



A Review Of Certain Plant-based Gums And Resins: Its Qualitative And Quantitative Analysis Along With Its Anti-microbial Activity

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ABSTRACT:

Plant-based gums and resins have been traditionally used for their medicinal properties as well as showing anti-microbial activity due to their unique phytochemical composition which involves identifying and quantifying the bioactive compounds present in these plant-based gums and resins.

This review paper discusses on an overview of the phytochemical composition, anti-microbial analysis and biochemical activity on a global scale including national and international level, on several plant that secrete gums and resins such as *Boswellia carteri* Birdw., *Commiphora molmol* (Engl.) Engl. ex Tschirch, *Boswellia papyrifera* (Caill.) Hochst., *Acacia nilotica* (L.) Willd. ex Delile, *Boswellia serrata* Roxb., *Ferula assa-foetida* L., *Boswellia rivae* Engl., *Commiphora myrrha* (T.Nees) Engl., *Sarcocolla* gum resin plant and *Boswellia dalzielii* Hutch. *Shorea robusta* Gaertn.f., *Commiphora myrrha*, *Operculina turpethum*, *Pinus roxburghii*, *Boswellia serrata*, *Commiphora mukul*, and *Gardenia resinifera* etc., various investigations have been done on, for their phytochemical screening which includes qualitative as well as quantitative analysis and anti-microbial (anti-bacterial and anti-fungal) analysis. However, previous studies have not been thorough in many areas, and there are facets that warrant further investigation.

KEY WORDS:

gums, resins, gums-resins, anti-microbial activity, qualitative and quantitative analysis

INTRODUCTION:

For time immemorial, humans have been aware of gums and resins, which are considered to be among the best Non-Wood Forest Products. Located in tropical moist and dry deciduous forests, plant-secreting gums and resins are commercially significant and yield a significant amount of gums and resins. Due to their unique phytochemical composition, these excretory products have shown its efficacy from the ancient times in the traditional system of medicine, in culinary, and other medicinal applications. Their medicinal values accrues from the bioactive compounds present in these plant-based gums and resins (Katiyar. 2017; Bhattacharya P. 2012).

As about two lakhs, eighty one thousand (2, 81,000) tons of gums are being produced by India. Therefore, India, is a rich centre of plant biodiversity having more than fifteen thousand (15,000) plant species including one hundred twenty (120) gums yielding plants (Anonymous. 2013).

Including Ayurvedic, Unani as well as Siddha, a traditional system of medicine, from where the use of the documented plant-based gums and resins finds its usage. These excretory products have found to

exhibit a wide range of activities (biologically) that includes the properties like anti-oxidant, anti-microbial, anti-inflammatory, etc. (Singh et al. 1994).

The extensive use of pesticides to treat a diverse group of microbiological illnesses has detrimental impacts on ecological systems. Exploration of naturally occurring medicinal substances has resulted from this. The creation of safer anti-microbial compounds from plant products to manage pathogenic illnesses has drawn more attention in recent years. Many plant diseases are treated with stems, leaves, seeds, roots, fruits, flowers, etc. While different plant parts are utilized to cure various range of sickness/ illnesses, plant excretions that includes oils, gums, and latex, has been used in ethnomedicine to treat a number of human and veterinary conditions (Ratnam et al. 2019).

As per the literature, there are **three** categories of natural resins and gums (NRGs) which we obtain from the plants: Natural Resins, Natural Gums, and Gums-resins (Prabha et al. 2017).

In India, gum and resins have been used as medicines since the time of Acharya Charak, the author of the Charak Samhita Granth (Singh et al. 1994).

INTERNATIONAL STATUS

Some work has been carried out in the year 2000 on *Commiphora molmol* (Myrrh), a resin of plant extract found in Italy. By using broth dilution technique with the use of Muller-Hinton, the determination of Minimum Inhibitory Concentration (MIC) was accomplished. Through an anti-microbial screening against both the bacterial strains of gram-bacteria and fungus. They observed that sesquiterpenes from myrrh had many interesting pharmacological activities. They also found that methoxyfuranoguaia-9-ene-8-one and furanodiene-6-one from myrrh, which shows an anesthetic action and an activity of bactericidal and fungicidal, without showing any apparent cell toxicity in the case of mammalian (Dolara et al. 2000).

In the year 2007, some work was carried out on the few species of *Boswellia* such as *Boswellia serrata*, *Boswellia rivae*, *Boswellia carteri* and *Boswellia papyrifera*, an oleo-gum resin essential oils found in India, Ethiopia, Somalia and Ethiopia respectively. Through an anti-microbial study of *Boswellia* species, they found that both the species of *Boswellia* i.e. *B. carteri* and *B. serrata*, that showed the same chemical properties with isoincense and isoincense acetate which acts as the major diterpenic components. By using GC-MS, they evaluated the anti-microbial activity of these oleo-gum resin oils against both the bacterial strains of gram-bacteria and also fungi and, in turn, the essential oil of the resins of *B. rivae* showed the significant result with the MIC value of 2.64µg/ml against the fungus named *Candida albicans* (Camarda et al. 2007).

Boswellia species, an oleo-gum resin essential oils found from the USA, were the subject of some research in the year 2008. They discovered that the essential oils of *Boswellia* species might successfully prevent the development of biofilms of medicinal significance by means of the species' anti-biofilm activity. The properties of the anti-biofilm which is commercially available essential oils from two *Boswellia* species were assessed by using methylthiazolotetrazolium (MTT) staining against yeast/ fungus and gram-positive bacteria (Schillaci et al. 2008).

In the year 2009 some work was carried out on *Boswellia papyrifera* (Caill.) Hochst. and *Commiphora molmol* (Engl.) Engl. ex Tschirch, an oleo-gum resin plant extract, found in Saudi Arabia. Through a phytochemical screening, they found that the oleo-gum resin contained many secondary bioactive compounds like phenolic compounds, alkaloids and saponins. The anti-microbial activity of methanol and water extracts of *Boswellia* and *Commiphora* an oleo-gum resin were evaluated by using a disc diffusion method and reported that this extract possessed some degree of anti-microbial activity against these two gram-bacteria (Abdallah et al. 2009).

In the year 2012, certain work were carried out on *Boswellia papyrifera* and *Commiphora molmol*, an oleo-gum resin plant extract which was found in Saudi Arabia and Sudan respectively. Through the preliminary process of the anti-bacterial activity determination of both the plant extracts which is mentioned above, they reported that the methanol extracts of both the plant extracts namely *B.*

papyrifera and *C. molmol* were found to have some degree of growth suppressant effects against some gram-bacteria (**Abdallah et al. 2012**).

In the year 2013, some work was done on *Commiphora molmol* (Engl.) Engl. Ex Tschirch, a resin plant extract found in Saudi Arabia. The significant activity against both the gram-bacteria and fungus was reported in the resins of *C. molmol* (**Adam et al. 2013**).

In 2013, the investigation of the physicochemical properties of exudates from *Ficus glumosa* Delile were done. The gum was found to be slight acidic, ionic in nature which shows its solubility in water, partially soluble in ethanol and insoluble in chloroform and acetone. These exudates of gum have the potential to be used as an additive in food industries and others.⁴⁰

In the year 2013, *Albizia zygia* gum was procured as dry exudates from the Falgore forest in Nigeria. In the study, by physiochemical, and GC-MS techniques, the gum was analyzed. Its gum was found to be soluble both in cold as well as in hot water. Its exudate appeared to be in brownish colour, ionic and acidic gum. Through GC-MS techniques, the gum indicated the presence of 41.18% of (E)-methyl octadec-7-enoate, 1.63% of (Z)-octadec-13-enal, 2.05% of 2,3-dihydroxypropyl oleate, 18.64% of methyl palmitate, 19.13% of methyl stearate, 0.82% of 2,3-dihydroxypropyl stearate, 11.88% of (9E,12E)-methyl octadeca-9,12-dienoate, 1.85% of methyl icosanoate, 0.58% of dimethyl phthalate and 0.70% of 3-((aminomethoxy) (hydroxy) phosphoryloxy) propane-1,2-diyl dipalmitate (**Eddy et al. 2013**).

In the year 2014, the physicochemical characteristics of *Albizia lebbeck* gum, an ionic gum originating in Nigeria, was examined (**Eddy et al. 2014**).

In the year 2014, some work was done on *Commiphora myrrha* and *Commiphora Africana* resin found in Sudan. Through a GC-MS analysis of both the chosen resins, they found that both the two resins were rich in sesquiterpene lactones and sesquiterpenes compounds that possessed anti-tumor as well as anti-inflammatory activity. Anti-bacterial and anti-fungal bioassay showed higher anti-microbial activity i.e. anti-fungal and anti-bacterial, in the oil of the myrrha as compared to the Africana oil against gram-bacteria and yeast, while anti-viral bioassay showed higher anti-viral activity in the Africana in comparison to myrrha oil (**Gadir et al. 2014**).

In the year 2014, some work was done on oleo-gum resin of *Ferula assa-foetida* L. which was found in Iran. Through an anti-leishmanial activity of *Ferula assa-foetida*, an oleo-gum resin against *Leishmania major*, they found that after 72 hours, in all the doses, asafoetida inhibited the growth of parasites i.e. in the phases of stationary as well as logarithmic. The measurement of ELISA suggested that after 48 hours, the viability of parasites significantly decreased i.e. showing (P value less than 0.05). The results indicated that the percentage inhibition is dependent on time (**Bafghi et al. 2014**).

In the year 2015, some work was carried out on *Commiphora myrrha*, an oleo-gum resin extract found in Saudi Arabia. Through the phytochemical screening of *C. myrrha*, as a major constituents, the presence of Sesquiterpenes and Furano sesquiterpenes was found. By using agar diffusion method, an oleo-gum resins of *C. myrrha*, in the extracts of aqueous, methanol and chloroform were determined, for the anti-microbial activity against gram-bacteria. They also determined their strong potential against killing the wide range of bacteria as well as fungi with no side effects (**Alhussaini et al. 2015**).

In the year 2016, few works were done on *Commiphora molmol* (Myrrh) oleo-gum-resin plant extracts found in Baghdad. Through a phytochemical screening of *C. molmol* (myrrh) plant extracts, they found that this oleo-gum resin plant contained many secondary bioactive compounds like terpenes, saponins, tannins, flavonoids and alkaloids. They evaluated the anti-bacterial activity of water, methanol and also chloroform extracts of *Commiphora molmol*, by using a gel diffusion assay and the MIC of plant extracts was determined by the technique of broth micro-dilution. They reported that *C. molmol*, possessed high anti-bacterial activity against both the gram-bacteria and yeast. They further concluded that oleo-gum resin methanol extracts from *C. molmol* (myrrh) has shown some degree of anti-bacterial activity and, in

turn, GC-MS analysis showed the presence of sesquiterpenes as the major constituents of the plant (Dalya et al. 2016).

In the year 2017, some work was done on *Sarcocolla* gum resin plant extract found in Saudi Arabia. Through a phytochemical analysis of *Sarcocolla* gum resin, he found that this resin contained many secondary bioactive compounds. He evaluated the anti-microbial activity of both water and ethanol extracts by the use of a well diffusion assay and reported that the *Sarcocolla* gum resin possessed high anti-microbial activity against gram-bacteria, and yeast. The anti-microbial activity of *Sarcocolla* gum resin, in turn, depended on the type of the solvent, the concentration of plant extract and the type of the microbes' used (Ibtisam. 2017).

In the year 2018, some work was done related to the survey of the ethnobotany of plants which were used as medicines or as a remedy to cure various human ailments in Malakand district. KP, Pakistan (Ullah et al. 2018).

In the year 2019, some work was done on *Boswellia dalzielii*, an oleo-gum resin plant extract found in West Africa. Through their study, they found that the GC-MS and GC-FID of the said extract was analysed. He reported that the compositions of essential oils of *B. dalzielii*, were rich in α -pinene. Moreover, there is difference in composition between samples from Faso and those from Nigeria which was found to be very slight (DeCarlo et al. 2019).

NATIONAL STATUS

As per the report, in the year 1982, the exudates of the *Moringa oleifera* gum contained a large number of polysaccharides such as D-galactose, D-mannose, L-arabinose, D-glucuronic acid, L-rhamnose and D-xylose (Bhattacharya et al. 1982; [https://doi.org/10.1016/S0008-6215\(00\)88067-2](https://doi.org/10.1016/S0008-6215(00)88067-2)).

In the year 2008, the research was undertaken on the physico-chemical studies of the acacia gum which was obtained from Aligarh, which includes parameters like extractive value, ash value, qualitative analysis (phytochemical screening) etc. The potential of the drug including its therapeutic values in curing different human ailments has been described (Jahan et al. 2008).

In the year 2009, initial testing for antibacterial activity was done on ethanolic extracts of *Boswellia serrata* gum resin. Significant anti-microbial activity was demonstrated by all ethanolic extracts, which were on par with the common medication tetracycline. In comparison to other extracts, the combination of all three extracts at same concentration displays a larger inhibitory zone (Rastogi et al. 2009).

In the year 2011, some work was carried out on the resins of *Shorea robusta* Gaertn. f. found in Donubai hills ranges of Srikakulam district of Eastern Ghats. Through the biological activity and phytochemical screening, they found that this plant extracts contained the biologically active compounds like alkaloids, tannins, phenolics, flavonoids, glycosides, triterpenoids, saponin and steroids. They evaluated the anti-microbial activity of the ethanol and water extracts of the oleo-resin of *Shorea robusta* Gaertn. f. by using disc-diffusion method. They reported that Sal resin possessed high anti-microbial activity against *Aspergillus flavus*, *Aspergillus niger*, *Candida albicans* and *Penicillium chrysogenum* (Murthy et al. 2011).

In the year 2011, Gum exudates from three kinds of Acacia trees in Batagarawa, Katsina State, were examined for their physicochemical characteristics. Moisture, water solubility, pH, relative density, melting temperature, viscosity, total ash, nitrogen, protein, and total soluble fiber were all found to differ significantly. The investigation revealed no tannin content and indicated that these gum might be used and exploited in industry (Yusuf. 2011).

In the year 2011 and 2012, some researchers reported that for the control of various plant diseases, as the primary means, currently synthetic fungicides are used. But at the same time, there is a negative perception about the use of synthetic chemicals, its resistance among the fungal pathogens, and expensive chemicals as these are newly developed, so there is a call/ need for the alternative control methods. Due to the less toxicity level in case of mammalian, very low effects on the environment and more acceptance from the public point of view, so there is an investigation for the uses of plant derived products for controlling the diseases and acts as control agents (Seema et al. 2011; Agrios. 2005; <https://doi.org/10.5897/AJB10.686>).

A study was conducted in the year 2012 on *Albizia procera* gum that was hand-picked in Mizoram, India, with the goal of using its exudates to create controlled release matrix tablets that included paracetamol. It was found that the release mechanism was peculiar after examining the properties of procera gum and paracetamol. The study suggests that this gum can be utilized as a medication for controlling in a various controlled retardant matrix core (Pachau et al. 2012).

In the year 2012, a study on the gums of *Albizia procera* (Albizia gum) was conducted. The gum was collected in the month of January to March from Aizawl, a capital city of Mizoram. The composition and characteristics of this gum of *A. procera* were examined. According to the investigation, the purified gum possesses a high quantity of carbohydrates, indicating its suitability for usage in many industries. In the industries of food, cosmetics and pharmaceuticals, it may be a viable alternative to natural emulsifiers and stabilizers. According to the results, the exudate gum might be a good excipient (Pachau et al. 2012).

In the year 2012, the characteristics of the gums of *Albizia procera* and its composition was also studied. They observed that the color of the Albizia gum was reddish brown which yields a clear and transparent solution in water. To show its purity, total carbohydrates, ash contents were determined. The major monosaccharides found in the gum exudate are galactose as well as arabinose (Pachau et al. 2012).

In the year 2013, some work was undertaken on the *Commiphora myrrha*, which is an oleo-gum resin, *Operculina turpethum*, which is a glycosidic resin, *Pinus roxburghii*, which is an oleo-resin, plant extracts found in New Delhi. Through the estimation of anti-bacterial activity of selected plant extracts which is rich in resin content, they evaluated the different concentrations of RRMEs of the mentioned plant samples by agar well diffusion method and, in turn, also evaluated the effect of anti-bacteria against both the bacterial strains and found that the RRMEs of the above said samples exhibited some/ very few degree of anti-microbial effect against both the types of bacterial strains (Bapat et al. 2016).

In the year 2014, some work was done on selected plant-based natural gums and resins found in Andhra Pradesh. Through an anti-microbial screening of various plant-based gums and resins, they found that the out of six plants which were prepared in multiple combinations of the organic solvents namely ethanol, methanol, acetone, n-butanol and were subjected to anti-microbial screening, out of these plant extracts which is prepared individually, in combination and in multiple, five plants showed the cognizable zone of expression i.e. 25mm>30mm inhibition (Sravani et al. 2014).

In the year 2002 and 2014, it was reported that there is an increase in the interest on plant extracts so as to develop the alternatives for the environmental-friendly synthetic fungicides for controlling the various fungal phytopathogens/ plant diseases (Reddy et al. 2002; Riad et al. 2014).

In the year 2015, the study on some physicochemical properties of the exudates of *Albizia furriginea* gum was undertaken. Their organoleptic characteristics was studied and found that the gum of Albizia was ionic, mildly acidic in nature, odourless, and the colour of the gum was yellow. The solubility test was also performed and reported that it shows its solubility in water, partially soluble in ethanol, and

insoluble in acetone and chloroform. The study indicated that there is the potency of the gum for various usage in industries and as food additives (2015).

In the year 2016, some work was done on *Boswellia serrata*, an oleo-gum-resin plant extract found in Rajasthan. Through a preliminary phytochemical screening of *B. serrata*, they found that this resin contained many secondary bioactive compounds like tannins, alkaloids, phenols, steroids, flavonoids and saponins. They determined the anti-microbial activity of four selected organic solvents of *B. serrata* namely petroleum ether, chloroform, ethyl acetate and methanol by using agar well-diffusion assay and reported that it possessed high anti-microbial activity against both the gram-positive and gram-negative bacterial strains and also yeast/ fungus. The *B. serrata*'s anti-microbial activity, in turn, was found to be dependent on the solvent type used, the plant extract's concentration and the type of microbes (Sharma et al. 2016).

In the year 2017, some investigation was carried out on the physiochemical properties of the gums of *Sterculia urens* and their solubility was checked and was reported to be slight acidic in nature, showed least solubility in cold water but showed its absorbance in water and as a result it swells, also shows its solubility in hot water but doesnot dissolve in organic solvents (<https://doi.org/10.20546/ijcmas.2017.607.402>).

In the year 2017, some work was done on the extracts of gum-resin of *Boswellia serrata*, *Commiphora mukul*, *Gardenia resinifera* and *Shorea robusta*, which is found in Gujarat, Pune and Madhya Pradesh. Through a screening of anti-fungal activity of sample extracts of gum-resin of the above mentioned samples by using poisoned food technique, they found that the anti-fungal activity of *G. resinifera* and *C. mukul* showed its statistical significant inhibition at 0.01%. Between these two mentioned extracts, the percentage (%) inhibition of *G. resinifera* was found to be the most significant (Bapat et al. 2017).

In the year 2018, an investigation showed that with the use of ethephon as gum inducer for the production of butea gum and in turn showed no effect on the physical and chemical properties of the gum exudates. It was found that with the use of ethephon, there is exudation seen in the case of *Butea monosperma* and also showed its effect on the physical and chemical characteristics of butea-gum which is exudated (Prasad et al. 2018).

In the year 2020, the physiochemical properties of *Sterculia urens* showing its exudated gum were investigated and was reported that the gum of *Sterculia urens* was slight acidic in nature, showed its least solubility in cold water but at the same time absorbs water and then swell, showed its solubility in hot water but insoluble in organic solvents. Therefore, for sustainable harvesting in major gum producing tree of Chhattisgarh state, the scientific tapping technique needs to be developed, the study was undertaken in ICAR Network Project so as to promote the living standard of the rural people and also to conserve the plant and generate the government's revenue (Katiyar et al. 2020).

In the year 2020, the study reveals how to use natural *Moringa oleifera* gum to manufacture metal oxides which is influenced by the concentration of the solution of the Moringa gum (Sannasi. 2020).

In the year 2022, the characteristics, makeup, and uses of *Moringa oleifera* gum in several industries are discussed. Accoring to a recent study of the literature, as it possesses distinct qualities, *Moringa oleifera* gum has the potential to compete with other well-known hydrocolloids like *gum acacia*, *gum tracanth*, *gum karaya*, etc. (Sanyogita et al. 2020).

In the year 2022, some work was done on *Moringa oleifera* gum which was found in Chennai, Tamil Nadu. Through GC-MS analysis of the gum of *Moringa oleifera*, polysaccharides revealed the presence of various sugars and molecules of sugar derivatives such as glucose, D-allose, xylose and galactose. As expected, it was also reported that against mealy bugs, the gums of *Moringa oleifera* also showed a high degree of pesticidal activity which is dependent on doses. By using plant-based excretory products,

biopesticides can be used as environmental friendly and shows no adverse effect/ safe to the non-targeted organisms. It was found that the plant gums also showed bio-pesticidal activity against the mealybugs, which in turn showed evidence in certain interstitial damage by the process of histopathological analysis (**Shobana et al. 2022**).

In the year 2022, the study explored the impact of carboxymethylation on the rheological characteristics and medication release of matrix tablet formulations, comparing native and carboxymethylated *Albizia procera* gum (**Mukherjee et al. 2022**).

In the year 2022, an investigation was done on documentation, survey, collection and organoleptic characteristics of certain plants that secrete gums and resins found in the district of Ranchi (**Prabha et al. 2022**).

In the year 2023, a study was done on Phytochemical analysis and therapeutic values of some plants that exudate gums and resins found in Ranchi (**Prabha et al. 2023**).

A study on the physico-chemical and qualitative characterization of specific plant that exudates out gums and resins which is discovered in the Ranchi district and was carried out in the year 2024 (**Prabha et al. 2024**).

In the year 2024, the study was done on the use of modified *Albizia procera* gum, which showed its efficacy as a release-retardant polymer, demonstrating enhanced strength, viscosity, and control over erosion and swelling, indicating potential for controlled medication release applications (**Mukherjee et al. 2024**).

In the year 2024, the study was proceeded to determine the Physico-chemical properties, heavy metals, toxins and microbes in *Moringa oleifera* Gum Powder (MoGP). The heavy metals, toxins, and microbes were analysed to ensure the safeness of *Moringa oleifera* gum powder. The development of physico chemical properties and microbiological analysis of gum powder revealed its suitability for use in new product development (**Ranjani et al. 2024**).

In the year 2024, gums are naturally occurring polysaccharides, minerals and proteins which are found in the seed coatings and as a resinous exudate from woody plants. It is said to have immune-stimulating, blood-sugar-regulating, anti-microbial, and anti-cancer effects (**Alshwyeha et al. 2024**).

CONCLUSION:

Several work has been carried out in the species of *Commiphora* and *Boswellia* which includes qualitative and quantitative analysis, anti-microbial analysis. As most of the work has been done on human pathogen. So, there remains a gap which can be filled by doing further research in the phytopathogenic microbes for anti-microbial activity.

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