

## **ROSA ALBA LINN.: A COMPREHENSIVE REVIEW ON PLANT PROFILE, PHYTOCHEMISTRY, TRADITIONAL AND PHARMACOLOGICAL USES**

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### **ABSTRACT**

Flowering or aromatic plants have played a significant role in mankind since the time immemorial. In current scenario, around 80% of the world population completely rely on plant-based treatment due to their low-cost, high availability, less side effects etc. Around 250000 species of flowering plants have been recognized till date, among them nearly 10% are considered to be herbs, which are mainly used for treatment of several diseases and disorders. *Rosa alba* Linn. is an important aromatic medicinal plant belonging to the family Rosaceae. *Rosa alba* Linn. is mainly cultivated in the rose valley of Bulgaria. Currently it is also cultivated in Turkey, Morocco, North America, Northwest Africa and some parts of Asia. It contains large number of phytoconstituents i.e., flavonoids, terpenoids, tannins, glycosides, anthocyanin, phenolic

compound, fatty oil and some small amount of organic and inorganic compounds. The plant is known to exhibit numerous medicinal properties such as antioxidant, antimicrobial, memory enhancers, cytotoxic, genotoxic etc. Nevertheless, traditionally it is also used in heart palpitation, headache, cold, leprosy, biliousness, burning sensation, ophthalmic, rheumatism, diabetes, inflammation, microbial infection, uterine infection, stomach problems as well as refrigerant, purifying agent, soothing agent, in skin care, anti-spasmodic, antiseptic, laxative, carminative etc. This review summarises the distribution, morphology, phytochemistry, pharmacology and traditional uses of *Rosa alba* Linn. based on the information gathered by ethno-botanical claims, researches and review articles.

**KEYWORDS:** *Rosa alba*, Ethnobotany, Phytoconstituents.

## INTRODUCTION

The importance of flowering or aromatic plants are clearly known to us since the beginning of human civilisation.<sup>[1]</sup> Plant has always been ultimate source of drug and food products.<sup>[2]</sup> The nature has provided immense number of plants and herbs, which are directly or indirectly acting as therapeutic agents and medicament for various ailments, but due to lack of proper study and exploration so many essential medicinal plants and herbs remain as unusable.<sup>[3]</sup> Currently, 250000 species of flowering plants are available throughout the world, where nearly 10% are considered to be as herbs and they are being traditionally using for treatment of several diseases and ailments. Meanwhile, around 80% people in the world wholly relies on plant-based treatment due to their high availability, less side effect, cheap price etc.<sup>[4]</sup> Aromatic plants are not only useful in treating ailments, meanwhile, they are equally important in social, cultural, economic and ecological aspects of local communities all over the world. Perfumery and cosmetics industries prepare various kind of cosmetics products such as lipstick, colorants, deodorants etc. due to their intense fragrance and wide varieties of colour.<sup>[5]</sup>

*Rosa alba* Linn. (*R. alba*) is one of the important medicinal plants, commonly known as white rose of york or chitta gulab (*in Hindi*), which belongs to family of Rosaceae.<sup>[6]</sup> The flowers are bitter in taste, pungent in odour, acrid, contain strong flavours and aphrodisiac in nature. The presence of huge number of phytoconstituents, make this plant pharmacologically important. Medicinally, it can be used for treating stomatitis, leprosy, burning sensation, bronchitis, biliousness, purification of blood and increase appetite. Moreover, flowers of *R. alba* impart activities like laxatives, carminatives, antiinflammatory, antirheumatics etc. and its perfume act as a tonic for brain and heart.<sup>[7]</sup> Various literature reviews had mentioned very useful information regarding wide number species of Rosaceae family. The order Rosales contains 9 families and about 6300 species. Among these 9 families, some important families include Rosaceae, Rhamnaceae, Ulmaceae, Cannabaceae, Urticaceae and Moraceae. The family Rosaceae comprises of 90 genera and 3000 species which can further be subdivided into 3 subfamilies: Rosoideae (28 genera/1200-1900 species), Spiraeoideae (57 genera/ 1350 species) and Dryadoideae (4 genera/31 species). This family is broad-based and mainly found in Northern hemisphere. The genus *Rosa* L. are perennial, dicotyledonous in nature and belonging to subfamilies of Rosoideae. In genus *Rosa*, 435 taxa, 308 species and 71 natural hybrids were recognised.<sup>[8]</sup>



**Fig. 1: A fully blossomed *R. alba*.**

## **BOTANICAL DESCRIPTION**

### **Taxonomy-**

#### **Botanical Classification<sup>[8]</sup>**

Kingdom: Plantae

Division: Magnoliophyta

Class: Magnoliopsida

Order: Rosales

Family: Rosaceae

Subfamily: Rosoideae

Genus: *Rosa*

Species: *alba*

### **Vernacular name**

Sanskrit: Taruni, Shatapatri

Hindi, Marathi, Gujarati: Gulab

English: Rose

Assamese, Bengali: Gulap

Tamil: Irasha

Arabic: Varde ahmer

Bodo: Gulab gufur<sup>[9]</sup>

## MORPHOLOGY

Regarding the morphological characteristics of plants belonging to Rosaceae family, it ranges between dwarf bushes to climbers or of semi woody shrubs whose stems are signified by prickles or sharp woody thorns. Sometimes, the plant may be rhizomatous in nature. Leaves belonging to this family are alternate and pinnately like compound. The sepals and petals are clumped together into a group of five, hence they are called pentamerous flowers.<sup>[10]</sup> Specifically, *R. alba* plants are shrubby and they used to raise up to a height of 3 meters. Branches comprises of thorns while leaves have serrate margins. There are various shades of colour found in rose plant but *R. alba* flowers are magnificently whitish in colour.<sup>[11]</sup>

Krasimir Rusanov *et al.* has described about phenotypic variation in *R. alba* by Institute of Roses, Essential and Medical Cultures (IREMC), Bulgaria revealed the existence of two distinct flower phenogroups of *R. alba* i.e., Phenogroup 1 (PG:1) and Phenogroup 2 (PG:2) based on their flower biometric data obtained by using Principle component analysis (PCA). These two phenogroups differ significantly in their flower weight, number of anthers and number of petals. PG:1 possess higher flower weight, smaller diameter, higher number of petals and lower number of anthers whereas PG:2 possess lower flower weight, bigger flower diameter, lower number of petals and higher number of anthers. The two phenogroups PG:1 and PG:2 of *Rosa alba* resembles *R. alba* Maxima and *R. alba* Semiplena flower phenotypes respectively. The PG:1 phenogroup is more suitable for industrial flower production because they have higher average weight and are more compact due to which the rate of damage is less during flower harvesting. On the other hand, PG:2 phenogroup is more fragile, part of their petal's loss easily during flower collection and storage, moreover, flowers got faded quickly after opening. Volatile oil content of PG:1 is more as compared to PG:2, therefore PG:1 phenogroup is use over PG:2 as a base for large scale production for industrial cultivation.<sup>[12]</sup>



**Fig. 2: Showing phenotypic variation belongs to phenogroups PG:1 and PG:2.**<sup>[12]</sup>

### **DISTRIBUTION**

The *R. alba* is commonly known as Bulgarian rose because this type of white rose is mainly cultivate in the Rose Valley of Bulgaria.<sup>[13]</sup> Rose oil is very expensive in nature, which is semisolid and pale yellow in colour. Currently, apart from Bulgaria, Turkey and Morocco has also became the leading producer of rose oil by cultivating *R. alba*.<sup>[14]</sup> Nevertheless, decent growth in white rose cultivation seen in European country, native Asia, North America and northwest Africa.<sup>[8]</sup> In India, *R. alba* grown in Gorakhpur (Uttar Pradesh) for essential rose oil extraction and ornamental use.<sup>[15]</sup>

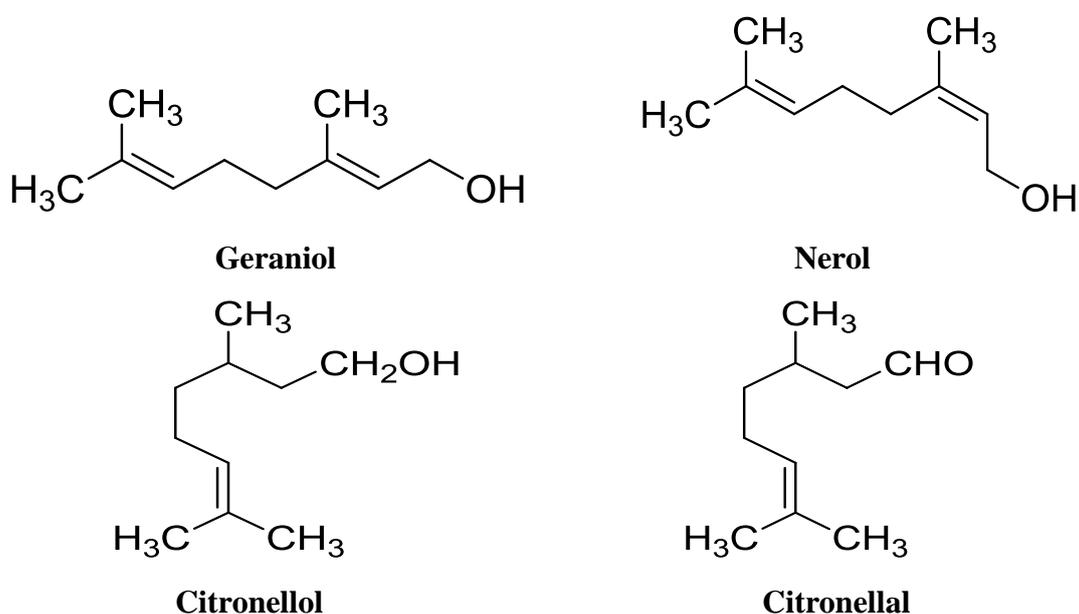
### **Phytochemical Constituents**

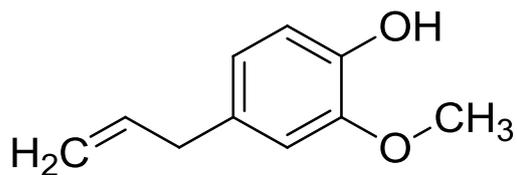
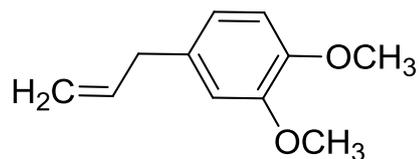
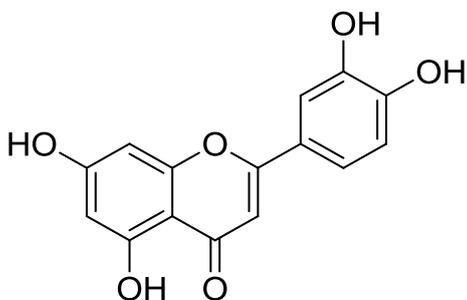
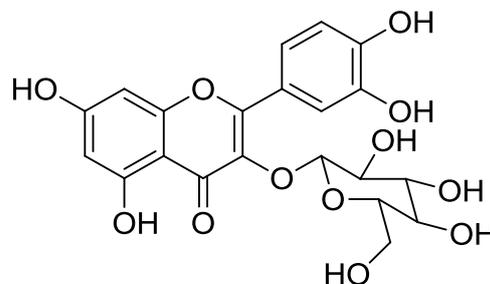
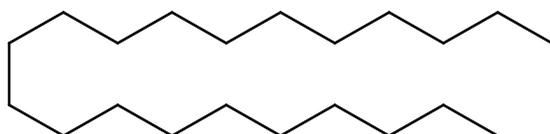
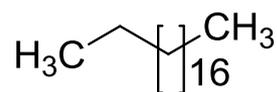
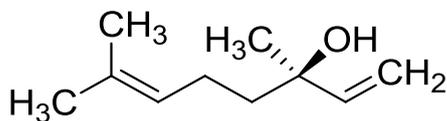
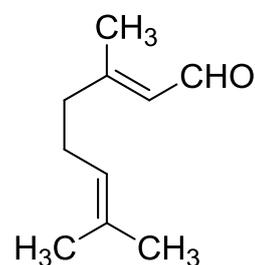
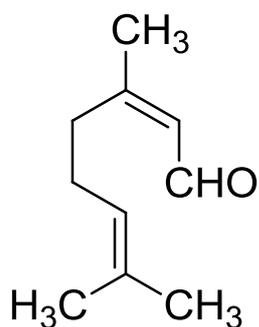
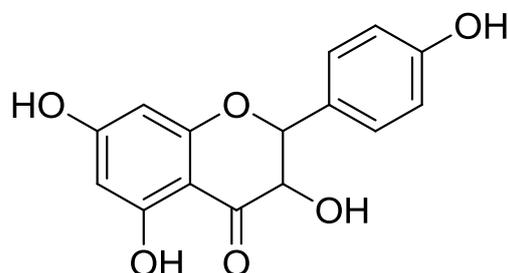
*R. alba* is one of the richest phytochemicals containing plants. Presence of wide varieties of phytochemicals, makes this plant traditionally as well as medicinally beneficial one. Phytochemicals are mainly present in petals and sepals of flower, leaves, fruits. Moreover, huge number of active phytoconstituents are also present in rose hip too. Rose hip contains various phytochemicals such as flavonoids, terpenoids, tannins, glycosides, anthocyanin, phenolic compound, fatty oil and some small amount of organic and inorganic compounds.<sup>[16]</sup> Among all this, importance of volatile oil is major concern because most of the pharmacological activities such as antimicrobial, antifungal, antidiabetic etc. were exhibited due to presence of volatile oil.<sup>[17]</sup>

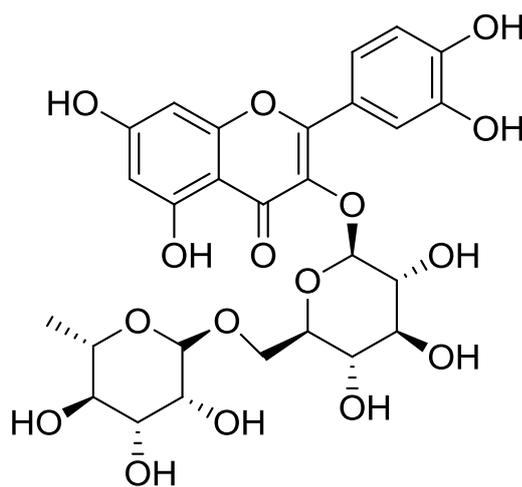
As per some studies, important phytoconstituents present in flowers, rose hip, leaves of *R. alba* are as- Geraniol, Nerol, Citronellol, Linaloon,  $\beta$ -phenylethyl alcohol, Neral (Cital 1), Geranial (Cital 2), Eugenol, Methyleugenol, Nonadecane, Eicosane, Heneicosane,

Tricosane,  $\beta$ -Ocimene,  $\alpha$ -Terpinoel,  $\beta$ -Citronellol, Geranial acetate, Methyl eugenol, Pentadecene, Hexadecene,  $\beta$ -Eudesmol, Squalene, Quercetin, Quercitrin, Kaempferol, Palmitic Acid, Rutin, Gallic acid, (E)-2-hexanal, (Z)-3-hexanal,  $\beta$ -Pinene,  $\beta$ -cyclocitral, Tetradecene,  $\beta$ -caryophyllene,  $\beta$ -ionone, Lauric acid, Benzyl benzoate etc.<sup>[12], [13], [18]–[20]</sup>

By using GC-MS chromatography technique Milka Milcheva Mileva, *et al.* have found that *R. alba* oil contains monoterpenes (Geraniol-18.28%, Nerol-7.74%, Citronellol-9%), phenylpropanoids (present in minor amount as Eugenol-0.02% and Methyleugenol-0.10%), terpenoids (Neral -0.70% and Geranial -0.90%) and finally some long chain high molecular weight hydrocarbon ( $C_{15}$  -  $C_{31}$ ) were also present such as Heneicosane (12.95%) and Nonadecene (10.75%).<sup>[20]</sup> Almira Georgieva *et al.* isolated various components from hydrosols of *R. alba* and *R. damascena* by using chromatographic technique. They identified 22 components, which represented 92.50% and 89.62% of the total content of *R. alba* and *Rosa damascena* Mill. hydrosols respectively. All the identified components were belonged to the groups: benzenoid compounds, oxygenated sesquiterpenes, aliphatic hydrocarbons, triterpenes, monoterpene hydrocarbons, and oxygenated monoterpenes. Total percentage content of various compounds that were found in *R. alba* hydrosols were - 76.63% oxygenated monoterpenes, 6.19% benzenoid compound, 8.34% aliphatic hydrocarbons, 0.69% monoterpene hydrocarbons, 0.36 oxygenated sesquiterpenes and 0.14% triterpenes. They also revealed that, main components which were obtained in higher amount of *R. alba* were Geraniol (36.44% *trans*-geraniol and 6.11% *cis*-geraniol) and 28.69% of  $\beta$ -citronellol present as total content of oxygenated monoterpenes.<sup>[19]</sup>



**Eugenol****Methyl Eugenol****Quercetin****Isoquercetin****Heneicosane****Nonadecene****Linalool****Citral A****Citral B****Kaempferol**



Rutin

**Fig. 3: Structures of major phytoconstituents present in *R. alba* Linn.**

### Traditional Use of *Rosa Alba* Linn

Since ancient time, *R. alba* has been used traditionally in various places of the world for different purposes. Traditionally, rose oil is used for the controlling depression, anxiety and other stress related condition mainly due to its calming and soothing effects.<sup>[21]</sup> Cosmetics and perfumery industry use rose oil, which act as a primary component for perfumes, creams, lotions and soaps. It also finds application in food industry as a flavouring agent in many food products such as cakes, biscuits, candies, jellies and beverages.<sup>[19], [22]</sup> *R. alba* Linn. has always being an ornamental plant and it has a long history in Bulgarian folklore. Traditionally, it is used in wedding rituals, holy believes and religious ceremonies in many parts of the world.<sup>[23],[19],[20]</sup> Also, it can be use in treatment of heart palpitation, headache, cold, leprosy, stomatitis, biliousness, burning sensation, ophthalmic, bronchitis, rheumatism, diabetes, inflammation, microbial infection, uterine infection, stomach problems etc. Moreover, it can be use as refrigerant, purifying and soothing agent, also, it helps in improving taste and appetite.<sup>[1], [7], [24], [25]</sup> Rose water is traditionally use for skin care, as antispasmodic and antiseptic agent.<sup>[19]</sup> In Tunisia, *R. alba* is known as ‘Nesri’ and the rose water is called as ‘Nesri water’, mainly use to prevent cardiovascular diseases and also as a flavouring agent for different drinks, jam, cake and marmalade.<sup>[18]</sup>

### Pharmacological Activities

Due to the presence of large number of phytoconstituents in rose oil, it shows different pharmacological activities like antioxidant, antimicrobial, memory enhancers, cytotoxic,

genotoxic, headache, soothing agent etc.<sup>[3],[6],[22],[24]–[27]</sup> The different aromatic merchandises of *R. alba* are mainly used in the physiotherapy, aromatherapy, perfumery and cosmetics.<sup>[17]</sup>

### Antioxidant Activity

Owing to the presence of phenols and flavonoids in the *R. alba* Linn., it shows antioxidant properties.<sup>[26]</sup> The antioxidant property of *R. alba* was evaluated by using DPPH (2,2-diphenyl-1-picrylhydrazyl) test and liposomal suspension and they have found that the extract of *R. alba* shows antioxidant properties.<sup>[28]</sup> Mileva *et al.*, had reported that *R. alba* essential oil significantly depressed the effect of oxidation by exhibiting a protective effect against Fe<sup>2+</sup>/ ascorbic acid induced lipid peroxidation in liposomes. The phytoconstituents of rose oil i.e., eugenol and methyleugenol shows strong radical-scavenging activity against DPHH. Whereas, nerol and geraniol inhibit the oxidation of liposomes in a concentration dependent manner, but Citronellol found to be most active. Because, 0.1 to 1% concentration of citronellol and geraniol shows same inhibitory activities as that of the reference i.e., butylated hydroxytoluene (BHT). Also, at 10% concentration citronellol inhibits the liposomes by 88% which is stronger than geraniol and BHT.<sup>[19],[22]</sup>

### Nootropic Activity

*R. alba* exhibited very well characterised learning and memory boosting capacity through symptomatic improvement. Acetylcholine is an important neurotransmitter in central nervous system involving in enhancing memory power.<sup>[29]</sup> Active constituents of *R. alba* inhibit acetylcholinesterase enzyme due to which breakdown of acetylcholine to acetyl and choline doesn't takes place, as a result the concentration of acetylcholine increases in synaptic region as well as in brain, and thereby improves memory power. The memory enhancing activity of *R. alba* was investigated by using passive avoidance test and elevated plus maze.<sup>[7]</sup> Because of this memory enhancing property, the phytoconstituents of *R. alba* helps in controlling cognitive disorders.<sup>[25], [30], [31]</sup>

### Antimicrobial Activity

*R. alba* possess some antimicrobial activity. The antimicrobial activity of *R. alba* was evaluated by using 96 well standardized microtitre plates by applying microdilution broth method.<sup>[32]</sup> According to Mileva M. *et al.* report, some of the clinically important pathogens present in mouth such as *Aggregatibacter actinomycetemcomitans*, *Enterococcus faecalis* and *Streptococcus mutans* were used for antimicrobial investigation of *R. alba*. Antimicrobial screening of *R. alba* revealed that it shows markedly less activity against gram positive

*Enterococcus faecalis* as compared to *Streptococcus mutans*. On the other hand, *R. alba* shows remarkable higher activity against Gram positive *Aggregatibacter actinomycetemcomitans*. *R. alba* shows antimicrobial activities due to the presence of phytoconstituents like monoterpenes which generally present in higher amount. Disruption of microbial cytoplasmic membrane takes place because of lipophilic character possess by monoterpenes, as a result membrane loss its penetrability for protons, bigger ions and finally normal cellular function get compromised.<sup>[17],[22],[33]</sup>

### Antidiabetic Activity

The flowering part of *R. alba* exhibits antidiabetic potential and the herbal formulation is mainly prepared by infusion method.<sup>[9]</sup> As stated by Mushtaq Ahmad *et al.* report, a powdered herbal mixture was used in diabetes, which was prepared by mixing *Syzygium cumini*, *Momordica charantia*, *Cyperus rotundus* and *R. alba* which helps in lowering blood glucose level. Oxidative stress is mainly responsible for number of diseases and pathological states such as diabetes, cardiovascular disease, cancer etc. Since *R. alba* possesses some potent antioxidant activity, which helps in the removal of free radicals and prevents oxidative stress development in biological system, therefore it can also be used as antidiabetic agent.<sup>[3],[6],[9]</sup>

### Cytotoxic and Genotoxic Activity

The phytoconstituents present in *R. alba* also shows some cytotoxic and genotoxic activity. The cytotoxic and genotoxic activity of *R. alba* can be determined by using chromosome aberration assay and comet assay. Cytotoxic and genotoxic activity of *R. alba* is mainly due to the presence of geraniol and citral. According to Gabrielle Jovtchev *et al.*, at higher concentration they act as a cytotoxic and genotoxic agent (500 and 1000 µg/ml) by significantly increasing the percentage of migrated DNA in the comet tail from isolated live cells similar to that of standard i.e., 1-methyl-3-nitro-1-nitrosoguanidine (MNNG). Geraniol acts by inducing the apoptosis and cell cycle arrest in cultured cancer cells and modulating the expression of various cell cycle regulators *in vivo* and *in vitro*. In case of *R. alba* only the isochromatid break appears with aberration clustering. At 1000 µg/ml concentration *R. alba* induced five aberration hotspots whereas the standard i.e. MNNG induced seven aberration hotspots. Also at low concentration like 250 and 500 µg/ml it only shows few aberration hot spots.<sup>[27],[34],[35]</sup>

## CONCLUSION

The rose is a beautiful creature of nature which symbolizes love. Flowers are the integral part of worships for God, because it has the ability of bring inner peace and love. *R. alba*, is a shrubby plant belonging to the family of Rosaceae, which mainly grows in Rose valley of Bulgaria, hence it commonly called as Bulgarian Rose. Being an ornamental plant, it has innumerable traditional as well as pharmacological uses because of its wide varieties of active phytoconstituents such as geraniol, nerol, citronellol, quercetin, isoquercetin, eugenol, methyleugenol, Nonadecane, Geranial acetate, Squalene, Kaempferol, Rutin etc. It's a source of expensive rose oil which has many traditional uses such as treatment of headache, cold, leprosy, stomatitis, burning sensation, bronchitis etc. It acts as the potent antioxidant due to which it can be used in inhibiting free radical oxidation which are harmful for our normal physiology. Various research works have able to bring out the potential of *R. alba* in the field of pharmacology and its activity such as nootropic, antimicrobial, cytotoxic and genotoxic, antidiabetic etc. All these narratives make the necessity to further investigate the effects of *Rosa alba* Linn, by scientific methods.

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## CONFLICT OF INTEREST

The authors have no any conflict of interest.

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