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The license may not give you all of the permissions necessary for your intended use. For example, other rights such as publicity, privacy, or moral rights may limit how you use the material. The paper details various procedures for phytochemical screening to identify the presence of specific compounds in plant extracts. Methods for detecting alkaloids, flavonoids, carbohydrates, glycosides, phytosterols, saponins, and tannins are outlined, utilizing various reagents and indicators such as Dragendorff's, Wagner's, and Mayer's for alkaloids; Shinoda's and Alkaline Reagent tests for flavonoids; Molisch's test for carbohydrates; as well as specific tests for glycosides, saponins, and tannins. These methods provide a systematic approach to evaluating phytochemicals, essential for understanding the bioactive compounds in plants. Phytochemical screening in the context of plant extracts is a fundamental process in the field of natural product research. Plant extracts are complex mixtures containing a wide variety of chemical compounds, known as phytochemicals. These phytochemicals can include alkaloids, flavonoids, tannins, terpenoids, and many others. The primary aim of phytochemical screening is to identify the presence or absence of these different classes of compounds in a given plant extract. Plants have been used for centuries in traditional medicine systems around the world. Understanding the phytochemical composition of plant extracts is crucial for several reasons. Firstly, it helps in validating the traditional uses of plants. For example, if a plant has been traditionally used to treat inflammation, phytochemical screening can help identify compounds such as flavonoids or terpenoids that are known to have anti - inflammatory properties. Secondly, it provides a basis for further research, such as the development of new drugs or nutraceuticals. 2. Significance of Phytochemical Screenings for Quality Control of Plant - Based Products Quality control is of utmost importance in the production and use of plant - based products. Phytochemical screenings play a vital role in this regard. 2.1 Standardization One of the key aspects of quality control is standardization. Different batches of plant extracts may vary in their phytochemical composition due to factors such as plant origin, growth conditions, and extraction methods. By conducting phytochemical screenings, it is possible to establish standard profiles for different plant - based products. For example, in the herbal medicine industry, a consistent level of active phytochemicals needs to be maintained in each batch of a product. This ensures that the product has the same efficacy and safety profile every time it is used. 2.2 Identification of Adulterants Another important significance of phytochemical screenings is in the identification of adulterants. In the commercial market, there is a risk of plant - based products being adulterated with cheaper or inferior substances. Phytochemical screening can detect any deviation from the expected phytochemical profile, which can indicate the presence of adulterants. For instance, if a high - value herbal extract is supposed to contain a specific alkaloid, and the screening shows a lack of this alkaloid or the presence of an unexpected compound, it could be a sign of adulteration. 3. Array of Screening Methods Available There are several screening methods available for analyzing phytochemicals in plant extracts, each with its own advantages and limitations. 3.1 Spectroscopic Methods Spectroscopic methods are widely used for analyzing the chemical structures of phytochemicals. These methods are based on the interaction of electromagnetic radiation with matter. 3.1.1 Ultraviolet - Visible (UV - Vis) Spectroscopy UV - Vis spectroscopy is a relatively simple and inexpensive spectroscopic technique. It is based on the absorption of ultraviolet and visible light by phytochemicals. Different classes of phytochemicals absorb light at different wavelengths. For example, flavonoids typically show absorption in the range of 250 - 500 nm. This method can be used as a preliminary screening tool to detect the presence of certain classes of compounds. However, it has limited specificity as many compounds may have overlapping absorption spectra. 3.1.2 Infrared (IR) Spectroscopy IR spectroscopy measures the absorption of infrared radiation by molecules. It provides information about the functional groups present in phytochemicals. Each functional group has a characteristic absorption frequency. For instance, the presence of a carbonyl group (C = O) in a compound can be detected by its absorption in the infrared region. IR spectroscopy is useful for identifying the types of bonds present in a phytochemical, which can help in classifying the compound. 3.1.3 Nuclear Magnetic Resonance (NMR) Spectroscopy NMR spectroscopy is a powerful technique for determining the structure of phytochemicals. It is based on the interaction of nuclei with a magnetic field. NMR can provide detailed information about the connectivity of atoms in a molecule, the number of different types of protons and carbons, and their chemical environments. However, it requires relatively pure samples and expensive equipment, making it more suitable for more advanced stages of analysis. 3.2 Chromatographic Methods Chromatographic methods are used for separating and analyzing phytochemicals based on their different physical and chemical properties. 3.2.1 Thin - Layer Chromatography (TLC) TLC is a simple and rapid chromatographic technique. A small amount of the plant extract is spotted on a thin - layer plate coated with a stationary phase, and a mobile phase is allowed to move up the plate by capillary action. Different phytochemicals will move at different rates depending on their affinity for the stationary and mobile phases. TLC can be used to separate and identify different classes of phytochemicals. For example, flavonoids can be separated from alkaloids using TLC. After separation, the spots can be visualized using various detection methods such as UV light or chemical reagents. 3.2.2 High - Performance Liquid Chromatography (HPLC) HPLC is a more advanced chromatographic technique. It offers high - resolution separation of phytochemicals. In HPLC, the plant extract is pumped through a column filled with a stationary phase at high pressure. The mobile phase is also carefully selected to optimize the separation. HPLC can be coupled with various detectors such as UV - Vis detectors, diode - array detectors, or mass spectrometers. This allows for the identification and quantification of individual phytochemicals in a complex plant extract. 3.3 Chemical Tests Chemical tests are traditional methods for detecting the presence of specific classes of phytochemicals. For alkaloids, the Dragendorff's reagent test can be used. A positive test results in the formation of an orange - red precipitate. To detect flavonoids, the Shinoda test can be performed. A positive reaction shows a pink - red color change. Tannins can be detected using the ferric chloride test. A blue - black coloration indicates the presence of tannins. 4. Preliminary Screening as a Precursor to Advanced Research Preliminary phytochemical screening serves as an important precursor to more advanced research in the field of plant - based products. 4.1 Isolating and Purifying Specific Phytochemicals Once the presence of a particular class of phytochemicals has been identified through preliminary screening, the next step is often to isolate and purify the specific compounds. For example, if a plant extract shows the presence of potentially bioactive flavonoids through spectroscopic or chromatographic screening, researchers can then use techniques such as column chromatography or preparative HPLC to isolate and purify the individual flavonoid compounds. This purified material can then be further studied for its pharmacological properties. 4.2 Pharmacological Studies The purified phytochemicals obtained after isolation can be used in pharmacological studies. These studies aim to understand the biological activities of the compounds, such as their antioxidant, anti - inflammatory, or antimicrobial properties. Preliminary screening helps in narrowing down the compounds of interest from the complex plant extract, making the pharmacological studies more focused and efficient. For example, if a plant has been traditionally used for treating a particular disease, the phytochemical screening can help identify the compounds that may be responsible for this activity, which can then be tested in vitro and in vivo for their efficacy. 5. Impact on Promoting Sustainable Use of Plant Resources in Various Industries The use of phytochemical screening methods has a significant impact on promoting the sustainable use of plant resources in different industries. 5.1 Pharmaceutical Industry In the pharmaceutical industry, by accurately identifying the phytochemicals in plants, it becomes possible to develop drugs more efficiently. This reduces the need for large - scale extraction of plants without a clear understanding of their active components. For example, if a particular compound with medicinal properties can be identified and synthesized in the laboratory, it may reduce the pressure on wild plant populations that are the source of the compound. This promotes the sustainable use of plant resources as it encourages conservation while still allowing for the development of new drugs. 5.2 Cosmetic Industry The cosmetic industry also benefits from phytochemical screening. Many plant - derived ingredients are used in cosmetics for their beneficial properties such as skin - conditioning or antioxidant effects. By screening for the presence of these active phytochemicals, companies can ensure the quality and efficacy of their products. Moreover, it helps in identifying sustainable sources of plant ingredients. For instance, if a particular plant extract is found to be rich in a desired phytochemical, efforts can be made to cultivate the plant sustainably rather than relying on wild - harvested sources, which may be over - exploited. 5.3 Food Industry In the food industry, phytochemical screening can be used to identify plants with high nutritional value. For example, plants rich in certain vitamins, minerals, or bioactive compounds can be identified and incorporated into functional foods or dietary supplements. This promotes the sustainable use of plant resources as it encourages the cultivation of these beneficial plants in a sustainable manner. Additionally, by understanding the phytochemical composition of food plants, it is possible to develop better preservation and processing methods to retain the nutritional value of the plants. 6. Conclusion In conclusion, preliminary phytochemical screening methods in plant extract analysis are of great significance. They play a crucial role in quality control of plant - based products, act as a precursor to advanced research, and promote the sustainable use of plant resources in various industries. The array of screening methods available, including spectroscopic, chromatographic, and chemical tests, each have their own strengths and weaknesses. Continued research and development in this area will further improve these methods and enhance our understanding of the complex world of phytochemicals in plant extracts. The main purpose of phytochemical screening in plant extract analysis is to identify the presence of various phytochemicals. It helps in quality control of plant - based products by ensuring their composition and properties. Moreover, it serves as a precursor for more advanced research such as isolating and purifying specific phytochemicals for pharmacological studies. What are the common spectroscopic methods used in phytochemical screening? Some common spectroscopic methods used in phytochemical screening include ultraviolet - visible (UV - Vis) spectroscopy, infrared (IR) spectroscopy, and nuclear magnetic resonance (NMR) spectroscopy. UV - Vis spectroscopy can provide information about the presence of chromophores in phytochemicals. IR spectroscopy is useful for identifying functional groups, and NMR spectroscopy helps in determining the chemical structure of phytochemicals. How does preliminary phytochemical screening contribute to more advanced research? Preliminary phytochemical screening acts as a starting point for more advanced research. By identifying the presence of certain phytochemicals, it guides the isolation and purification processes of specific compounds. This is crucial for pharmacological studies as pure compounds are often required to accurately study their biological activities and potential therapeutic effects. Why is phytochemical screening important for the sustainable use of plant resources? Phytochemical screening is important for the sustainable use of plant resources as it allows for a better understanding of the chemical composition of plants. This knowledge can help industries to optimize the extraction and utilization of valuable phytochemicals, reducing waste and over - exploitation of plant species. It also enables the identification of plants with unique or rare phytochemicals, which can be conserved and sustainably managed. Can phytochemical screening help in differentiating between different plant extracts? Yes, phytochemical screening can help in differentiating between different plant extracts. Since different plants contain different types and amounts of phytochemicals, screening methods can detect these differences. By analyzing the phytochemical profiles of various plant extracts, it is possible to distinguish them based on their chemical composition, which is useful for quality control, authentication, and research purposes. Related literature Phytochemical Analysis: A New Perspective" "Advanced Phytochemical Screening Techniques: Current Trends" "The Role of Phytochemical Screening in Plant - Based Drug Discovery" TAGS: Chemical compounds produced by plants Red, blue, and purple colors of berries derive mainly from polyphenol phytochemicals called anthocyanins. Cucurbita fruits, including squash and pumpkin, typically have high content of the phytochemical pigments called carotenoids. Phytochemicals are naturally-occurring chemicals present in or extracted from plants.[1][2] Some phytochemicals are nutrients for the plant, while others are metabolites produced to enhance plant survivability and reproduction.[3] The fields of extracting phytochemicals for manufactured products or applying scientific methods to study phytochemical properties are called phytochemistry.[2][3] An individual who uses phytochemicals in food chemistry manufacturing or research is a phytochemist. Phytochemicals without a nutrient definition have no confirmed biological activities or proven health benefits when consumed in plant foods.[2] Once phytochemicals in a food enter the digestion process, the fate of individual phytochemicals in the body is unknown due to extensive metabolism of the food in the gastrointestinal tract, producing phytochemical metabolites with different biological properties from those of the parent compound that may have been tested in vitro.[4] Further, the bioavailability of many phytochemical metabolites appears to be low, as they are rapidly excreted from the body within minutes.[4] Other than for dietary fiber, no non-nutrient phytochemicals have sufficient scientific evidence for providing a health benefit. Some ingested phytochemicals may be toxic, and some may be used in cosmetics, drug discovery, or traditional medicine.[3] Phytochemical derives by compounding the Ancient Greek word for plant (phytón, phyto) with chemical,[2] as first used in English for plant chemistry and organic chemistry around 1850.[5] Phytochemicals are chemicals produced by plants through primary or secondary metabolism.[2][6] They generally have biological activity in the plant host and play a role in plant growth or defense against competitors, pathogens, or predators.[7] As components of plants, all individual phytochemicals make up the whole plant as it exists in nature.[2][8] Phytochemicals are generally regarded as research compounds rather than essential nutrients because proof of their possible health effects has not been established yet.[1][2][9] Phytochemicals under research can be classified into major categories, such as carotenoids[10] and polyphenols, which include phenolic acids, flavonoids, stilbenes or lignans.[9] Flavonoids can be further divided into groups based on their similar chemical structure, such as anthocyanins, flavones, flavanones, isoflavones, and flavanols.[4][9] Flavanols are further classified as catechins, epicatechins, and proanthocyanidins.[4][9] In total, between 50,000[11] and 130,000[12] phytochemicals have been discovered. Phytochemists study phytochemicals by first extracting and isolating compounds from the origin plant, followed by defining their structure or testing in laboratory model systems, such as in vitro studies or in vivo studies using laboratory animals.[2][7] Challenges in that field include isolating specific compounds and determining their structures, which are often complex, and identifying what specific phytochemical is primarily responsible for any given biological activity.[2][7] Further, upon consuming phytochemicals in a food entering the digestion process, the fate of individual phytochemicals in the body is unknown due to extensive metabolism in the gastrointestinal tract, producing smaller phytochemical metabolites with different biological properties from those of the parent compound, and with low bioavailability and rapid excretion.[4] Other than for dietary fiber,[13] no non-nutrient phytochemical has sufficient scientific evidence in humans for an approved health claim.[14] Berries of Atropa belladonna, also called deadly nightshade, containing the toxic phytochemicals, tropane alkaloids Without specific knowledge of their cellular actions or mechanisms, phytochemicals can be toxic or used in traditional medicine. For example, salicin, having anti-inflammatory and pain-relieving properties, was originally extracted from the bark of the white willow tree and later synthetically produced to become the common, over-the-counter drug, aspirin.[15][16] The tropane alkaloids of Atropa belladonna were used as poisons, and early humans made poisonous arrows from the plant.[17][18] Other uses include perfumes, such as the sesquiterpene santolols, from sandalwood.[19] The English yew tree was long known to be extremely and immediately toxic to animals that grazed on its leaves or children who ate its berries; however, in 1971, paclitaxel was isolated from it, subsequently becoming a cancer drug.[7] The biological activities for most phytochemicals are unknown or poorly understood, in isolation or as part of foods.[2][7][9] Phytochemicals with established roles in the body are classified as essential nutrients.[1][2] The phytochemical category includes compounds recognized as essential nutrients, which are naturally contained in plants and are required for normal physiological functions, so must be obtained from the diet in humans.[2] Some phytochemicals are known phytotoxins that are toxic to humans;[20][21] for example aristolochic acid is carcinogenic at low doses.[22] Some phytochemicals are antinutrients that interfere with the absorption of nutrients.[23] Others, such as some polyphenols and flavonoids, may be pro-oxidants in high ingested amounts.[24] Non-digestible dietary fibers from plant foods, often considered as a phytochemical,[13] are generally regarded as a nutrient group having approved health claims for reducing the risk of some types of cancer[25] and coronary heart disease.[26] Phytochemical dietary supplements are neither recommended by health authorities for improving health[9][27] nor are they approved by regulatory agencies for health claims on product labels.[14][28] While health authorities encourage consumers to eat diets rich in fruit, vegetables, whole grains, legumes, and nuts to improve and maintain health, evidence that such effects result from specific, non-nutrient phytochemicals is limited or absent.[1][2] For example, systematic reviews and/or meta-analyses indicate weak or no evidence for phytochemicals from plant food consumption having an effect on breast, lung, or bladder cancers.[29][30] Further, in the United States, regulations exist to limit the language on product labels for how plant food consumption may affect cancers, excluding mention of any phytochemical except for those with established health benefits against cancer, such as dietary fiber, vitamin A, and vitamin C.[31] Phytochemicals, such as polyphenols, have been specifically discouraged from food labeling in Europe and the United States because there is no evidence for a cause-and-effect relationship between dietary polyphenols and inhibition or prevention of any disease.[14][32] Among carotenoids such as the tomato phytochemical, lycopene, the US Food and Drug Administration found insufficient evidence for its effects on any of several cancer types, resulting in limited language for how products containing lycopene can be described on labels.[33] Phytochemicals in freshly harvested plant foods may be degraded by processing techniques, including cooking.[34] The main cause of phytochemical loss from cooking is thermal decomposition.[34] A converse exists in the case of carotenoids, such as lycopene present in tomatoes, which may remain stable or increase in content from cooking due to liberation from cellular membranes in the cooked food.[35] Food processing techniques like mechanical processing can also free carotenoids and other phytochemicals from the food matrix, increasing dietary intake.[34][36] In some cases, processing of food is necessary to remove phytotoxins or antinutrients; for example societies that use cassava as a staple have traditional practices that involve some processing (soaking, cooking, fermentation), which are necessary to avoid illness from cyanogenic glycosides present in unprocessed cassava.[37] Allelopathy List of antioxidants in food List of phytochemicals in food Nutrition Secondary metabolites ^ a b c d "Phytochemicals". 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Media related to Phytochemicals at Wikimedia Commons Dr. Duke's Phytochemical and Ethnobotanical Databases – United States Department of Agriculture Retrieved from " 2 7-Phloroeckol Names Preferred IUPAC name 4-(3,5-Dihydroxyphenoxy)-8-(2,4,6-trihydroxyphenoxy)oxanthrene-1,3,6-triol Other names 7-Phloroethol Identifiers CAS Number 662165-35-7 N[ChemSpider] 3D model (JSmol) Interactive image ChEBI CHEBI:65790 Y ChEMBL ChEMBL456228 ChemSpider 8656347 PubChem CID 10480940 UNII 97GCC12YF0 CompTox Dashboard (EPA) DTXSID201030418 InChI InChI=1S/C24H16O12/c25-9-1-10(26)3-12(2-9)34-22-17(31)8-18(32)23-24(22)36-21-16(30)6-13(7-19(21)35-23)33-20-14(28)4-11(27)5-15(20)29/h1-8,25-32HKey: JLEVVQRBEATTCM-UHFFFAOYSA-NInChI=1/C24H16O12/c25-9-1-10(26)3-12(2-9)34-22-17(31)8-18(32)23-24(22)36-21-16(30)6-13(7-19(21)35-23)33-20-14(28)4-11(27)5-15(20)29/h1-8,25-32HKey: JLEVVQRBEATTCM-UHFFFAOYAP SMILES C1=C(C=C(C=C1O)OC2=C(C=C(C3=C2OC4=C(C=C(C=C4O3)OC5=C(C=C(C=C5O)O)O)O)O)O)O Properties Chemical formula $C_{24}H_{16}O_{12}$ Molar mass 496.37 g/mol Except where otherwise noted, data are given for materials in their standard state (at 25 °C [77 °F], 100 kPa). Infobox references Chemical compound 7-Phloroeckol is a phlorotannin found in the edible brown algae arame (Ecklonia bicyclis) and turuarame (Ecklonia stolonifera).[1] ^ Gunathilaka, Thilina L.; Samarakoon, Kalpa; Ranasinghe, Pathmasiri; Peiris, L. Dinithi C. (25 April 2020). "Antidiabetic Potential of Marine Brown Algae—a Mini Review". Journal of Diabetes Research. 2020: 1–13. doi:10.1155/2020/1230218. PMC 7197011. PMID 32377517. This article about an aromatic compound is a stub. You can help Wikipedia by expanding it.vte Retrieved from " 3 The following pages link to 7-Phloroeckol External tools (link count transclusion count sorted list) · See help page for transcluding these entries Showing 50 items. View (previous 50 | next 50) (20 | 50 | 100 | 250 | 500)Capsaicin (links | edit) Tannin (links | edit) Dietary fiber (links | edit) Kavalactone (links | edit) Flavonoid (links | edit) Polyphenol (links | edit) Phytochemical (links | edit) Saponin (links | edit) Phytosterol (links | edit) Phloroglucinol (links | edit) Arame (links | edit) List of phytochemicals in food (links | edit) Phenylpropanoid (links | edit) Anthraquinones (links | edit) Betalain (links | edit) Hydrolysable tannin (links | edit) Xanthonoid (links | edit) Condensed tannin (links | edit) Phlorotannin (links | edit) Eckol (links | edit) Phenolic acid (links | edit) Isocoumarin (links | edit) Naturally occurring phenols (links | edit) Chalconoid (links | edit) 1,4-Naphthoquinone (links | edit) Phlorofucofuroeckol A (links | edit) Dieckol (links | edit) Tetraphlorethol C (links | edit) Tetrafucol A (links | edit) 8,8′-Bieckol (links | edit) 6,6′-Bieckol (links | edit) Eckstolonol (links | edit) Difucol (links | edit) Diphlorethol (links | edit) 7-phloroethol (redirect page) (links | edit) Arame (links | edit) 4-(3,5-dihydroxyphenoxy)-8-(2,4,6-trihydroxyphenoxy)dibenzo-p-dioxin-1,3,6-triol (redirect page) (links | edit) C24H16O12 (redirect page) (links | edit) List of natural phenols and polyphenols molecular formulas (links | edit) 7-Phlorethol (redirect page) (links | edit) 7-Phloroethol (redirect page) (links | edit) 7-phloroeckol (redirect page) (links | edit) Ecklonia stolonifera (links | edit) Bifuhalol (links | edit) Trifucol (links | edit) Diarylheptanoid (links | edit) Phytosteroid (links | edit) Talk:7-Phloroeckol (transclusion) (links | edit) User:NotWith/WikiProject Polyphenols/templates (links | edit) User:NBonawitz/sandbox (links | edit) User:Y-S.Ko/Wikipedia course/Chemistry (links | edit) User talk:Miszatomic/Archive 15 (links | edit) Wikipedia:WikiProject Chemistry/Lists of pages/Chembox articles (links | edit) View (previous 50 | next 50) (20 | 50 | 100 | 250 | 500) Retrieved from " WhatLinksHere/7-Phloroeckol" As a library, NLM provides access to scientific literature. Inclusion in an NLM database does not imply endorsement of, or agreement with, the contents by NLM or the National Institutes of Health. Learn more: PMC Disclaimer | PMC Copyright Notice . 2022 Aug 2;11(15):2011. doi: 10.3390/plants11152011 Medicinal plants are the product of natural drug discoveries and have gained traction due to their pharmacological activities. Pathogens are everywhere, and they thrive in ideal conditions depending on the nutrients, moisture, temperature, and pH that increase the growth of harmful pathogens on surfaces and textiles. Thus, antimicrobial agents and finishes may be the solution to the destruction of pathogens. This review article presents an analysis of various aspects of producing antimicrobial finishings, the microorganisms, their mechanism of attachment to natural and synthetic fibre, the effect of microbial growth, and the principle and mechanism of the microbial activity of the medicinal plants. Furthermore, the extraction methods, qualitative and quantitative phytochemical evaluations of antimicrobial efficacy, and developments of antimicrobial treated textiles using various agents are covered in this review. Keywords: antimicrobial agents, textile finishings, extractions, solvents, phytochemical screening, qualitative analysis, quantitative analysis Antibiotics play a vital role in fighting bacterial infections, but antibacterial resistance has caused havoc in the healthcare and pharmaceutical sector that accelerates socio-economic losses [1]. Multidrug Resistance is said to increase by 10 million deaths per year by 2050 [1,2]. Biological screening, separation of the phytochemicals, and clinical trials of the medicinal plants have advanced over the years unfolding the secrets of ancient herbal remedies [3]. Traditional medicine is effective in dealing with diseases caused by bacteria or oxidative stress [4,5,6]. Natural compounds have been extensively explored for new drug discoveries [7] Humanity has always been fascinated by natural compounds from pre-biotic, microbial, plant, and animal sources. Extracts of different parts of plants contain bioactive compounds that fight against diseases such as alkaloids, steroids, tannins, glycosides, volatile oils, fixed oils, resins, phenols, terpenoids, and flavonoids [8] The phenolic phytochemicals from plants play a key role as antimicrobial agents [6,9] Antimicrobial agents decay the protein components of the cell wall, disrupting the work of enzymes and DNA and RNA replication [10] Table 1 shows a selection of plants, their phytochemicals responsible for antimicrobial activity, and their applications. Representation of medicinal plant extracts and their applications. Plant Name Phytochemicals Applications Sutherlandia fructecens Saponins, pinitols, flavonoids, triterpenoids, Cannavanine, cycloartane glycosides, flavonol glycosides, and aminobutyric acid [11]. Wound treatment, cancer treatment, diabetes, skin diseases, rheumatism, urinary tract infection, fever, gonorrhoea, kidney, and liver problems [11]. Eucomis autumnalis Homoisoflavanones, terpenoids, and diben-α-pyrones [12]. Reducing fever, urinary diseases, stomach, lower backaches, and syphilis. Eucomisautumnalis issometimes used to induce labour [12]. Plumbago auriculata Tannins, phenols, alkaloids, saponins, flavonoids, plumbagin, α-amyrin, capensisone, and diomuscinone [13]. Treating headaches, warts, skin infections, wounds, and fractures [13]. Catharanthus roseus Vinblastine, deoxyvinblastin, vincoline, cathanranthamine, rosicine, leurosine, vindoline and vincristine [14]. Treating rheumatism, venereal diseases, skin infections, high blood pressure, and diabetes [15]. Aspalathus linearis Spalathin, orientin, isoquercitrin, and luteolinhyperoside [15]. Treat insomnia, stomach cramps, allergies, and digestive problems as well as improve appetite [16]. Centella asiatica Triterpenoids, centellose, medacassoside, triaponosides, flavonoid quercetin, rutin, kaempferol, patuletin, apigenin, polyacetylenes, phenolic acids, sterols [17]. Treating fever, leprosy, syphilis, tuberculosis, leprosy, asthma, epilepsy, mental disorder, and minor wounds. Consumed as a vegetable and used as a spice [17]. Sclerocarya birrea Glucosides, steroids, glycosides, flavonoids, fatty oils, alkaloids, phenols, resins, calcium, and phosphorus [18]. Treating dysentery, rheumatism, malaria, and diarrhoea [18]. Hypoxis hemerocallidea Rooperol, β-sitosterol [19]. Immune booster, purgative, and laxative tonic. Treat tuberculosis, urinary tract infection, infertility, cancer, diabetes, and wounds [19]. Galenia africana Trihydroxyflavanone, trihydroxychalcone, dihydroxychalcone, trihydroxy-3-methoxychalcone [20]. Treat venereal sores, eye infections, asthma, tuberculosis, cough, wounds, skin infections and relieve toothache [20]. Textiles are carriers of microorganisms and are subjected to the growth of microorganisms, such as bacteria and fungi, depending on the food, acidic pH, temperature, time, oxygen, and moisture [11]. Bacteria interrelates with fibres in phases, from initial attachment onto fibres to the growth and damage to the fibres [12]. Cotton is one of the ideal natural fibre fabrics for the growth of pathogens than polyester. Neely [21]. has shown the survival of several gram-positive bacteria (Staphylococcus aureus, Enterococcus faecalis) on standard hospital fabrics made of 100% cotton clothing, 100% cotton terry towels, 60%/40% cotton/polyester-scrub suits and lab coats, and 100% polyester drape. A study by Neely [21] showed the growth of bacteria within 48 h, most bacterial growth survived at least a day, and some survived more than 90 days. Natural fibre textiles are more prone to microbial growth and could lead to the spread of infections [14]. A study by Gupta [22] reports that the attachment of the bacteria onto the fabric is dependent on the characteristics of the fabric, the contact time of the microbe onto the fabric, surface roughness, and moisture retention for natural and synthetic fibres reacting differently to microbial growth [2]. Natural fibres are more prone to microbial attack because they retain water easily. Microbial growth on synthetic fibres like polyester is slower due to their polymer backbone [12]. The ideal antimicrobial treatment for textiles must be effective against a broad spectrum of pathogens but exhibit low toxicity to the user. It must be cost-effective, durable to launder, and not alter the quality or appearance of the textile [23]. A study by Gao et al., [24] reported that microbes are microscopic organisms that exist as unicellular, multicellular, or cell clusters. They consist of an outermost cell wall that constitutes polysaccharides. The cell wall maintains the integrity of cellular components and shields the cell from the extracellular environment. Beneath the cell wall is a semi-permeable membrane that encloses intracellular organelles and multiple enzymes and nucleic acids. The enzymes are responsible for the chemical reactions within the cell, followed by the storage of nucleic acid genetic information of the organism. The purpose of antimicrobial agents is to destroy the cell wall or alter cell membrane permeability, denature proteins, inhibit enzyme activity, or inhibit lipid synthesis so that the cell does not survive. The modes of antimicrobial action of antimicrobial agents define the existence of antimicrobial agents. The antimicrobial agents target mainly the cell wall, and cell membrane, denature protein, inhibit enzyme activity, and inhibit lipid synthesis. There are various classes of antimicrobial agents that possess different mechanisms of action against microbes. Table 2 shows the different antimicrobial classes, the mechanisms of action, and the activity spectrum, respectively [25]. Adapted with permission from Ref. [25]. 2014, Dr Patricia Tille. Representation of mechanisms of action of antimicrobial agents [25]. Adapted with permission from Ref. [25]. 2014, Dr Patricia Tille. Antimicrobial Class Mechanism of Action Activity Spectrum β-lactams They inhibit cell wall synthesis by binding enzymes in peptidoglycan production Gram-negative bacteria and gram-positive bacteria could differ with individual antibiotic Aminoglycosides Hinders the protein synthesis by binding 30S ribosomal subunits Gram-negative bacteria and Gram-positive bacteria Chloramphenicol Inhibits the protein synthesis by binding 50S ribosomal subunits Gram-negative bacteria and Gram-positive bacteria Fluoroquinolones Inhibits DNA synthesis by binding the DNA gyrase topoisomerase IV Gram-negative bacteria and gram-positive bacteria, but it could differ with individual antibiotic Glycylglycines Inhibits the protein synthesis by binding 50S ribosomal units A wide spectrum of gram-negative bacteria and gram-positive species Ketolides Inhibits protein synthesis by binding 50S ribosomal subunits Gram-positive cocci including certain macrolide resistance strains and Gram-negative strains Lipopeptides Binding and disruption of cell membrane Gram-positive bacteria including β-lactams and glycopeptides Nitrofurantoin The mechanism is unknown and may have bacterial enzyme targets and damaging DNA Gram-negative bacteria and gram-positive bacteria Oxazolidinones Hinders the initiation of protein synthesis by binding 50S ribosomal subunits Wide variety of Gram-positive bacteria including those resistant antimicrobial classes Polymyxins Disrupts cell membrane c Poor activity against most Gram-positive bacteria. Gram-negative bacteria Rifampin Hinders RNA synthesis by binding DNA dependent, RNA polymerase Gram-positive and certain Gram-negative bacteria Streptogramins Hinders the protein synthesis by binding two separate sites on the 50S ribosomal subunit Gram-positive bacteria Tetracycline Inhibits protein synthesis by binding of 30S ribosomal subunit Gram-negative bacteria and gram-positive bacteria and several intracellular bacterial pathogens Sulfonamides Hinders the folic acid pathway, binding the enzyme dihydropteroate synthase Gram-negative bacteria and gram-positive bacteria Trimethoprim Hinders with the folic acid pathway by binding the enzyme dihydrofolate reductase Gram-negative bacteria and gram-positive bacteria Textiles are regarded as the only barrier between humans and pathogens. Plant-based extracts and materials provide an efficient and natural microbial resistivity. Antimicrobial textiles are essential in the apparel, commercial, and healthcare sector [26]. A study by Vastrad et al. [27] reported on the evaluation of total phenolic content and flavonoid content using leaf extracts (eucalyptus and lemongrass) with methanol, ethanol, chloroform, and distilled water extract indicated the potential of antimicrobial application of textiles. The antimicrobial agents and finishing on textiles may allow the re-use of face masks, and clothing, reducing PPE kits in health care, reducing domestic laundering that may lead to a reduction in water consumption, curtailing the worldwide pandemic, global warming, and environmental degradation. The selection of pre-treatment and processing methods may influence the reduction in extraction time, an increase in extraction yield, quality of the biological compounds, and reduction in input energy [28]. The drying of any biomass inhibits microbial growth [18], and it aids in the longer shelf life and transportation costs due to the weight and space of dry products [29,30,31]. Drying can affect the phytochemical components of the thermally sensitive components [29,32,33,34], and the process can also contribute to improved conservation of the bioactive compounds against oxidative [35] and enzymatic activities [36] and spoilage bacteria [30,37,38], enabling cellular destruction [28,30,35]. There are many different drying methods, e.g., thermal through natural convection (shade and open sun drying), forced convection (oven drying, solar drying, and heat pump drying), freeze-drying, greenhouse drying, microwave drying, and infrared drying [28]. The freeze-drying method retains the bioactive compounds of the dried product due to minimal thermal damage to the cell tissue, thermolabile compounds, and its porous surface, enabling increased penetration of solvents [30,35,39] Olive leave extracts pre-treated with a hot air drier at 120 °C showed higher phenolic recovery compared to freeze-drying (loss of polyphenols reached up to 39% in dry weight). Freeze-drying shows great potential in the extraction of the total phenolic content [35,40]. Ahmad-Qasem [35] reported that temperature plays a key role in the drying process as it may be beneficial or unfavourable to the microstructure of the biomass and the use of hot air drying at a high temperature. The study by Ahmad-Qasem [35] also reported better extraction efficacy of some phenolic compounds in olive leaves when compared to samples dried at lower temperatures and by drying at a moderate to low temperature may need a longer drying time to reach the desired moisture content of the biomass. The solvent selection is crucial in determining the bioactive compounds of plants used for extractions. Ideal extraction solvent properties include low toxicity, evaporating easily at low temperatures, having good solubility of the target compound, and being sufficiently volatile. The factors affecting the selection of solvents are the rate of extraction, diversity of compounds extracted, ease of handling of extracts, and the cost-effectiveness of the extraction solvents and targeted compounds. Plants consist of various bioactive compounds with varying polarities. Various techniques have been developed and used to obtain pure compounds determining the structure and biological activity [41]. Many solvent extractions have been done to obtain phytochemical compounds for their activity against pathogens. Different phytochemicals have different structural features and consist of different phytochemical compounds as well as action mechanisms as described below: Phenols and polyphenols are obtained from acetone and ethanol solvent extractions which consist of C3 sidechain, hydroxyl groups and a phenol ring e.g., catechol, epicatechin, cinnamic acid that has antimicrobial, anthelmintic, and antidiarrheal activity. The mechanism of action of polyphenols binds to proteins (adhesins), inhibits enzyme-substrate deprivation, complexes with the cell wall, makes intestinal mucosa more resistant and reduces secretion, increases the supply of digestible proteins by animals by forming protein complexes in the rumen, and causes a decrease in gastrointestinal-tract metabolism [42,43]. Chloroform, methanol, and ethanol solvents extract mainly quinones. They consist of aromatic rings, two ketone substitutions e.g., hypericin that has antimicrobial activity. The mechanisms of action of quinones inactivate enzymes, complex with the cell wall, and bind to proteins (adhesins) [42,43]. Ethanol and water mainly extract tannins which consist of polymeric phenols e.g., ellagitannin which has antimicrobial anthelmintic and antidiarrheal activities. The mechanism of action of tannins allows the binding of proteins (adhesins), inhibits enzyme-substrate deprivation, complexes with the cell wall, makes intestinal mucosa more resistant and reduces secretion, increases the supply of digestible proteins by animals by forming protein complexes in the rumen, and causes a decrease in gastrointestinal-tract metabolism [42,43]. Chloroform solvents extract mainly flavonoids which consist of phenolic structure, a carbonyl group, hydroxylated phenols C3 –C5 unit linked to an aromatic ring, flavones and a +3-hydroxyl group that has antimicrobial, anthelmintic and antidiarrheal activity. The mechanism of action of flavonoids is complex with the cell wall, binds to proteins (adhesins), inhibits the secretion of autocoids and prostaglandins and inhibits contractions caused by spasms [42,43]. Ether solvent extracts mainly coumarins and it consists of phenols made up of fused benzenes e.g., warfarin with antimicrobial activity. The mechanism of action of coumarins allows the interaction with eukaryotic DNA [42,43]. Water, ethanol, chloroform, and ether solvents extract mainly terpenoids which consist of fatty acids and acetate units with antimicrobial activity. The mechanism of action of terpenoids inhibits the release of autocoids and prostaglandins [42,43]. Lectins and polypeptides can be extracted by water which consists of mainly extracts proteins e.g., mannose-specific agglutinin, and fabatin that has antimicrobial activity. The mechanism of action of lectins and polypeptides blocks viral fusion or adsorption. [42,43]. Alkaloids can be extracted by ethanol and ether solvents which consist of heterocyclic nitrogen compounds e.g., berberine, piperine, palmatine and tetrahydropalmatine which has antimicrobial, anthelmintic and antidiarrheal activity. The mechanism of action of alkaloids inhibits the secretion of autocoids and prostaglandins and possesses anti-oxidating effects, thus reducing nitrate generation, which is useful for protein synthesis and suppresses the transfer of sucrose from the stomach to the small intestine. [42,43]. Glycosides are mainly obtained when extracted by ethanol solvent, which consists of sugar plus a non-carbohydrate moiety e.g., amygdalin which has antidiarrheal activity. The mechanisms of action of glycosides inhibit the secretion of autocoids and prostaglandins [42,43]. Saponins can be extracted by methanol, water, and hydro-alcoholic 70 % methanol which consists of amphipathic glycosides e.g., vina-ginsenosides R5-R6 with antidiarrheal activity. The mechanism of action of saponins inhibits histamine release in-vitro [42,43]. The selection, identification, and collection of plants are critical for phytochemical studies. It is crucial to have the plants identified by a plant specialist. Many plants are selected through either traditional means by humans or by investigations based on reports of their biological properties. During extraction, solvents diffuse in the plant material and dissolve compounds with similar polarity. The plant's bioactive chemicals depend on the plant material origin, conditions of the plant it has grown or cultivated in, moisture content, and particle size of the plant parts. The different extraction methods will also affect the composition of the secondary metabolites of the extracts namely, type of extraction, time of extraction, temperature and nature of the solvent, solvent concentration, and polarity. The determination of biologically active compounds from plant materials is crucial and dependent on the type of solvent used [44]. Solvents are selected based on their availability, low toxicity, boiling point, ease of evaporation, and solvent polarity [45,46]. The FAO/WHO Expert Committee reported seventeen solvents that are allowed and regarded as safe to use for food and personal-care products. Resistance to antibiotics has become a serious problem globally. ESKAPE are multidrug-resistant pathogens such as Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa, and Enterobacter species who are responsible for Hospital-Acquired Infections (HAI). New antibiotics have been produced over the years. The resistance by the ESKAPE pathogens to the drugs has accelerated tremendously [47]. A Priority Pathogen List (PPL) was released by the WHO in 2016 as a guide to research, discovery, and development of new antibiotics globally [48]. Pathogens occupy the surfaces of fabrics depending on the contact time, moisture retention, and surface roughness. Staphylococcus aureus and Escherichia coli pathogens cause hospital infections leading to pneumonia and sepsis. It is, therefore, important to keep track of the availability of alternative medicinal plants and herbs to conquer this challenge [49]. The discovery of new drugs that can be mastered with the use of plant extracts is a hoard of a spectrum of secondary metabolites [50,51,52,53,54,55,56]. Enterococcus faecium is a Gram-positive bacterium that causes infections; it is increasingly resistant compared to Vancomycin-resistant Enterococci faecium [57,58]. E. faecium lives in the gut microbiome of animals [59,60]. Food is an excellent hideout for the strains to remain dormant [61]. Treatment is dependent on second-line antibiotics [62]. Urinary tract infections, bacteraemia, and endocarditis are caused by this bacterium [60]. Staphylococcus aureus is a Gram-positive bacterium prevalent on the human skin, particularly in immune-compromised individuals. This bacterium causes infections on medical implants and forms biofilms that make it extremely difficult to treat with antibiotics. The Methicillin-resistant Staphylococcus aureus developed resistance against β-lactam antibiotics [58]. Community Associated-Methicillin-Resistant Staphylococcus aureus lineages are associated with skin and soft tissue infections. The Methicillin-resistant Staphylococcus Aureus strains are associated with pneumonia and bloodstream infections [63]. Klebsiella pneumoniae is a Gram-negative bacterium that causes urinary tract infections septicaemia, surgical wound infections, pneumonia, endocarditis, pyogenic liver abscess cystitis, and endogenous endophthalmitis [64]. The Cephalosporin- and carbapenem-class antibiotics have been the base treatment for Enterobacterales infections, such as Klebsiella pneumoniae. The efficacy of the antibiotics is compromised by the widespread acquisition of genes and encoding enzymes that aid in the respective resistance to these critical drugs [65]. Acinetobacter baumannii is a Gram-negative bacterium that is more common in hospital settings [66]. It is aerobic and non-fermenting pleomorphic. This bacterium can resist dehydration. It forms biofilms, surface adhesins, and secretions systems that help this bacterium thrive in its environment [67]. The infection rates of A. baumannii are low compared to the ESKAPE pathogens [68]. Pseudomonas aeruginosa is a Gram-negative bacterium associated with respiratory infections and displays resistance to multiple classes of antibiotics [68]. P. aeruginosa grows and colonizes in moist environments, especially in healthcare settings in the context of chronic wounds, respiratory support, or urinary tract devices, immune evasion, and antimicrobial resistance [69]. It's a Gram-negative bacterium, anaerobic in nature. Enterobacter aerogenes, known as Klebsiella aerogenes are responsible for the increasing hospital-acquired infections [69]. Immunocompromised individuals are more susceptible to urinary and respiratory tract infections to this bacterium [70]. Escherichia coli which is not part of the ESKAPE pathogens is the major cause of bloodstream and urinary tract infection (UTI) in both community and health care settings globally. Sepsis is one of the most common manifestations of E. coli urinary tract infection. E. coli is the most common Gram-negative bacterial species isolated from blood and urine cultures [71]. Many biocide agents already exist on the market. They are classified into the following compounds [72]: Quaternary Ammonium Compounds: These compounds represent a group of compounds. They consist of a subgroup of alkyl linear ammonium compounds, composed of hydrophobic alkyl chain and hydrophilic-counterpart. Quaternary Ammonium Compounds damage cell membranes, modify proteins and inhibits DNA production. They are applied in cotton, polyester, nylon and wool fibres. These compounds are active against a wide range of pathogens but lack physical bonding in textiles. Triclosan: These compounds are odourless chlorinated bisphenol and improve the durability of laundering. They are active against a wide range of pathogens. They block lipid biosynthesis and hinder the integrity of the cell membranes. They are applied to polyester, nylon, cellulose acetate and polypropylene. Metals and metallic salts: At low concentrations, they are exceptionally active against pathogens. They generate reactive oxygen species, damaging cellular proteins lipids and DNA. Silver, copper, zinc, and cobalt are used has been widely used as antimicrobial agents and applied to cotton, wool, nylon, and polyester. Chitosan: is a natural hydrophilic copolymer. It's a linear polysaccharide that is biocompatible, non-toxic,

non-carcinogenic, and antimicrobial. They are applied to cotton, wool, polyester and nylon fibres. The low molecular weight results in inhibiting the synthesis of mRNA, preventing protein synthesis, and the high molecular weight causes leakage of intracellular substances or blocks the transport of essential solutes. Poly (Hexamethylene Biguanide): These agents are polycationic amines biguanide repeat units separated by aliphatic chains. They interact with membrane phospholipids, resulting in disturbance and the fatal leakage of cytoplasmic materials. They are applied to cotton, nylon, and polyester fibres. N-halamines: They are heterocyclic organic compounds. N-halamines prevent the cell enzymatic and metabolic processes, causing the consequent microorganism destruction. They are applied in cotton, nylon, polyester and wool fibres and are active against a wide range of pathogens. Many plant-based compounds with a wide range of antimicrobial activity spectrum have been identified and are commercially available. Table 3 shows the wide range of commercially available antimicrobial agents on the market. Representation of commercially available antimicrobial agents on the market [72]. Product Name Company Description Agion® Sciessent, Beverly, MA, USA Silver and zeolite-based additive AlphaSan® Milliken Chemical, Spartanburg, SC, USA Silver-based additive BioGaurd® AEGI Microbe Shield, Huntersville, NC, USA Finishing agent based on 3-trimethoxysilylpropyldimethyloctadecylammonium chloride Biozac ZS Zschimmer & Schwarz Mohsdorf GmbH, Burgstadt, Germany PHMB-based finishing agent Cosmocil CQ™ Lonza, Basel, Germany Polyaminopropyl biguanide- based additive Eosy® Unitika, Osaka, Japan Finishing agent based on chitosan Irgaurd® 1000 BASF, Ludwigshafen, Germany Finishing agent based on triclosan Irgasan Sigma Aldrich, St. Louis, MO, USA Finishing agent based on triclosan Microban® Microban International, Huntersville, NC, USA Triclosan-based agent Reputex™ Lonza, Basel, Germany PHMB-based finishing agent Sanigard KC L. N. Chemical Industries, Maharashtra, India Finishing agent belonging to the QAC group Saniguard Nano-ZN L. N. Chemical Industries, Maharashtra, India Finishing solution based on aqueous nano-dispersion of zinc oxide Sanitised® SANITIZED AG, Burgdorf, Germany Finishing agent based on 3-trimethoxysilylpropyldimethyloctadecylammonium chloride Silpure® Thomson Research Associates, Toronto, ON, Canada Silver particles-based finishing agent Silvadur™ The Dow Chemical Company, Midland, MI, USA Interpenetrating polymer network with silver ions SmartSilver® Nanohorizon Inc., Philadelphia, PA, USA Silver nanoparticles-based agent Silverion 2400 Pure Bioscience, Inc., El Cajon, CA, USA Stabilised silver complex-based agent There are various extraction methods, e.g., solvent extraction, distillation method, pressing, and sublimation. Solvent extraction is the most widely used method where the natural products undergo a process where the solvent penetrates through the plant cell wall and the solute dissolves in the solvents the solute followed by collecting the extract. It has been reported that the size of the plant material, properties of the solvent solid to solvent ratio extraction temperature, and extraction time will affect the extraction efficiency [73,74]. The selectivity of the solvents, solubility, cost and safety play a crucial role in solvent extraction. Solvents with the same polarity as the polarity of the solute will result in a greater yield. High temperature affects dispersion and solubility. High temperatures may result in solvents being lost and extracts with impurities and the degradation of thermolabile compounds. The extraction efficiency increases with extraction time. Increasing time will not affect the extraction. The greater the solvent to solid ratio, the greater the extraction yield [75]. Various extraction methods are used to extract the desired bioactive compounds from the plant materials, e.g., solvent extraction, distillation method, pressing, and sublimation. Solvent extraction is the most widely used extraction method when extracting from plant material. In this extraction process, the plant parts are dried in a controlled environment at low temperatures and milled into a powder and weighed. The powder is added to a beaker with solvents and kept at room temperature for thirty minutes. The contents are shaken every twenty-four hours for seven days. The extract is filtered using Whatman filter paper under vacuum and drying at room temperature in a watch glass dish. The weight of the powder is recorded before and after drying [76]. Fresh plant parts are grounded in a blender. The solvent is added and shaken vigorously for 5–10 min or left for 24 h followed by filtration of the extract. The filtrate can be dried under reduced pressure and redissolved in the solvent to determine the concentration, or it can be centrifuged for clarification for further studies [44]. In this extraction method, the solvent of increasing polarity from a non-polar solvent (hexane) to a polar solvent (methanol) is used to ensure a broad polarity range of compounds being extracted and to prepare crude extracts [44]. In this extraction method, solid material is placed in a thimble in the extractor. The solvent is heated until reflux. The vapour rises, and the solvent is condensed and fills up the thimble. The extraction is repeated [77,78]. A whole or coarsely powdered plant is soaked in the solvent in a container for a period under continuous mixing until agitation until the biomass matter is dissolved [44]. In this extraction method, the plant parts are brought to a boil in water followed by cooling, straining, and passing sufficient cold water through the drug to produce the required volume [77]. In this extraction method, the plant parts are macerated with either cold or boiling water [77]. In this extraction method, the plant parts are macerated under gentle heating [77]. In this extraction method, the raw material is placed in an appropriate amount of solvent for approximately 4 h in a closed container. Additional solvent is added to the top of the raw material and macerated in a closed container for 24 h. The percolator is opened, and the extract is poured out drip-wise. Additional solvent is added until the percolate measures about three-quarters of the required volume of the finished product. The marc is pressed, and the pressed liquid is added to the percolate. Additional solvent is added to produce the required volume, and the mixed liquid is clarified by filtration or by decanting [77]. This method uses ultrasound technology to assist in the extraction of the bioactive compounds under frequencies ranging from 20 kHz to 2000 kHz. The ultrasound increases the permeability of cell walls and produces cavitation and ruptures the plant cell wall [77]. In this extraction method, enzymes are used to increase the yields during the extraction. Enzymes are used to soften the tissues of biomass and facilitate the degradation of the cells [79]. This extraction method uses microwave radiation and solvents to extract bioactive compounds. Microwave energy is generated through microwave radiation that heats the solvents whilst increasing the kinetics of the extraction. Moisture occurs in the plant cells when heat is applied and evaporates. The microwave effect generates pressure on the cell wall and results in cell rupture. Exudation occurs and leads to an increase in extraction yield [79]. This is an extraction method using ultrasonic sound waves that pass through the solvent, producing energy by enhancing the diffusion of the solvent into the sample array. The Ultrasonic-Assisted Extraction is cost-effective in terms of the quantity of solvent used, temperature, and time [79]. In this extraction method, supercritical fluids at high temperatures and pressures above the critical values are applied to the extraction material. The pressure is adjusted, and the supercritical fluids return to their gas phase and evaporate without leaving solvent residues [79]. This extraction method is conducted under high pressures and temperatures that aid in the high solubility of the compounds in the solvent and result in high diffusion of the solvent into the sample array [79]. Table 4 shows the various extraction methods used when extracting biomass. Extraction methods used in biomass extractions [75]. Method Solvent Temperature Pressure Time Volume Consumed The Polarity of Natural Products Maceration Water, Aqueous and non-aqueous solvents Room temperature Atmospheric Long Large Dependent on extracting solvent Percolation Water, Aqueous and non-aqueous solvents Room temperature, occasional heat Atmospheric Long Large Dependent on extracting solvent Decoction Water Under heat Atmospheric Moderate None Polar compounds Reflux extraction Aqueous and non-aqueous solvents Under heat Atmospheric Moderate Moderate Dependent on the extracting solvents Soxhlet extraction Organic solvents Under heat Atmospheric Long Moderate Dependent on extracting solvent Pressurised liquid extraction Water, aqueous and non-aqueous solvents Under heat High Short Small Dependent on extracting solvent Supercritical fluid extraction CO2 Near room temperatures High Short None or small Non-polar to moderate compounds Ultrasound-assisted extraction Water, aqueous and non-aqueous solvents Room temperature or under heat Atmospheric Short Moderate Dependent on extracting solvent Microwave-assisted extraction Water, aqueous and non-aqueous solvents Room temperature Atmospheric Short Moderate Dependent on extracting solvent Pulsed electric field extraction Water, aqueous and non-aqueous solvents Room temperature or under heat Atmospheric Short Moderate Dependent on extracting solvent Enzyme assisted extraction Water, aqueous and non-aqueous solvents Room temperature or heated after enzyme treatment Atmospheric Moderate Moderate Dependent on extracting solvent Chromatography is a technique used to separate molecules based on their size, shape, and charge. The analyte in the solvent passes through a molecular sieve which leads to its separation. Paper and thin layer chromatography readily provide qualitative information and through which it becomes possible to obtain quantitative data. In this technique, a sheet of paper is used to carry out separations which acts as both support as well a medium for separation. The sample is placed near the bottom of the filter paper and the filter paper is placed in the chromatographic chamber with solvent. The solvent moves forward by capillary action carrying soluble molecules along with it. Low porosity paper will produce a slow rate of movement of the solvent and thick papers have increased sample capacity [80]. This technique is used to separate the samples based on the interaction between a thin layer of adsorbent attached to the plate with low molecular weight compounds. Different adsorbents are used to separate various compounds [80]. This technique is used to separate volatile compounds. The rate of kinetics for the chemical species is determined through its distribution in the gas phase. Gas chromatography involves a sample being vaporized and injected onto the head of the chromatographic column. The sample is transported through the column by the flow of the inert, gaseous mobile phase. The column itself contains a liquid stationary phase which is adsorbed onto the surface of an inert solid [80]. This technique separates compounds based on their interactions with solid particles of a tightly packed column and the solvent of the mobile phase. The Diode Array Detector measures the absorption spectra of the analytes to aid in their identification of the compounds [80]. The study of bioactive compounds encompasses phytochemical and pharmacological approaches [81] Many plant parts contain bioactive components, e.g., bark, leaves, stems, fruits, and seeds [82]. Phytochemicals are chemicals produced by the various parts of the plants namely, alkaloids, flavonoids, terpenoids, steroids, tannins, glycosides, etc. The bioactive compounds have various antimicrobial and antibacterial properties [83]. Qualitative phytochemical screening plays a crucial role in identifying various biochemical compounds produced by plants. The quantification of those metabolites may assist in the extraction, purification, and identification of the bioactive compounds for human use [83]. The preliminary qualitative phytochemical screening is carried out as per standard methods described by Trease & Evans 1989. The extracts are dissolved in dilute hydrochloric acid and filtered individually and tested for the presence of alkaloids. Mayers test: The extraction added to the Mayers reagent. A yellow cream precipitate formation indicates the presence of alkaloids. Wagner's test: Wagner's reagent is added to the extraction if a brown-reddish brown formation is observed, and it indicates the presence of alkaloids. Detection of Flavonoids Lead acetate test: A few drops of lead acetate solution is added to the extracts. A yellow-colour precipitate indicates the presence of flavonoids. Sulfuric acid test: A few drops of sulfuric acid are added to the extracts, and the formation of orange colour indicates the presence of flavonoids. A few drops of acetic anhydride are added to the extracts and the formation of violet to blue to green in some samples indicates the presence of steroids. Salkowski's Test: Extract of 5 mg of the selected plant part is mixed with 2 mL chloroform and 3 mL concentrated sulfuric acid added carefully to form a layer. A reddish-brown colour indicates the presence of terpenoids. Bontrager's Test: About 5 mg of the extract is boiled with 10% HCl for a few minutes in a water bath. It's filtered and allowed to cool. An equal volume of CHCl3 is added to the filtrate. A few drops of 10% NH3 are added to the mixture and heated. The formation of pink colour indicates the presence of anthraquinones. Ferric chloride test: A few drops of ferric chloride are added to the 10 mL extract. A bluish-black colour indicates the presence of phenol. Lead acetate test: A few drops of lead acetate solution is mixed with 10 mg extract. A yellow colour indicates the presence of phenol. A 0.5 mg of the extract is mixed vigorously with 5 mL of distilled water. The formation of frothing indicates the presence of saponins. A few millilitres of the extract are mixed with a few millilitres of water and heated in a water bath. The mixture is filtered. Ferric chloride is added to the filtrate. The dark green colour indicates the presence of tannins. A 0.5 mg of the extract is dissolved individually in five ml of distilled water and filtered. The filtrate is used to test the presence of carbohydrates [84]. One gram of extract sample is added to a 250 mL beaker, and 200 mL of 10% acetic acid in ethanol is added, covered, and left for settling for 4 h. The extract is filtered and concentrated in a water bath to one-quarter of the original volume. Concentrated ammonium hydroxide is added dropwise to the extract until the precipitation is complete. The solution is allowed to settle, and the precipitate is collected and washed with dilute ammonium hydroxide, followed by filtration. The residue is dried and weighed [85]. A gram of sample is extracted repeatedly with 100 mL of 80% aqueous methanol. The mixture is filtered through Whatman no.1 filter paper into a pre-weighed 250 mL beaker. The filtrate is transferred to a water bath and allowed for evaporation to dryness and followed by weighing off the sample [83]. The sample is placed in a beaker and boiled for 15 min with 50 mL of ether for the extraction of phenolic compounds. five mL of the extract is pipetted out into a 50 mL flask followed by the addition of 10 mL of distilled water, 2 mL of ammonium hydroxide solution, and 5 mL of concentrated amyl alcohol. The samples are left to react for 30 min for colour development and read at 505 nm [83]. The biocidal analysis evaluates the effectiveness of antimicrobial textiles. Several test methods have been established through quantitative antimicrobial tests. The number of microbes present on the finished fabrics can be counted and expressed as a percentage or as a log reduction. The test methods for quantitative determination are ATCC TM100, JIS L1902, AATCC90 percentage reduction, and ISO 20743 shake flask reduction methods [86]. The Parallel Streak Method (AATCC TM147) is a qualitative method used to determine the antibacterial activity of diffusible antimicrobials agents on treated textile materials. The Parallel Streak Method has proven to be effective. This method shows antibacterial activity against both Gram-positive and Gram-negative bacteria. The sterilised agar is dispensed (cooled to 47 °C (117 °F) by pouring 15 mL into each standard (15 × 100 mm) flat bottomed petri dish. Allow agar to gel firmly before inoculating. The inoculum is prepared by transferring 1.0 mL of a 24-h broth culture into 9.0 mL of sterile distilled water containing it in a test tube or small flask. A 4 mm inoculating loop is used, loaded with one loopful of the diluted inoculum and transferred to the surface of the sterile agar plate by making five streaks approximately 60 mm in length, spaced 10 mm apart by covering the central area of a standard petri-dish without refilling the loop. The specimen is pressed onto the agar surface with a sterile spatula. After 18 to 24 h of incubation at 37 °C, the plates are examined for bacterial growth directly underneath the textiles and around the edges of the textiles. If the antimicrobial substance diffuses into the agar, an inhibition area is formed, and its size indicates the effectiveness of the antimicrobial effect or the rate at which the active agent is released [21,24]. AATCC 100 (Suspension Test) is a quantitative antimicrobial test method used to determine the antibacterial activity of the textiles and fabrics against bacteria. The bacterial counts are recorded, and a percent reduction is measured using initial count and remaining count data [24]. Durability by washing method (ASTM E3162-18 or AATCC61-2A) is used to determine the durability of laundering. This test method is an accelerated laundering test method to measure the durability of antibacterial agents applied to textiles under simulated home laundering conditions. Ten grams of the coated fabric for laundering is prepared, followed by adding a 500 mL defined detergent solution. Set the washing machine at a temperature of 50 °C under abrasive action using stainless steel balls to simulate five home launderings for a 45-min laundering cycle at 40 revolutions per minute. After each cycle, remove the fabric and rinse with water thoroughly by hand. Repeat, depending on the total number of washes required. Plants are a unique source of bioactive compounds with biological activities and medicinal properties. The choice of solvents plays an important role in the extraction of bioactive chemicals. Antimicrobial agents and textile finishes have gained traction over the years. Synthetic antimicrobial agents show great effectiveness against pathogens but cause harm to the environment and human health. More research on plant-based antimicrobial agents and finishing should be done to extend the longevity of the antimicrobial power and durability to laundering on textiles substrates. The rise of "super germs" has become a global health problem due to antibiotic resistance. More research needs to be done on medicinal plants as a source of alternative medicines using unexplored medicinal plants for their bioactive properties and solvents that are generally regarded as safe. There should be more in-depth studies done on the most economical pre-treatment, drying, and extraction methods for future therapeutics. The authors wish to acknowledge the support from the team members and the Cape Peninsula University of Technology University Research Fund Cost centre R971. ISO International Standards Organization AATCC American Association of Textile Chemists and Colourists JIS Japanese Industrial Standards PC Paper Chromatography TLC Thin Layer Chromatography GC Gas Chromatography HPLC High-performance liquid chromatography QAC Quaternary Ammonium Compounds mRNA messenger Ribonucleic acid HAI Health Associated Infections PPL Priority Pathogen List WHO World Health Organization RNA Ribonucleic acid DNA Deoxyribonucleic acid UTI Urinary Tract Infection ESKAPE Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumanni, Pseudomonas aeruginosa, Acinetobacter aerogenes Writing—original draft preparation, E.N.; Supervision, M.B. Funding acquisition M.B.; Writing review and editing, M.B., E.N., D.M. and P.N. All authors have read and agreed to the published version of the manuscript. The authors declare no conflict of interest. This research received no external funding. 1.O'Neill J. 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