

## Effect of Treatment with Cleome Scaposa DC and Cleome Viscose L on Plasma Cholesterol and Atherogenic Index

Muslim Abbas<sup>1\*</sup>, Shahid Ali<sup>2</sup>, Yasir Murtaza<sup>3</sup>, Shabnam Khan<sup>4</sup>, Sadaf Fatima<sup>5</sup>, Santosh Kumar Sidhwani<sup>6</sup>

<sup>1</sup> Department of Pharmacology, Jinnah Medical & Dental College, Sohail University, Karachi, Pakistan

<sup>2</sup> Department of Pharmacology, Bolan University, Quetta, Pakistan

<sup>3</sup> Department of Urology, Ziauddin University, Karachi, Pakistan

<sup>4</sup> Department of Anatomy, Jinnah Medical & Dental College, Sohail University, Karachi, Pakistan

<sup>5</sup> Department of Physiology, Jinnah Medical & Dental College, Sohail University, Karachi, Pakistan

<sup>6</sup> Department of Pathology, Ziauddin University, Karachi, Pakistan

**Abstract:** This study aims to evaluate the effect of Cleome scaposa DC and Cleome viscose L on the lipid profile in Albino rabbits. The goal of the study was to discover newer ways to treat hyperlipidemia. Thirty albino rabbits were randomly divided into three groups (n = 10, per group). The daily oral dosing of ethanol extract of Cleome scaposa DC and ethanol extract of Cleome viscose L was administered respectively to groups 1 and 2, while group 3 was considered the control group. Blood samples were taken at the end of the first, second, and fourth weeks. There was significant reduction in total cholesterol (F2, 4 = 10.85, P < 0.05), triglyceride levels (F2, 4 = 1.686, P < 0.05) and low-density lipoprotein (LDL) levels (F2, 4 = 1.97, P < 0.045) in the treated groups of albino rabbits. A significant increase was seen in high-density lipoprotein (HDL) levels (F2, 4 = 29.095, P < 0.05) in both groups treated. Cleome scaposa and Cleome viscose decreased total cholesterol. Both the herbs possess various constituents, which would be beneficial for treating different diseases. Studies regarding the phytochemistry of these herbs will be required before knowing the mechanism of action.

**Keywords:** Cleome scaposa, Cleome viscose, albino rabbits.

## 克萊姆·斯卡波薩和克萊姆·維斯科薩治療對血漿膽固醇和動脈粥樣硬化指數的影響

**摘要：**本研究旨在評估蜘蛛花斯卡波薩和蜘蛛花人造絲對白化兔脂質分佈的影響。該研究的目的是發現治療高脂血症的新方法。將 30 隻白化兔隨機分為三組（每組 10）。第 1 組和第 2 組分別每日口服仙人掌乙醇提取物和粘膠仙人掌乙醇提取物，第 3 組為對照組。在第一、第二和第四周結束時採集血樣。總膽固醇（F2, 4 = 10.85, 磷 < 0.05）、甘油三酯水平（F2, 4 = 1.686, P < 0.05）和低密度脂蛋白水平（F2, 4 = 1.97, 磷 < 0.045）在白化兔治療組中。治療組的高密度脂蛋白水平顯著增加（F2, 4 = 29.095, P < 0.05）。蜘蛛花斯卡波薩和蜘蛛花粘膠降低了總膽固醇。這兩種草藥都含有多種成分，有利於治療不同的疾病。在了解作用機制之前，需要對這些草藥的植物化學進行研究。

**关键词：**蜘蛛花斯卡波薩，蜘蛛花人造絲，白化兔。

Received: October 5, 2021 / Reviewed: November 1, 2021 / Accepted: December 9, 2021 / Published: January 28, 2022

About the authors: Muslim Abbas, Department of Pharmacology, Jinnah Medical & Dental College, Sohail University, Karachi, Pakistan; Shahid Ali, Department of Pharmacology, Bolan University, Quetta, Pakistan; Yasir Murtaza, Department of Urology, Ziauddin University, Karachi, Pakistan; Shabnam Khan, Department of Anatomy, Jinnah Medical & Dental College, Sohail University, Karachi, Pakistan; Sadaf Fatima, Department of Physiology, Jinnah Medical & Dental College, Sohail University, Karachi, Pakistan; Santosh Kumar Sidhwani (Dr.), Department of Pathology, Ziauddin University, Karachi, Pakistan

Corresponding author Muslim Abbas, [muslimdmdm@gmail.com](mailto:muslimdmdm@gmail.com)

## 1. Introduction

Traditionally, various herbs are being used for the management of different diseases. Three types of traditional medicines have gained popularity in the past 5000 years: Chinese, Japanese, and Indian. Moreover, since the end of the twentieth century, many developing countries have begun to adopt these traditional herbs for treating or relieving symptoms of various diseases [1, 2]. Most of the drugs used in the past were derived from plants, and the usage still continues [3]. Even after the revolutionization of medical practices and the discovery of synthetic drugs, 90% of Africans and 70% of Indians are still dependent on traditional medicines. Its use is restricted to developing countries, but herbal medicines have gained tremendous fame in industrialized countries also [4]. Herbal medicines have been more common due to their wide range of indications and higher potencies than modern drugs [5]. Herbal medicines are based on plants or unpurified extracts of plants that are believed to work together to treat different diseases or at least their symptoms [6]. These plant-based medicines can be based on one plant or can be a combination of different herbs that may induce therapeutic effects synergistically [7]. Traditional medicine includes the practices coming from earlier generations, as the name indicates, but also comprises complementary and alternative medicines based on extracts taken from animals and minerals [8]. It has been given different titles worldwide like Ayurveda, Kampo, Hanbang, Unani, Homeopathy, and Western herbal medicine [9].

Cleome species are found in all tropical parts of the world. They are flower-producing plants and comprise about 150 kinds. These were included in the Capparaceae family; later, they were termed separately as the Cleomaceae family [10]. Cleome viscosa is a common weed in tropical parts of the world that comprises long slender pods with seeds inside. The plant is a sticky herb and has yellow flowers. Its phytochemical evaluation found that it has triterpenoids, saponins, tannins, flavonoids, and steroids [11, 12]. According to Harpreet et al. [13], Cleome viscosa contained camphene, phenol, coumarin, carboxylic acid,  $\alpha$ -morphine, polyphenols, alloocimene, citronellol, and cedrene. All parts of this plant are useful in treating different diseases in Ayurveda. Leaves can heal wounds and ulcers. Cleome viscosa has shown anthelmintic, antimicrobial [14], analgesic, anti-inflammatory [15], immunomodulatory, antipyretic psychopharmacological, anti-diarrheal [16], and hepatoprotective [17] activities. Whole herbs are used to treat cardiovascular, gastrointestinal, and respiratory disorders. Juice of Cleome viscosa has beneficial effects in patients with piles and earache. It has shown anticonvulsant and analgesic activity in animal models [18].

Cleome scaposa DC is part of the flowering genome of Cleomaceae, which is commonly known as Khastoori Boti. It grows annually with a height of 10-30 cm, white flowers having a yellow tint, and a linear capsule of 20-30 mm length having brown-black colored seeds of 0.6 mm diameter [19]. Every part of the Cleome scaposa DC plant can remedy allergic manifestations, diabetes mellitus, and gastric disorders. It is also seen to have diuretic, analgesic, and antipyretic effects [20]. It has gained much fame for its wound healing characteristics [21]. The current study was designed to evaluate the effects of Cleome scaposa DC and Cleome viscosa L on lipid profile.

## 2. Methods

### 2.1. Plant Material and Extract Preparation

The whole plants of Cleome scaposa DC and Cleome viscosa L were collected from the Department of Pharmacognosy, University of Karachi. The plant was dried under shade for seven days at room temperature. The dried plant was pulverized using a mechanical grinder and passed through a 40  $\mu$ m mesh. The extract was obtained using 90% ethanol as a solvent, later removed by vacuum.

### 2.2. Animals

Thirty albino rabbits weighing about 900-1600 g were acquired from the animal house of University of Karachi. Each group had an equal number of male and female animals. The daily oral dosing of ethanol extract of Cleome scaposa DC and ethanol extract of Cleome viscosa L was administered to the first and second group of albino rabbits, while the third group was taken as a control group. For habituation of animals, the animal house of Pharmacology department, University of Karachi, was used for one week before dosing where the temperature was maintained at 21-23°C along with 12h day and 12h night cycles. The animals had free access to food and water during the experimental period. All experimental procedures were approved by the Board of Advanced Studies and Research, University of Karachi.

### 2.3. Groups

Thirty albino rabbits were randomly divided into three groups (n = 10, per group). Each group had an equal number of male and female animals.

Group 1 - control: Animals received 0.9 % normal saline orally for 30 days.

Group 2 - Cleome scaposa DC: Animals received 250 mg [19] of Cleome scaposa DC orally for 30 days. The extract was prepared in ethanol.

Group 3 - Cleome viscosa L: Animals received 300 mg [22] of Cleome viscosa L orally for 30 days. The extract was prepared in ethanol.

## 2.4. Assessment of Lipid Profile

Blood samples were taken at the end of the first, second, and fourth weeks. Blood samples were centrifuged at 3000 rpm for 15 minutes, and serum was separated. Cholesterol, Triglycerides VLDL, LDL, and HDL levels were assessed using Humalyzer 3000 and semi-automatic analyzer Model # 16700 within three hours of blood withdrawal.

## 2.5. Statistical Analysis

Data were analyzed using SPSS software (version 20.0). Results were represented as mean±S.E.M. One-way ANOVA followed by Tukey's post-hoc test was used to explore differences between 3 or more groups. The Student's t-test was used to compare two groups where applicable. A p-value <0.05 was considered significant in all analyses.

## 3. Results

The data showed significant variation in blood lipid levels in groups treated with *C. scaposa* and *C. viscosa*. There was a significant reduction ( $p < 0.05$ ) in blood total cholesterol levels after treatment with both plants ( $F_{2, 4} = 10.85$ ) (Fig. 1).

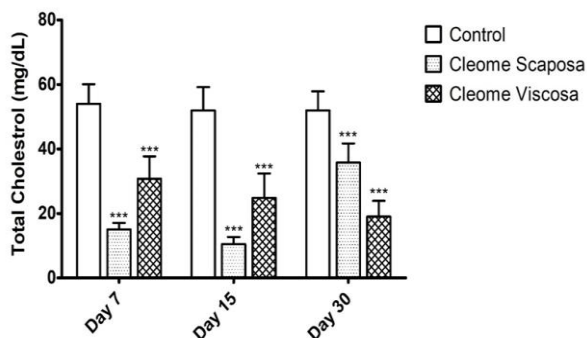


Fig. 1 Effect of *Cleome scaposa* and *Cleome viscosa* on total cholesterol level

Notes: The number of animals per group (n) was 10; The observations are given as mean ± S.E.M. \*\*\* $P < 0.001$ , \*\* $P < 0.01$ , \* $P < 0.05$ ; ANOVA followed by Tukey's test (Table 1)

However, individual lipids showed a mixed pattern of variation as follows. Among the treatment group, there was a significant change in the blood levels of triglycerides ( $F_{2, 4} = 1.686$ ), HDL cholesterol ( $F_{2, 4} = 29.095$ ), LDL cholesterol ( $F_{2, 4} = 1.97$ ), and VLDL cholesterol ( $F_{2, 4} = 1.72$ ) (Table 1).

Table 1 Variation in lipid profile following treatment with *Cleome scaposa* and *Cleome viscosa*

Lipids	Day	Control	Cleome scaposa	Cleome viscosa
Triglycerides	7	46.0±2.10	133.3±21.10***	56.1±6.90***
	15	46.0±2.20	44.3±7.20	91.6±7.60***
	30	44.0±5.90	55.6±8.90	11.7±4.90***
HDL	7	26.0±2.10	11.1±1.10***	6.2±0.90***
	15	24.0±7.20	3.7±0.20***	6.9±0.60***
	30	24.0±8.90	14.0±1.90***	9.3±0.90***
LDL	7	8.0±0.10	22.4±1.50***	15.6±0.70***
	15	8.0±0.20	5.2±0.70***	9.1±0.60
	30	8.0±0.90	18.3±0.90***	9.4±0.90
VLDL	7	8.0±0.10	22.7±1.50***	10.9±0.70

Continuation of Table 1

15	8.0±0.20	10.5±0.70	18.3±0.60***
30	8.0±0.90	13.5±0.90***	3.2±0.90***

Notes: The number of animals per group (n) was 10. The observations are given as mean ± SEM.

\*\*\* $P < 0.001$ , \*\* $P < 0.01$ , \* $P < 0.05$ ; One-way ANOVA followed by Tukey post-hoc test.

Post-hoc analysis indicated a reduction in blood levels of total cholesterol on days 7, 15, and 30 as compared to the control group, especially with *C. viscosa*. A transient rise in triglycerides was noted with both plants. It reduced below the baseline in the group treated with *C. viscosa* on day 30. Blood HDL levels significantly decreased compared to the control group, whereas LDL and VLDL levels were significantly increased. An interesting finding was a steady reduction in variation of lipid levels in the treated group, as shown by low SEM, especially on day 30. According to atherogenic index and LDL/HDL ratio, *Cleome viscosa* shows a longer latency but greater magnitude to reach the observable beneficial effects: low LDL/HDL ratio, low atherogenic index, and low Total cholesterol/HDL ratio as compared to *Cleome scaposa* (Table 2).

Table 2 Comparison of lipid profile ratios following treatment with *Cleome scaposa* and *Cleome viscosa*

Lipids	Day	Cleome scaposa	Cleome viscosa	p-value
LDL/HDL	7	2.02±0.13	2.53±0.52	0.009
	15	1.32±0.38	1.33±0.19	0.939
	30	1.35±0.31	1.02±0.15	0.007
Atherogenic Index of Plasma (AIP)	7	1.02±0.31	0.96±0.07	0.540
	15	1.04±0.11	1.12±0.07	0.048
	30	0.59±0.15	0.10±0.06	<0.001
Total Cholesterol/HDL	7	1.35±0.20	5.0±0.69	<0.001
	15	2.61±0.65	3.63±0.44	0.001
	30	2.64±0.55	2.07±0.22	0.007

Notes: The number of animals per group (n) was 10. The observations are given as mean ± SEM Student's t-test.

## 4. Discussion

This study shows an important observation regarding reduction in total blood cholesterol levels after treatment with *Cleome scaposa* and *Cleome viscosa*. This finding highlights the promising role of herbal medicine in controlling dyslipidemia. A shift is observed in the research using advancing herbal medicine. More researchers are now working on different herbs to raise their effectiveness in treating various diseases. For which we require the approval of the Pharmacological society. No condemnation of herbal medicine by the research community can be accepted without the proper assessment. At the same time, the extensive use of herbal remedies without inference is also not recommended [23]. A person has increased levels of LDL and triglycerides, whereas decreased HDL levels are at high risk for developing cardiovascular diseases [24].

This study helped to evaluate the group of *Cleome scaposa* and *Cleome viscosa* for their toxicological profile and analyzed their effects on cholesterol, triglycerides, HDL, LDL, and VLDL levels. The mechanism of action of herbal medicines involved in treating hypercholesterolemia is very complex and difficult to understand. It is believed that herbal medicines contain some potentially active compounds which are yet to be identified, like camphene found in *Cleome viscosa* was observed to have a cholesterol-lowering effect [13].

Camphene administration in hyperlipidemic animals reduces the total cholesterol and triglycerides. HepG2 cells treatment with camphene led to a reduction in cellular cholesterol content, which is the same as an HMG-CoA reductase inhibitor [25]. Administration of camphene is responsible for the lipid-lowering effect, and it may be due to lipolytic enzymes reactivation with the early clearance of lipids from circulation is possible by camphene [26].

According to the current study reduces the level of cholesterol at 7, 15, and 30 days of administration and triglycerides at 15 days administration of *Cleome viscosa* without any serious effect, and it may be due to the presence of constituent camphene found in this plant [13]. In a conventional system of medicine roots, seeds, and leaves of the plant are widely used as a cardiac stimulant [15].

LDL oxidation is inhibited by Flavonoids action, which increases LDL levels [27], resulting in the attenuation of atherosclerosis [28]. High levels of Peroxidases are found in *Cleome scaposa* extracts. These Peroxidases cause a decrease in hyperlipidemia. Flavonoids inhibit thrombus formation and coagulation, resulting in reducing the risk of atherosclerosis.

*Cleome scaposa* and *Cleome viscosa* plants both comprise various compounds that are therapeutically very significant. The phytochemistry of *Cleome scaposa* is not much discovered because of which the exact mechanism of action of this herb and its effects on the management of various diseases cannot be identified. Long-term dosing of *Cleome viscosa* showed a significant decrease in cholesterol and LDL due to the flavonoids. Reduction in total lipids is due to a reduction in the concentration of LDL and cholesterol. According to the studies conducted in the past few decades, an increase in the levels of total cholesterol, LDL cholesterol, and VLDL cholesterol in the serum results in Acute Myocardial Infarction. The current study suggests that the plants of *Cleome scaposa* and *Cleome viscosa* are composed of numerous therapeutically important compounds. After 30 days of the administration, they showed a significant decrease in LDL, VLDL, and triglycerides levels that lower the risk of developing cardiovascular diseases, including Myocardial Infarction, and could be very beneficial for lowering and controlling the lipids in the circulation

and indirectly protecting against atherosclerosis. Very little is known about their phytochemistry which requires further studies to be carried out to find the mechanism of action and other characteristics of the extracts of these herbs and identify their role in the treatment of different diseases.

## 5. Conclusion

Treatment with *Cleome scaposa* and *Cleome viscosa* reduced blood total cholesterol levels steadily by day 30 compared to control. To the best of our knowledge, this is the first report of the effects of *C. scaposa* on blood lipids. Since little is known about the phytochemistry of *C. scaposa*, the precise mechanism of action of its different properties could not be elucidated. Further studies are needed to explore the role of both plants in the treatment of dyslipidemias.

## Ethical Approval

IRB: Approved by Board of advanced studies and research, University of Karachi Ref# BASR/NO./02178/Pharm. Dated: September 09, 2015.

## Acknowledgment

The authors would like to thank the manuscript reviewer, Dr. Nasir Ali Afsar, Professor of Pharmacology, Jinnah Medical and Dental College, Karachi.

## References

- [1] VICKERS A., and ZOLLMAN C. Hypnosis and relaxation therapies. *The BMJ*. 1999, 319: 1346-1349.
- [2] PETROVSKA B.B. Historical review of medicinal plants usage. *Pharmacognosy Reviews*, 2012, 6: 1-5.
- [3] FIRENZUOLI F., and GORI L. Herbal Medicine Today: Clinical and Research Issues. *Evidence-Based Complementary and Alternative Medicine*, 2007; 4: 37-40.
- [4] PAL S.K., and SHUKLA Y. Herbal Medicine: Current Status and the Future. *Asian Pacific Journal of Cancer Prevention*, 2003, 4: 281-288.
- [5] ZHANG X. Integration of Traditional and Complementary Medicine into National Health Care Systems. *Journal of Manipulative and Physiological Therapeutics*, 2000, 23: 139-140.
- [6] BANERJEE K., ROY C.M., SENGUPTA K., SETT S., and MITRA A. Influence of anthropogenic and natural factors on the mangrove soil of Indian Sundarban Wetland. *Journal of Environmental Protection*, 2012, 6: 80-89.
- [7] SHARAF M., EL ANSARI M.A., and SALEH N.A. Flavonoid soffour *Cleome* and three *Capparis* species. *Biochemical Systematics and Ecology*, 1997, 25: 161-166. DOI.10.1016/S0305-1978(96)00099-3
- [8] NIRAIMATHI K.L., KARUNANITHI M., and BRINDHA P. Phytochemical and in vitro screening of aerial part of *Cleome viscosa*. *International Journal of Pharmacy and Pharmaceutical Sciences*, 2012, 4: 27-30.
- [9] RAJANI A., SUNITHA E.M., and SHAILAJA K. Analysis of phytochemical constituents in leaf extract of *Cleome viscosa*. *World Journal of Pharmaceutical Research*, 2014, 3: 1008-1013.

- [10] SINGH H., MISHRA A., and MISHRA A.K. Cleome viscosa Linn. (Capparaceae): A Review. *Pharmacognosy Journal*, 2015, 7: 226-229.
- [11] WAKE R.R., PATIL N.A., and KHADABADI S.S. In Vitro Antimicrobial activity of extracts of seeds of Cleome viscosa Linn. *International Journal of Pharmaceutical Sciences and Research*, 2011, 2: 2232-2236.
- [12] SALMAN A., MUNNAWAR S., HASAN M., and IQBAL A. Analgesic and Anti-emetic activity of Cleome viscosa L. *Pakistan Journal of Botany*, 2011, 43: 119-122.
- [13] DEVI B.P., BOOMINATHAN R., and MANDAL S.C. Evaluation of anti-diarrheal activity of Cleome viscosa L extracts in rats. *Phytomedicine*, 2002, 9: 739-742.
- [14] GUPTA N.K., and DIXIT V.K. Evaluation of hepatoprotective activity of Cleome viscosa Linn. extract. *Indian Journal of Pharmacology*, 2009, 41: 1-36.
- [15] ANBURAJ J., SINGH C.R., SUNDARRAJ S., and KANNAN S. In vitro regeneration of Cleome viscosa – an important medicinal herb. *Indian Journal of Pharmaceutical Sciences*, 2011, 41: 36-40.
- [16] MALIK S., AHMAD S., SADIQ A., ALAM K., WARISS H.M., AHMAD I., HAYAT M.Q., ANJUM S., and MUKHTAR M. A comparative ethnobotanical study of Cholistan (an arid area) and Pothwar (a semi-arid area) of Pakistan for traditional medicines. *Journal of Ethnobiology and Ethnomedicine*, 2015, 30: Article number 31.
- [17] HAMEED M., ASHRAF M., AL-QURIANY F., NAWAZ T., AHMAD M.S.A., AL-QURIANY, F., and YOUNIS A. Medicinal flora of the cholistan desert: A review. *Pakistan Journal of Botany*, 2011, 43: 39-50.
- [18] SHAHEEN N., AHMED S., AZHAR I., and HASAN M. Analgesic, anti-inflammatory and antiemetic activities of Cleome scaposa DC. *Phytopharmacology*, 2013, 4: 106-113.
- [19] PANDURAJU T., PARVATHI B., RAMMOHAN M., and REDDY C. Wound healing properties of Cleome viscosa Linn. *Hygeia: Journal for Drugs and Medicines*, 2011, 3: 41-45.
- [20] CALAPAI G., and CAPUTI A.P. Herbal medicines: can we do without pharmacologist? *Evidence-Based Complementary and Alternative Medicine*, 2007, 4: 41-43.
- [21] MANNINEN V., TENKANEN L., KOSKINEN P., HUTTUNEN J.K., MANTTARI M., HEINONEN O.P., and FRICK M.H. Joint effects of serum triglyceride and LDL cholesterol and HDL cholesterol concentrations on coronary heart disease risk in the Helsinki Heart Study. *Implications for Treatment Circulation*, 1992, 85: 37-45.
- [22] VALLIANOU I., PEROULIS N., PANTAZIS P., and HADZOPOULOU-CLADARAS M. Camphene, a Plant-Derived Monoterpene, Reduces Plasma Cholesterol and Triglycerides in Hyperlipidemic Rats Independently of HMG-CoA Reductase Activity. *PLoS One*, 2011, 6(11): 20516.
- [23] TSUTSUMI K. Lipoprotein lipase and atherosclerosis. *Current Vascular Pharmacology*, 2003, 1: 11-17.
- [24] NADERI G.A., ASGARY S., SARRAF-ZADEGAN N., SHIRVANI H., and GHARIPOUR M. Anti-oxidant effect of flavonoids on the susceptibility of LDL oxidation. *Molecular and Cellular Biochemistry*, 2003, 246: 193-196.
- [25] FUHRMAN B., and AVIRAM M. Flavonoids protect LDL from oxidation and attenuate atherosclerosis. *Current Opinion in Lipidology*, 2001, 12: 41-48.
- [26] KASEM W., and FATAHY S. Flavonoids and isoenzymes as chemotaxonomic markers in Cleome L. *Current Botany*, 2016, 7: 11-16.
- [27] WANG L., WEI L., WANG L., and XU C. Effects of peroxidase on hyperlipidemia in mice. *Journal of Agricultural and Food Chemistry*, 2002, 50: 868-870.
- [28] VAN DAM R.M., NAIDOO N., and LANDBERG R. Dietary flavonoids and the development of type 2 diabetes and cardiovascular diseases. *Current Opinion in Lipidology*, 2013, 24: 25-33.

### 參考文:

- [1] VICKERS A. 和 ZOLLMAN C. 催眠和放鬆療法。英國醫學雜誌。1999, 319: 1346-1349.
- [2] PETROVSKA B.B. 藥用植物使用歷史回顧。生藥學評論, 2012, 6: 1-5.
- [3] FIRENZUOLI F. 和 GORI L. 今日草藥: 臨床和研究問題。循證補充和替代醫學, 2007; 4: 37-40.
- [4] PAL S.K. 和 SHUKLA Y. 草藥: 現狀和未來。亞太癌症預防雜誌, 2003, 4: 281-288.
- [5] ZHANG X. 將傳統和補充醫學納入國家衛生保健系統。手法和生理治療學雜誌, 2000, 23: 139-140.
- [6] BANERJEE K., ROY C.M., SENGUPTA K., SETT S. 和 MITRA A. 人為和自然因素對印度孫德爾班濕地紅樹林土壤的影響。環境保護學報, 2012, 6: 80-89.
- [7] SHARAF M., EL ANSARI M.A. 和 SALEH N.A. 黃酮類蜘蛛花人造絲和三種卡帕里斯物種。生化系統學與生態學, 1997, 25: 161-166. DOI. 10.1016/S0305-1978(96)00099-3
- [8] NIRAIMATHI K.L., KARUNANITHI M. 和 BRINDHA P. 蜘蛛花粘膠地上部分的植物化學和體外篩選。國際藥學與藥物科學雜誌, 2012, 4: 27-30.
- [9] RAJANI A., SUNITHA E.M. 和 SHAILAJA K. 分析了粘多醣葉提取物的植物化學成分。世界藥物研究雜誌, 2014, 3: 1008-1013.
- [10] SINGH H., MISHRA A. 和 MISHRA A.K. 蜘蛛花粘膠。(山植科): 評論。生藥學雜誌, 2015, 7: 226-229.
- [11] WAKE R.R., PATIL N.A. 和 KHADABADI S.S. 蜘蛛花粘膠種子提取物的體外抗菌活性。國際藥物科學與研究雜誌, 2011, 2: 2232-2236.
- [12] SALMAN A., MUNNAWAR S., HASAN M. 和 IQBAL A. 蜘蛛花粘膠巴基斯坦植物學雜誌的鎮痛和止吐活性, 2011, 43: 119-122.
- [13] DEVI B.P., BOOMINATHAN R. 和 MANDAL S.C. 評價蜘蛛花粘膠提取物在大鼠中的抗腹瀉活性。植物醫學, 2002, 9: 739-742.
- [14] GUPTA N.K. 和 DIXIT V.K. 蜘蛛花粘膠的保肝活性評價。提煉。印度藥理學雜誌, 2009, 41: 1-36.
- [15] ANBURAJ J., SINGH C.R., SUNDARRAJ S. 和 KANNAN S. 蜘蛛花人造絲(一種重要的藥草)的體外再生。印度藥物科學雜誌, 2011, 41: 36-40.
- [16] MALIK S., AHMAD S., SADIQ A., ALAM K., WARISS HM, AHMAD I., HAYAT MQ, ANJUM S. 和 MUKHTAR M. 膽鹼(乾旱地區)和波思瓦爾的比較民族植物學研究巴基斯坦(半乾旱地區)的傳統藥物。民族生物學和民族醫學雜誌, 2015年, 30: 第31條。
- [17] HAMEED M., ASHRAF M., AL-QURIANY F., NAWAZ T., AHMAD M.S.A., AL-QURIANY, F. 和

YOUNIS A. 膽鹼沙漠的藥用植物群：綜述。巴基斯坦植物學雜誌，2011，43：39-50。

[18] SHAHEEN N.、AHMED S.、AZHAR I. 和 HASAN M. 蜘蛛花斯卡波薩的鎮痛、抗炎和止吐活性。植物藥理學，2013，4：106-113。

[19] PANDURAJU T.、PARVATHI B.、RAMMOHAN M. 和 REDDY C. 蜘蛛花粘膠的傷口癒合特性。海吉亞：藥物和藥物雜誌，2011，3：41-45。

[20] CALAPAI G. 和 CAPUTI A.P. 草藥：我們可以沒有藥理學家嗎？循證補充和替代醫學，2007，4：41-43。

[21] MANNINEN V.、TENKANEN L.、KOSKINEN P.、HUTTUNEN J.K.、MANTTARI M.、HEINONEN O.P. 和 FRICK M.H. 赫爾辛基心臟研究中血清甘油三酯、低密度脂蛋白膽固醇和高密度脂蛋白膽固醇濃度對冠心病風險的聯合影響。對治療循環的影響，1992，85：37-45。

[22] VALLIANOU I.、PEROULIS N.、PANTAZIS P. 和 HADZOPOULOU-CLADARAS M. 茨烯，一種植物衍生的單萜，可降低高脂血症大鼠的血漿膽固醇和甘油三酯

，與羥甲基戊二酰輔酶一個還原酶活性無關。公共科學圖書館一號，2011，6（11）：20516。

[23] TSUTSUMI K. 脂蛋白脂肪酶和動脈粥樣硬化。當前的血管藥理學，2003，1：11-17。

[24] NADERI G.A.、ASGARY S.、SARRAF-ZADEGAN N.、SHIRVANI H. 和 GHARIPOUR M. 黃酮類化合物對低密度脂蛋白氧化敏感性的抗氧化作用。分子和細胞生物化學，2003，246：193-196。

[25] FUHRMAN B. 和 AVIRAM M. 類黃酮保護低密度脂蛋白免受氧化並減輕動脈粥樣硬化。脂質學當前觀點，2001，12：41-48。

[26] KASEM W. 和 FATAHY S. 黃酮類化合物和同工酶作為化學分類標誌物蜘蛛花當前植物學，2016，7：11-16。

[27] WANG L.、WEI L.、WANG L. 和 XU C. 過氧化物酶對小鼠高脂血症的影響。農業與食品化學雜誌，2002，50：868-870。

[28] VAN DAM R.M.、NAIDOO N. 和 LANDBERG R. 膳食類黃酮與 2 型糖尿病和心血管疾病的發展。脂質學的當前觀點，2013，24：25-33。