Review Article

BIOLOGICAL AND ANTIOXIDANT ACTIVITIES OF *SILENE* SP.

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ABSTRACT

Silene L. is one of the most recognized and widespread genus of Caryophyllaceae family, with more than 700 species on the earth. It is originated from the Mediterranean Region, and this genus is spread out in mild climates all over the world. In this study, antimicrobial and antioxidant activities realized by using *Silene* species were examined and it was observed that many species had these effects thanks to their bioactive compounds. Besides; bacteria, virus and fungi species used in antimicrobial researches, were also detected.

Keywords: *Silene*; antimicrobial; antioxidant.

INTRODUCTION

With more than 700 species in approximately 39 sections, *Silene* L. is one of the most recognized and largest genus of Caryophyllaceae family^{1,2}. Information about this large genus, have not been completed yet. Approximately 700 species have been detected in Eurasia (ca.600 spp.), Africa (ca.40 spp.), N. America (ca.50 spp.), and one of two spreading centers of this genus is; Pamir and Hindi Kush region, along with their adjacent zones, and the second centre has been indicated as Transcaucasia and Azerbaijan³. Besides Central and Northern Europe, this genus is also grows up naturally in African and North American flora^{2,4,5}. Approximately 40 % of the species located in the Mediterranean Region are found to be endemic⁶. Besides being annual, biennial and perennial, *Silene* species have a very complex structure. Most of its species are hermaphrodite and a very few number of its species are dioecious or gynodioecious⁶. One of these flowering plants, *S. vulgaris*, that is widely observed in the entire European flora, is known as “Bladder Champion”^{4,7}. In this study, it is aimed to specify the antimicrobial, antiviral and antioxidant studies that have been carried out with *Silene* species up until now. Along with many bacteria species used in this context, mushroom and virus species have also been detected. Also in literature analyses, antioxidant impact study of only a few species have been observed.

Chemical Compounds

Up until now, studies have been carried out to determine the chemical compounds that *Silene* species contain. Many bioactive compounds have been obtained in the phytochemical researches carried out on these species. It is a known fact that biological activities are realized thanks to these compounds. By this time, more than 400 compounds have been isolated including the phytosteroids². It has also been reported that some species of this genus contain ecdysteroids, phyto-ecdysteroids, saponins and triterpens⁵, lipids (triglycerides, free fatty acids, free sterols), benzoid compounds (phenylacetaldehyde), volatile monoterpenes alkenes (α -pinene, β -pinene, limonene), vitamins, organic acids, microelements, amino acids^{2,5}, vegetable nutrients, proteins, carbonhydrates and luifä⁹.

Biological Activity

It has been observed that the first microbial study on *Silene* species in this context was carried out by Hoffman *et al.*¹⁰ in 1993. In this study which was carried out with *Silene parishii* species brought up in Southwest America, it has been observed that the ethanol extract of this plant was completely effective on *B. subtilis*, partially effective on *Candida albicans*, and had no effect on *S. aureus* and *K. pneumonia*¹⁰. The effect of five species (*S. alba* ssp. *ericalcinea*, *S. arguta*, *S. chlorifolia*, *S. dichotoma* ssp. *sibthorpiana*, *S. vulgaris*) aerial particles collected from Turkey on *Mycobacterium tuberculosis* species, was examined and it has been indicated that four species except for *S. alba*, have an antibacterial effect¹¹. It has also been indicated that; stem, leaf and flowers of *S. latifolia*, were effective against *S. aureus*, yet *S. vulgaris* did not have this effect¹². Bajpai *et al.*⁴ have proven that the volatile oil obtained from *S. armeria* species, has a lethal effect on several pathogenic fungi. Antibacterial and anti proliferative effect of the water extract of *S. wallichiana* species, was examined and it has been observed that methanolic extract prevented the development of *Acinetobacter* sp., *E. faecalis*, *K. oxytoca*, *P. agglomerans*, *P. rettgeri*, *P. aeruginosa* ve *S. aureus*¹³. The study to determine the antiviral effect was only carried out on *S. vulgaris* species. In this study conducted by Orhan *et al.*¹⁴, the effect of lipophilic extract of *S. vulgaris* on *Herpes simplex* virus type-1 and *Parainfluenza*-3 virus, was examined and it has been reported that the plant has an antiviral effect at varying rates. Antioxidant effect mechanism of *Silene* species, has also been the subject of many researches. High antioxidant activity has been detected in *S. uralensis* species¹⁵. It has been reported that butanol extract of *S. wallichiana*, has a large antioxidant effect¹³. According to different results obtained; it has been determined that the ethanol extract of *S. alba* ssp. *divaricata*'s leaves¹⁶ and the seeds of *S. cserrei*¹⁷ and *S. repens* species¹⁸ has high antioxidant effect¹⁵.

Table 1: The investigations with *Silene* sp. *The sample from Turkey

SPECIES	Antioxidant Activity	Antimicrobial Activity																										REFERENCES						
		VIRUS		BACTERIA														FUNGI																
		Herpes simplex virus-1	Parainfluenza -3	Acinetobacter sp.	Actinomyces viscosus	Bacillus sp.	Citrobacter freundii	Escherichia coli	Enterobacter sp.	Enterococcus faecalis	Haemophilus influenza	Klebsiella sp.	Micrococcus luteus	Morganella morganii	Mycobacterium sp.	Lactobacillus casei	Listeria monocytogenes	Pantoea agglomerans	Proteus sp.	Pseudomonas aeruginosa	Salmonella typhimurium	Shigella flexneri	Staphylococcus sp.	Streptococcus sp.	Borysthis cineria	Candida albicans	Colletotrichum capsici		Epidermophyton sp.	Fusarium sp.	Phytophthora capsici	Rhizoctonia solani	Rhodoaorula rubra	Sclerotinia sclerotiorum
<i>S. aegyptiaca</i>	x																																	20
<i>S. alba</i> ssp. <i>divaricata</i>	x																																	16
<i>S. alba</i> ssp. <i>ericalcinea</i> *														x								x												11, 21
<i>S. armeria</i>																								x			x		x	x			x	4
<i>S. arguta</i> *														x																				11
<i>S. brachuica</i>										x		x						x	x															22
<i>S. chlorifolia</i> *	x					x		x				x		x	x				x	x		x				x		x						11, 23, 24
<i>S. conoidea</i>						x		x				x		x					x	x		x												23
<i>S. conoidema</i>						x		x				x							x			x												25
<i>S. coronaria</i>	x																																	26
<i>S. cserei</i>	x							x											x			x				x								17, 27
<i>S. dichotoma</i> ssp. <i>sibthorpiana</i> *														x																				11
<i>S. guntensis</i>	x				x			x												x														28, 29
<i>S. gynodioca</i>	x						x													x														5
<i>S. italica</i>						x										x							x											30
<i>S. latifolia</i>						x	x		x				x		x					x	x		x	x			x							12, 23, 30, 31, 32
<i>S. montbretiana</i> *							x		x	x			x	x		x				x						x						x		1
<i>S. multifida</i> *							x		x	x									x	x			x				x							33
<i>S. nutens</i>																							x											21
<i>S. parishii</i>							x						x										x				x							10
<i>S. repens</i>	x																																	18
<i>S. salsuginea</i> *							x		x							x			x	x			x											34
<i>S. swertifolia</i>	x						x		x											x	x		x											5, 23
<i>S. spergulifolia</i>	x						x													x														5
<i>S. uralensis</i>	x																																	15
<i>S. virginica</i>									x													x		x										31
<i>S. viridiflora</i>																			x	x														22
<i>S. vulgaris</i> *	x	x	x			x	x		x	x	x			x	x					x	x	x	x	x			x							11, 12, 14, 27, 30, 35, 36, 37, 38
<i>S. wallichiana</i>					x			x	x		x							x	x	x			x											13

According to Table 1, including the antimicrobial study of 24 species, it has been detected that studies has been carried out with 29 *Silene* species in total. It has been found out that; ground surface parts and isolated compounds or fatty acids of the plants had been used in the studies carried out to determine the biologic activities of *Silene* species. Again it has been found out that 8 species of the plants studied within this scope, belonged to the samples collected from Turkey. 165 out of approximately 700 *Silene* species in the world, are found in the flora of Turkey (the percentage of endemism 45 %) ¹⁹. In other words, as Turkey has almost ¼ of this species, these types of studies have been focused on this region. It has been observed that many different species had antimicrobial activities at different rates. In this context, effect mechanisms as Gr-positive, Gr-negative on various bacteria, viruses and many fungi have been reported. It has been observed that Gr-positive bacteria used in this study are *Actinomyces viscosus*, *Bacillus* sp., *Enterococcus faecalis*, *Micrococcus luteus*, *Mycobacterium* sp., *Lactobacillus casei*, *Listeria monocytogenes*, *Staphylococcus* sp., *Streptococcus* sp. The preferred Gr-negative bacteria are these; *Acinetobacter* sp., *Citrobacter freundii*, *Escherichia coli*, *Enterobacter* sp., *Haemophilus influenza*, *Klebsiella* sp, *Morganella morganii*, *Pantoea agglomerans*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, *Salmonella typhimurium*, *Shigella flexneri*. The plant species subjected to antibacterial studies at most, is *S. vulgaris* on which the effect of 13 bacteria, has been examined. It is followed by *S. latifolia* whose effect on ten bacteria, has been examined. *P. aeruginosa*, on which the effect of 16 different plants was examined, has been the most preferred bacteria type. *Staphylococcus* species, on which the effect of 15 bacteria was examined, have been the second most studied bacteria type. These are followed by *Bacillus* species. It has been observed that no other organism was examined on *S. dichotoma* ssp. *sibthorpiana* and *S. arguta* species, except for *M. tuberculosis*. It has been observed that antifungal studies carried out on the different species of *Silene* genus, were conducted with nine different fungi species such as *Botrytis* sp., *Candida albicans*, *Colletotrichum capsici*, *Epidermophyton* sp., *Fusarium* sp., *Rhizoctonia solani*, *Rhodotorula rubra*, *Phytophthora capsici*, *Sclerotinia sclerotiorum* (Table 1). Among *Silene* species, the antifungal activity of only 8 species, was investigated. It has been found out that the effect of only 6 fungi in *S. armeria* species, was examined and that, no bacterial study was carried out. It has been determined that the most preferred fungus species in antifungal studies, was *C. albicans* on which the effect of seven different plant species, was examined. It has been found out that, in literature studies conducted; only the effect of *S. vulgaris* species on two viruses was examined when determining the antiviral activity of this genus, and that, the viral effect of no other species, was examined. It has been observed that both the microbial and antioxidant effect of 8 out of 13 species, were examined. Besides, five *Silene* species, whose antioxidant characteristics were examined, have been detected and it can be seen that these are *S. aegyptiaca* sp. It has been found out that, the species whose antioxidant effects were also examined along with their antimicrobial characteristics are *S. chlorifolia* sp.

CONCLUSION

According to the data obtained from this study, like many other plants, *Silene* species have also an antibacterial, antifungal and antiviral effect at varying rates. This study proves that, new antimicrobial and antioxidant agents can be identified through plant extracts and these plant molecules might create alternative resources. Because, it seems that with their practical structure, plants will continue to be important resources in the future, for the development of new chemotherapeutic agents. As it is a known fact that there are more than 700 *Silene* species on the earth, it can be said that these studies conducted, are inadequate. The number of taxons whose antimicrobial activity has been examined, does not even correspond to 4 % of the genus. In this context, there would be many researchers who wonder about the effects of large remaining part of this genus. Data obtained from this research, are not adequate, but it is considered that they would be a guide for these types of studies to be carried out in the future.

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