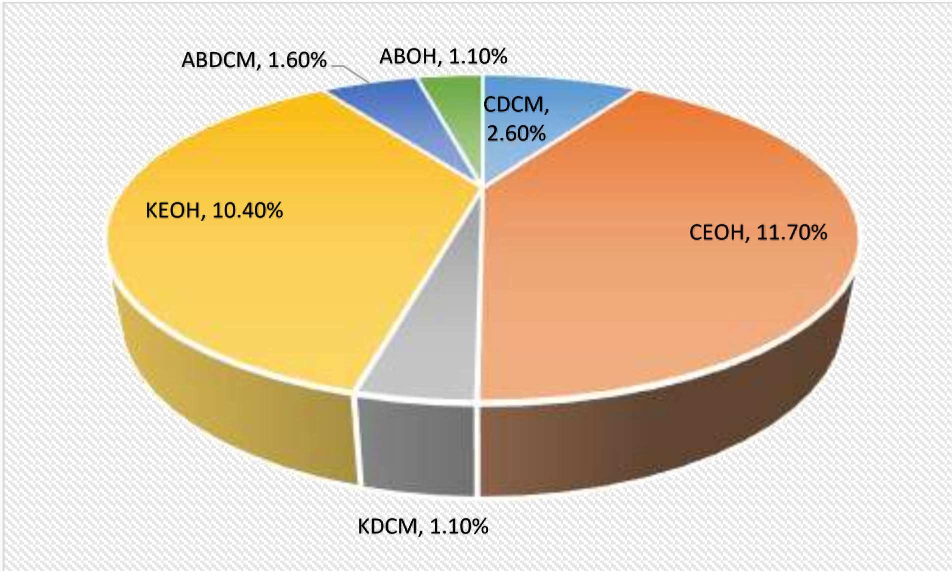
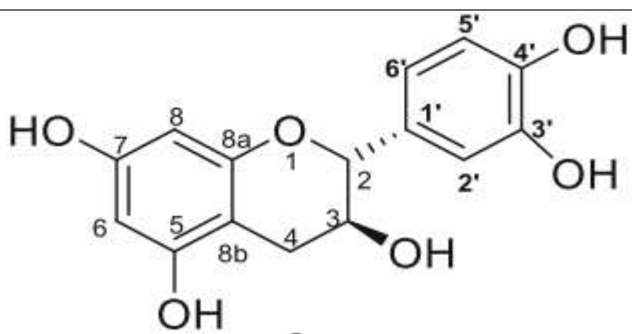


Figure 2: S. surratensis, H. abyssinica, and N. mitis ethanol and DCM extract yield percentages

The physical characteristics and percentage yield of the dichloromethane (DCM) and ethanol (EOH) extracts made from the three medicinal plants—Spathatensis, H. abyssinica, and N. mitis—are shown in Table 1. The DCM extract from S. surattensis, CEOH (ethanol extract from S. surattensis), KDCM (DCM extract from H. abyssinica), KEOH (ethanol extract from H. abyssinica) as a crystal-like dark brown solid, ABDCM (DCM extract from N. mitis) as a dark brown solid, and ABOH (ethanol extract from N. mitis) as another dark brown solid were the different colour and texture of the extracts. The yields as a percentage varied from 1.1% to 11.7%, suggesting different levels of extraction process effectiveness.



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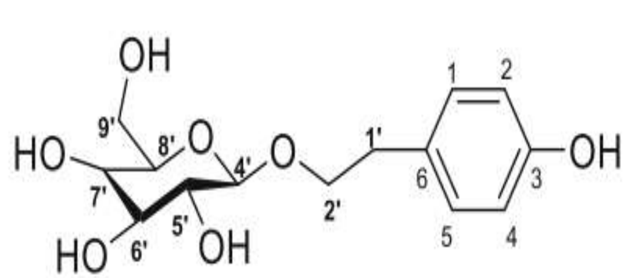

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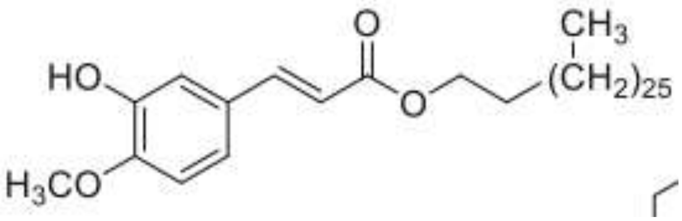

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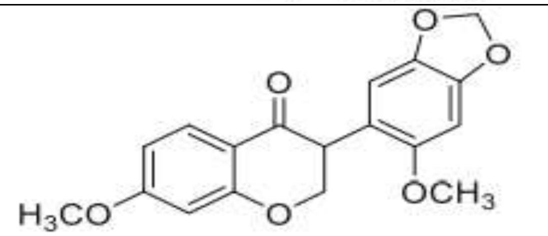

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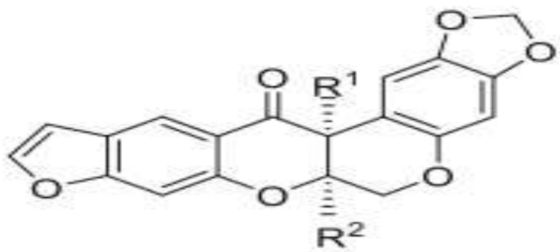

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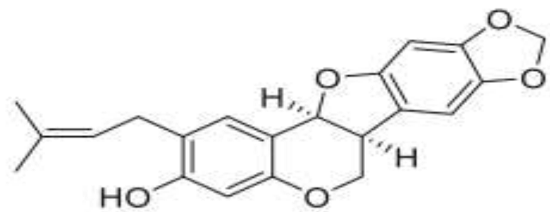

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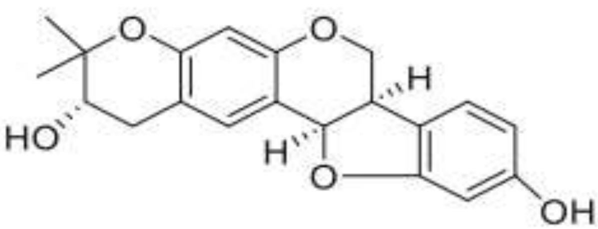

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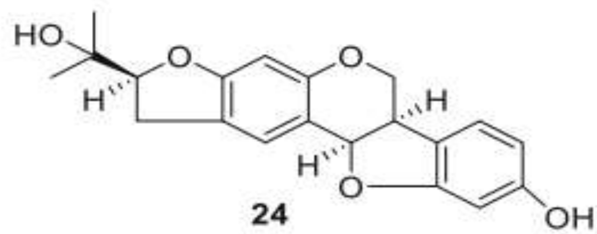

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Figure 3: Compounds isolated from KEOH and ABDCM

Compounds 2, 5, and 7 (Figure 3) demonstrated substantial percentage inhibitory activities of 96.7 ± 0.5%, 53.1 ± 8.8%, and 84.5 ± 1.1% when compared to the positive control Acarbose, which showed 85.1 ± 0.3% inhibition (Table 3). These compounds were evaluated at 250 µg/mL for their AG inhibitory activities.

Table 3: Detecting chemicals with AGI action

Samples (250 µg/mL) in 50% DMSO	% Inhibition
1	96.7± 0.5
2	48.1 ± 1.9

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3	15.2 ± 0.9
4	18.7 ± 0.4
5	53.1 ± 8.8
6	30.2 ± 2.2
7	84.5 ± 1.1
8	28.2 ± 3.3
Acarbose 0.1 M	85.1 ± 0.3
DMSO 50%	0

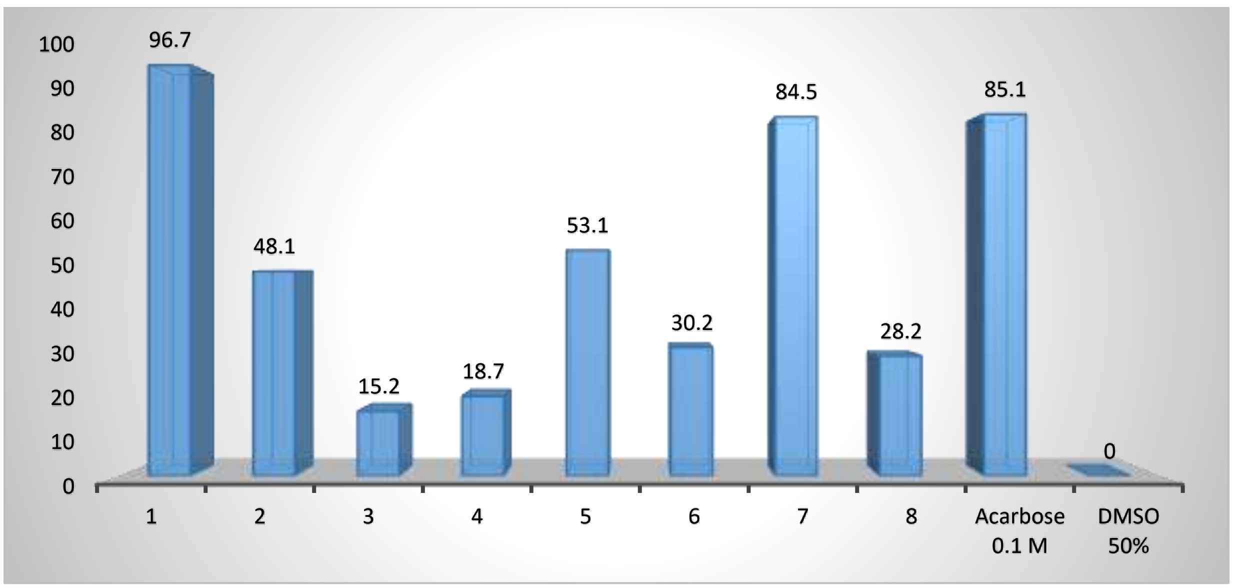

Figure 4: Screening of compounds for AGI activity

The compounds that were screened for alpha-glucosidase inhibitor (AGI) activity are shown in Table 3. The samples were evaluated at a concentration of 250 µg/mL in 50% DMSO. Sample 1 had the maximum inhibition at 96.7 ± 0.5%, followed by sample 7 at 84.5 ± 1.1%. The percentage inhibition numbers show how well each sample inhibits AGI activity. Using acarbose as a positive control, the measured effective inhibition was 85.1 ± 0.3% at a concentration of 0.1 M, which is similar to the results obtained with sample 7. On the other hand, sample 3 had the least amount of inhibition, at 15.2 ± 0.9%. There was no inhibition (0%) in the DMSO control.

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5. CONCLUSION

The great potential of medicinal herbs to revolutionise dermatological medicines is immense. A plethora of bioactive chemicals with a symphony of therapeutic activities are available in nature's abundance and are just waiting to be used for the health and beauty of our skin. Every herb has a special code for healthy, glowing skin, from gotu kola's ability to promote collagen to turmeric's ability to fight bacteria that cause acne. Imagine the gentle anti-inflammatory flavonoids of chamomile treating eczema, or the antioxidant power of green tea's polyphenols diminishing wrinkles. The options are as varied as the vivid colours of the plant kingdom. The three medicinal plants that were chosen for this study's extracts demonstrated noteworthy inhibitory actions against T. brucei rhodesiense, P. falciparum, α-amylase (AA), and αglucosidase (AG). Some of the specific compounds causing these inhibitory effects have been identified in this work, providing hints about potential lead compounds for the creation of novel treatments against illnesses brought on by these substances.

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