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Research Article

Qualitative phytochemical analysis of *Curcuma longa* root extract

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Abstract

The active group (s) content of Curcuma longa rhizomes (CLR) makes it a medicinal plant with a reasonable therapeutic potential. Therefore, in this study, we attempted to clarify these groups using standard preliminary phytochemical screening tests. Results revealed detection of Alkaloids, Glycosides, Carbohydrates, Cardiac Glycoside(s), Saponin, Gallo-tannins, or Catecho-Tannins (hydrolysable or condensed), respectively, Flavonoids, Resins, Steroids, Fixed oils, and Protein compounds. Anthraquinones, Gums or Mucilage and Terpenoids were not noticeable. Phlobatannins content is suspect. These findings may prove CLR is a rich source of active groups, suggesting that it may be a nutraceutical-based medicine in the pharmaceutical and cosmetic industries.

Keywords: Active Groups, Phytochemical Screening, *Curcuma longa* rhizomes, Medicinal Plant.

Introduction

Plant medicine was the first form of traditional medicine that existed in human civilization prior to the development of the modern healthcare system (Abdulrahman et al., 2018). The first known healer in history is the Egyptian Imhotep (3rd millennium BC), and the first universally recognized usage of plants as therapeutic agents was shown in the cave paintings at Lascaux in France, which have radiocarbon dates between 13,000 and 15,000 BCE (Mosihuzzaman, 2012). According to the World Health Organization (WHO), due to poverty and a lack of access to modern medication, approximately 65-80% of the world's population lives in underdeveloped countries and relies primarily on plants for primary health care (Calixto, 2000). With the passage of time and even with the spread of the modern pharmaceutical industry, traditional herbal treatment is frequently practiced for historical, cultural, and ecological reasons. This is particularly true because it has remained accessible, is more compatible, and is widely accepted (Kunwar et al., 2010). Herbs are used to treat a variety of illnesses, both acute and chronic, including serious conditions. The absence of side effects is one of the greatest advantages of herbal medication. Additionally, they frequently provide long-term advantages for general wellness (Sam, 2019). In the United States of America, adverse or side effects of synthetic medications account for about 8% of hospital admissions. Approximately 100,000 people per year pass away as a result of these toxins. Herbal-related hospitalizations or fatalities are extremely uncommon and difficult to locate. Even the US National Poison Control Centers' database does not include a section for side effects from plants. People turn to herbal therapy every year because they think that plant medicines are free from negative side effects (Karimi et al., 2015).

Phytochemistry has emerged as a separate field of study in recent years and is near to plant biology, organic chemistry and pharmacology. It discusses the broad range of organic compounds that plants produce and accumulate, as well as their natural distribution and pharmacological functions which help in the treatment of diseases (Harborne & Harborne, 1973).

Crude extract of medicinal plants contains a variety of phytochemicals, including Alkaloids, Flavonoids, Tannins, Terpenoids, Steroids, and Glycosides, according to qualitative phytochemical analysis. Pharmaceutical companies are particularly interested in the phytochemical analysis of plants

since it is crucial for the manufacture of new pharmaceuticals to treat a variety of disorders (Suriyavathana & Roopavathi, 2016).

One of these plants is *Curcuma longa*, *which* belongs to the *Zingiberaceae* family and whose rhizomes produce a bright yellow spice that has a number of therapeutic uses. It is utilized for dyeing, cosmetic purposes (Omosa et al., 2017). Herbaceous and perennial plant with widely distributed throughout the world's tropical and subtropical climates and is typically grown in Asian nations, namely in India and China. Indian term for "haldi," whose rhizomes are oblong, ovate which frequently short-branched (Akram et al., 2010; Lal, 2012; Yadav et al., 2017).

Curcuma longa has been used for a very long time in many traditional medical systems, because of its extensive variety of pharmacological qualities and uses (Law et al., 2020). CLR has following activities innate and adaptive immune response-activator (Sumadi et al., 2022), endothelial function enhancer (de Oliveira & Alvares, 2022), anti-viral, anti-bacterial, anti-parasitic and anti-fungal (da Silva et al., 2018; Chen et al., 2015), the anti-rheumatic activity (Dcodhar et al., 2013), anti–cancer (Abbas Momtazi & Sahebkar, 2016), wound healing effect (Chereddy et al., 2013), anti-oxidant (Chen et al., 2015), cardiovascular protective, anti-diabetic–anti-obesity (Gutierres et al., 2015), (Pulido-Moran et al., 2016), hepatic, respiratory and neurological protective agent (Pulido-Moran et al., 2016), analgesic effect, antipyretic action and anti-inflammatory (Edwards et al., 2017; Zhran et al., 2023 unpublished data). In a previous study, we have found that curcumin have anti-inflammatory, antipyretic and analgesic effects. The main objective of the current study was underlining the phytochemicals in relation to the use of CLR in traditional medicine. It is expected that the significant phytochemical characteristics of CLR that were discovered via our research, may be very beneficial in the pharmacological sector.

Methods and Materials

Plant part used

The CLR that are commonly used in folk medicine, were obtained from our local environment where the dry rhizomes and root are available at shops of herbs and spices elsewhere in Egypt; one kg of the dry rhizomes and root was purchased from a Harraz® company at Shubra, Cairo province and identified by a botany specialist (Fig.1).

Ethical Approval

Experiments for this study were ethically approved by the Scientific Research Ethics Committee (Animal Care and Use), Faculty of Veterinary Medicine, Benha University, Benha, Egypt (Approval no. BUFVTM 05-03-23).

Equipment

Beakers, test tubes, pipettes, water bath, hot flame, filter papers, digital scale, cotton mesh paper, glass rod, dropper, test tube holder, spatula, mortar and pastel.

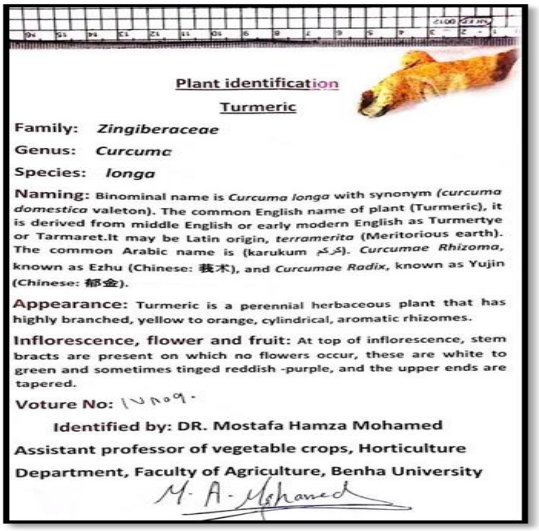

Fig. 1 The CLR were identified by a botany specialist

Chemicals and reagents

Analytical grade chemicals and solutions were employed for the rest of the study. Mayer's regent, Wagner's regent, Hager's regent, Dragendorff's regent, tannic acid regent, Molisch's regent, Fehling's regent, Benedict's regent, vanillin-hydrochloric acid regent, Wilson's regent, Millon's regent, and Biuret regent were among the reagents used for the detection of various phytochemical groups.

Phytochemical analysis

Phytochemical screening of *Curcuma longa* for the presence of different active principle groups, including Alkaloids, Glycosides, Anthraquinones, Cardiac Glycosides, Saponins, Tannins, Flavonoids, Resins, Gums, Terpenoids, Oils and Proteins was carried out. All tests were performed as triplicates and given marks from (-) to (+++) according to the strength of the color or precipitate that appeared.

Detection of Alkaloids

About one g of the crushed CLR was extracted with 10 mL of diluted 1% HCl, with aid of heat; and then the mixture was filtered (Harborne, 1973). In clean and dry test tubes, two mL of the filtrate were treated, separately, with a few drops of Mayer's or Wagner's or Hager's or Dragendorff's or tannic acid 10% reagents. Creamy, brown, yellow, deep yellow, buffy precipitation with those detecting reagents, respectively, was judged as indicator for alkaloidal substance content.

Detection of Glycosides/Carbohydrates

Five grams of the crushed CLR was mixed with 30 mL of distilled water and heated. The watery extract was then decanted and the supernatant was tested for its content of a Carbohydrate and/or a glycosidal substance following the classical procedure reported by (Claus & Tyler, 1967) and (Balbaa, 1986), with minor modifications, in the following tests:

Molisch's test*:* About 0.2 mL of α-naphthol alcoholic solution 10% was added to two mL of the tested water filtrate in a clean and dry test tube; then by addition of 2 mL of sulphuric acid onto the inside wall of the tube, a bluish violet zone formation denotes presence of Glycosides and/or Carbohydrates.

Fehling's test*:* Equal amounts of the concentrated extract and Fehling's reagent were mixed and heated for a few minutes. Precipitation with changing of color ranging between yellow to brown, indicates the presence of certain glycone as a part (or not) from Glycosides and/or Carbohydrates.

Benedict's test*:* Equal aliquots of the concentrated extract and Benedict's reagent were mixed in a clean and dry test tube and heated for a few minutes. Precipitation with change of color to any degree from yellow to red-brown, denotes the presence of reducing sugar(s) as a part (or not) from Glycosides and/or Carbohydrates.

To differentiate if the constituent is a Glycoside and Carbohydrate; Fehling's and Benedict's tests were repeated twice, the first with aqueous extract of the CLR. While the second with the acidulated (H_2SO_4) extract (that was then neutralized by 5% NaOH solution); stronger color in the second trial indicates a Glycoside in general. Special tests to detect special Glycoside categories were performed as follows:

Baljet's test*:* A few drops of sodium picrate solution were added to 1 mL of the concentrated extract. Orange discoloration denotes presence of Cardiac Glycosides.

Killer-Killiani test*:* Two mL of acetic acid (glacial) with a drop of ferric chloride solution were added to five mL (100 mg/mL in methanol) of the crushed CLR extract in clean and dry test tube. One mL of conc. sulphuric acid was added to form a zone above the prepared mixture. Formation of a bluish-brown ring at the interface indicates deoxy- sugar that is characteristic for Cardiac Glycosides (Evans & Evans, 2002).

Schonteten's Reaction *(*Borax test*):* To 2 mL of the aqueous CLR extract (1 g/10 mL), 0.1 g of Borax was added and heated until dissolved. A few drops of the liquid were poured into a test tube almost full of water; a green fluorescence indicates Anthraquinones Glycoside.

Detection of Saponins

Foam *(*Froth*)* test*:* The ability of saponin to produce froth upon shaking and to produce emulsion with oil was used as a test for its detection (Harborne, 1973). About two g of the crushed dry CLR was heated in 20 mL of distilled water in a water bath for five minutes and then filtered. In a clean dry 25 cm cylinder, ten mL of the filtrate was mixed with 5 mL of distilled water and shaken vigorously and froth formation was observed. To complete the test, then three drops of olive oil were mixed with the formed froth (if any), shaken vigorously and observed for emulsion formation. At least ten cubic mm height of froth that stands for at least 10 minutes indicates Saponins; and emulsion formation confirms it.

Detection of Tannins/Phenols

About 2 g of the CLR powder were extracted in 20 mL ethanol (50 %) by heating in water bath for 10 minutes at 70 °C and tested for presence Tannins and/or other Phenolic compounds in the CLR extract using the following tests (Ramakrishnan, 2004).

Gelatin test*:* Equal amounts of the extract and 1% gelatin solution in sodium chloride (0.85%) were mixed in a clean dry test tube. Formation of white/cloudy/buffy precipitate indicates the presence of Tannins (in general) in the CLR extract.

Lead acetate test*:* Two mL of 10% lead acetate filtered, clear solution, and were added to 2 mL of the extract. A bulky white precipitate indicates the presence of Tannins and/or Phenolic compounds.

Ferric Chloride test*:* A few drops of $FeCl_3$ solution (1%) were added to an aliquot of 2 mL of the prepared extract, formation of bluish-black or greenish color denotes the presence of Gallo- or Catecho- tannins (hydrolysable or condensed), respectively.

Hydrochloric acid test*:* Half g of the CLR powder were boiled with 5 mL of 1% HCl for 10 minutes; the formation of a red precipitate indicated the presence of Phlobatannins (Evans & Evans, 2002).

Vanillin test: Two mL of vanillin-HCl reagent were added to an aliquot of five mL of the alcoholic CLR powder extract (1 g seed/10 mL alcohol). Formation of a red or pink deposit denotes the presence of Gallic acid (hydrolysable tannin).

Detection of Flavonoids

Shinoda's (Cyanidin) test: Two mL of 10% ethanolic extract of the crushed CLR powder (1 g/10 mL; w/v) were mixed with 0.5 ml of HCl (10%) and a few mg of magnesium metal turnings. Development of a reddish color denotes the presence of Flavonoids (Evans & Evans, 2002).

Wilson's test*:* Some Flavonoids (5-oxyflavones and 5-oxyflavonoles) with Wilson's reagent develop brightly yellow colour with yellowish-green fluorescence, if present in CLR extract.

Lead Acetate test: A few drops of clear lead acetate solution (10%) were added to two mL of the crushed CLR ethanolic extract in a clean and dry test tube. Appearance of a yellow colored precipitate denotes presence of Flavonoids.

Alkaline reagent test: Two mL of the CLR aqueous extract were treated with 10% solution of ammonium hydroxide; observation of yellow fluorescence denotes the presence of Flavonoids.

Detection of Resins

Fifty mL of 95% ethanol were added to about 5 g of the dry grind of the plant CLR. The mixture was heated in shaking water bath for about 20 minutes, then decanted or filtered. Formation of a precipitate upon the addition of about 5 mL of distilled water denotes a resinous content (Harborne, 1973).

Detection of Gums/Mucilages

One g of the powdered CLR was dissolved in 10 mL of distilled water in a large clean dry test tube. Twenty-five mL of absolute alcohol were then added gradually with constant stirring. Appearance of white/cloudy precipitate denotes the presence of Gums/Mucilages (Whistler & BeMiller, 1993).

Detection of Terpenoids/Steroids

Presence of Terpenoids and derived Steroids in CLR was carried out by the following tests:

Salkowski's test*:* One hundred mg of the crushed CLR were extracted in 2 ml of chloroform, and then 3 ml of concentrated H_2SO_4 were carefully added onto the wall of the test tube. After standing for minutes, appearance of reddish coloration at the lower layer confirms the presence of Steroids; while turning it into yellow indicates Terpenoids (Harborne, 1973).

Libermann-Burchard test: The chlorformi extract was treated with a few drops of acetic anhydride and then heated. After cooling, equal amount of concentrated H_2SO_4 was added carefully onto the inside wall of the test tube. Appearance of a brown ring at the interface and turning of the upper layer into green indicate presence of steroids; while formation of a dark red colour indicates Terpenoids.

Detection of Fixed oils

Spot (Stain) test*:* Petroleum ether or benzene CLR extracts were tested for presence of Fixed oils/Fats. A small amount of an extract was pressed in between the folds of a filter paper. Appearance of oil stains denotes content of Fixed oil/Fat (Kokate, 2008).

Detection of Proteins/Amino acids

The crushed CLR powder (1 g) was mixed with 10 ml of distilled water in a clean dry test tube, and filtered through Whatmann No.1 filter paper. Then, the filtrate was subjected to tests for Proteins and/or free amino acids, including:

Millon's test: A few drops of Millon's reagent were added to two mL of the prepared CLR filtrate. A buffy white precipitate that turns red upon heating denotes the presence of Proteins (Rasch & SWIFT, 1960).

Biuret test: An aliquot of 2 mL filtrate was treated with a few drops of Biuret reagent (see above). Turning of the light blue color into violet/mauve color denotes the presence of peptide bonds/Proteins (Harborne, 1998).

Data presentation and analysis

Each preliminary qualitative screening test has been as triplicate for each active group. The strong to weak range of the positive result is indicated by ± to3+. Negative outcomes are denoted by a (-).

Results and Discussion

Phytochemical screening revealed presence of Alkaloids, Glycosides, Carbohydrates, Cardiac Glycoside(s), Saponins, Gallo- or Catecho- tannins (hydrolysable or condensed), respectively, Flavonoids, Resins, Steroids, Fixed oils and Protein compounds (Table 1 & 2 & 3). Anthraquinones Gums or Mucilages and Terpenoids were not noticeable (Table 1 & 3). Phlobatannins content is suspect (Table 2).

The richest bioresource for medications used in traditional and modern medical systems, and chemical components for synthesized drugs is found in medicinal plants. Because they are widely accessible, inexpensive, safe, and backed by public trust, traditional herbal medicines are encouraged, and promoted in national health care programmes by the World Health Organization (WHO) (Pandey & Tripathi, 2014). There are currently 121 active chemicals that are believed to be produced from plants, accounting for approximately 25% of all medications given around the world. 11% of the 252 medications on the WHO's list of essential medicines are solely derived from plants (Rates, 2001). For their primary healthcare, about 80% of people in Asia and Africa rely on traditional medicines. In India, about 80% of the rural population uses medicinal herbs or traditional medical practices. The Indian herbal business uses 960 plant species in total, 178 of which are employed in significant volumes exceeding 100 metric tons annually (Sahoo et al., 2010). According to reports, plant-based medications have been used successfully to treat skin conditions, AIDS, cancer, diabetes, jaundice, hypertension, tuberculosis, and many other infectious diseases (Khan & Ahmad, 2019). Plant medications differ from synthetic drugs in that they have unique qualities. They frequently lack knowledge of the active principle and

contain many active compounds. Consider the more than 2000 chemicals found in the Chinese medicinal plant Huang-qin (Scutellaria baicalensis) (Saxena et al., 2007).

Turmeric had a roughly two-fold increase in protein and fat content when grown on dark-red soil compared to other soil types. In Okinawa, Japan, the plants should be grown in order to provide a high output of turmeric with high curcumin, fat, protein, and Fe levels. Future investigations should look into if any specific combinations of soil characteristics, nutrients, and/or pH level are required to improve the quality of turmeric (Hossain & Ishimine, 2005).

Based on previous information, the active principle components of CLR differ according to type of soil and methodology. Although many previous investigations were done about the photochemical screening of turmeric, the present phytochemical analysis depends on the different active principle components of CLR related to different soils.

In the previous study, (Zhran et al, 2023, unpublished data), it was explained that CLR has neuropharmacological effects. These effects include antinociceptive action, relieve the inflammatory response and normalize body temperature which also was explored with (Pande et al., 2023), Therefore, the present project allows us to screening the active groups of CLR responsible for these therapeutic activities.

Table 1. Results of Alkaloids, Glycosides/ Carbohydrates and special Glycosides groups detection of the CLR.

Active group	Test	Result
Alkaloids	Mayer's	-
	Wagner's	+++
	Hager's	++
	Dragendorff's	+
	Tannic acid 10%	+++
Glycosides/ Carbohydrates	Molisch's	+++
	Fehling's	+++
	Benedict's	+++
Cardiac glycosides	Baljet's	+++
	Kileer-Killiani	+++
Anthraquinones glycosides	Schonteten's	-

CLR extract was discovered to contain Alkaloids, Glycosides (Cardiac Glycosides) and Carbohydrates containing compounds, absence of some active groups includes Anthraquinones, (Table 1). These findings are in line with those of Patil et al. (2019), who found Alkaloids and Glycosides content in CLR in Maharashtra, India. The presence of Alkaloids, Glycosides and Carbohydrate in CLR has been extracted using various solvents (water, methanol, chloroform, petroleum ether, and benzene) in Agra, India, according to Gupta et al. (2015), who also reported a similar observation. In addition to that it is reported the presence of Cardiac Glycosides with disappearance of Anthraquinones in CLR, (Table 1) which is partially agree with screening of Oghenejobo and Bethel (2017), who discussed that ethanolic extract of turmeric has both types of Cardiac Glycosides and Anthraquinones active groups in Abraka, Nigeria. This difference in results is corresponding to research methodology, environment.

Alkaloids are a valuable source of conventional antimicrobial activity. In cases of mental illness, Alkaloids are known to keep normal blood (Othman et al., 2019). Alkaloids are regarded as nitrogenous bases, which can regulate up the nervous system (Kurek, 2019), in addition to that ,Alkaloid can be pain killer, anti-spasmodic (Antherden 1969), (Stray, 1998). This may be interpreted that CLR as analgesic agent.

Plant Glycosides are such as Flavonoids, Coumarins, Anthraquinones, and Phenolics. The vast majority of secondary metabolites found in plants are Glycosides. Glycosides have a wide range of structural variations, and because of their established bioactivities and long history of usage, they are crucial to the practice of pharmacognosy (Bartnik & Facey, 2017). Cardiac Glycosides containing CLR, are used most recently in the treatment of tumors as well as the management of cardiopathy and atrial arrhythmia (Prassas & Diamandis, 2008).

Table 2. Results of Saponin, Tannins/Phenols, special Tannins and Flavonoids groups detection of the CLR.

Active group	**Test**	**Result**
Saponin	Froth	+
Tannin	Gelatin	+++
	Lead acetate	+++
	FeCl3 test	++
Phlobatannins	Hydrochloric acid test	±
Gallic acid	Vanillin test	+++
Flavonoids	Shinoda's (Cyanidin) test	+++
	Wilson's	+++
	Lead acetate	++
	Alkaline reagent	+++

Phytochemical analysis of CLR was relieved positively appearance of Saponins, (hydrolysable or condensed) Tannins/Phenols compounds and Flavonoids containing compounds with suspected detection of Phlobatannins, (Table 2). These yield are partially compatible with those of Oghenejobo and Bethel (2017), who stated that ethanolic extract of turmeric has Saponins, Tannins, Phenols,

Flavonoids and Phlobatannins as active groups in Abraka, Nigeria. This difference in results is corresponding to research methodology, environment. On other hand theses yield are partly conflicts with phyto-anylasis of Prashanth and Bhavani (2013) who documented that absences of Saponins, Tannins and Phenols with presences of Flavonoids in ethanolic extract of CLR, in Hyderabad, India. This conflict in findings, because of research methodology, environment.

Hunting free radicals, binding to metal ions, or blocking the pathways of enzymes that create free radicals are some of the ways Flavonoids carry out their anti-inflammatory and anti-oxidative activities (Pizzino et al., 2017). According to numerous tumor bioassays, the chemo- preventive effect of turmeric may decrease proliferation of tumor cells, which have been attributed to the presence of Flavonoids (Singh et al., 2002).

A group of phenolic chemicals found in woody flowering plants is known as Tannin, sometimes known as tannic acid. It has been administered internally to stop diarrhea and intestinal bleeding as well as an anti-poisoning for metallic, alkaloidal, and glycosidic toxins, since it forms precipitates that are insoluble. It has also been used to treat throat infection, hemorrhoids, as well as eruptions of the skin due to its styptic action and astringent property (Britannica, 2021).Tannins and polyphenolic chemicals are parts of prospective phytomedicine that have therapeutic benefits against pathogens, function as pre-biotics for improving immunity, and serve as antimicrobials (Gurning et al., 2022).

Saponins & their related compounds are a class of glycosidic substance that is crucial to the food, agricultural, and pharmaceutical industries. In addition to a few negative effects like cytotoxicity, they have significant therapeutic promise in the areas of hypo-lipidemia, hypoglycemia, anti-asthma, antioxidant, anti-hypertensive, and anti-microbial action (Sharma et al., 2023).

Table 3. Results of Resins, Gums/Mucilages, Terpenoids/Steroids, Oils/Fats and Protein detection of the CLR.

Active group	Test	Result
Resins	Distilled water	+
Gums/Mucilages	Absolute alcohol	-
Terpenoids/Steroids	Salkowski's test	+++
	Libermann-Burchard	+
Protein	Millon's	+++
	Biuret	±
Oils/Fats	Stain	+

As documented in (Table 3), phyto-analysis of CLR is yield the following appearance of Resins, Steroids, Fixed oils and Protein compounds. However that, some active groups are absent, such as Terpenoids and Gums/Mucilages. These findings are partially similar to those of Subedi (2019), who reported that aqueous or alcoholic Figextract of CLR contain Terpenoids and steroids with absences of Proteins in Pokhara, Nepal. This conflict in findings is related to research methodology, environment. There is some compatibility recorded between our finding and other one of Velurajan and Balamurugan (2019), who stated that Resins, Fixed oils /Fats, Protein, Gums and Mucilage are positive existence and Terpenoids are missing in alcoholic extract of CLR, in Tamilnadu, India. This difference in results is related to research methodology, soil.

Plant Steroids are divided into various classes according to their chemical makeup and pharmacological effects, such as anti-tumor, immunosuppressive, hepatoprotective, antibacterial, plant growth hormone regulator, sex hormone, anthelminthic, cytotoxic, and cardio tonic activity. However, their main effect is an anti-inflammatory one (Patel & Savjani, 2015). These may suggest CLR as potent ant-inflammatory drug.

Since early in the history of human civilization, natural Resins have been recognized for their antiseptic and antibacterial properties. Oleoresins, gum-resins, and oleo-gum-resins are the names for the Resins connected to Gums, Volatile Oils, and Gums, respectively (Shuaib et al., 2013).

Plant Protein significantly contributes to the world's food supply since it contains essential amino acids for meeting human physiological needs. However, many adaptive plant Proteins are used as medications because they are created utilizing molecular tools from biotechnology. Enter the food supply, antimicrobial, biomarker, emulsifying, and surfactant characteristics, as well as hormoneoneses, enyzemeses and vitamin synthesis for this particular value. The precise protein composition is related to this significance (Nehete et al., 2013).

Fixed Oils are extracted for flavoring food, as preservatives in desserts, to stabilize edible fats as cotton seed oil, and for use in pharmaceutical products (Mahboubi, 2018). Caster oil can use in treatment of constipations (Kalaskar et al., 2010).

Conclusion

According to phytochemical screening, *CLR* extract is abundant in Alkaloids, Glycosides, Carbohydrate, Cardiac Glycosides, Saponins, Gallo- or Catecho-Tannins (hydrolysable or condensed), as well as Flavonoids, Resins, Steroids, Fixed Oils, and Protein compounds. These findings make the extract of CLR as potential pharmaceutical agent of nutritional origin.

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Conflict of Interest

The author hereby declares no conflict of interest.

Consent for publication

The author declares that the work has consent for publication.

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