EXPERIMENTAL STUDY

The effects of *Capparis ovata* seed oil on the healing of traumatic skin wounds

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ABSTRACT

BACKGROUND: *Capparis ovata* contains alkaloids, lipids, polyphenols, flavonoids, and also is rich in antioxidants. Conventionally, in Turkey, the flower buds, root, bark, and fruits of *C. ovata* are used for their analgesic, anti-inflammatory, anti-rheumatism, tonic, and diuretic effects. The aim of this study was to examine the effect on wound healing of *C. ovata* seed oil (COSO), which is known to have antioxidant, anti-inflammatory, and antibacterial properties.

METHODS: In the study, 20 Wistar albino female rats were randomly divided into two groups of 10 animals each. A standard full-thickness skin defect was created on the back area of the rats. In both groups, after cleaning the wounds with saline daily, no active substance other than saline was applied to the control group, while 1 cc/day COSO was applied to the wounds of the rats in the study group. On the post-operative 14th day, the rats were reanesthetized and wound area measurements were made. Then, excision was performed to include 1 cm of intact tissue around the wound, which remained unhealed, and samples were taken for histopathological examination.

RESULTS: The changes in wound areas showed that after 14 days, the improvement in the group treated with caper oil (32.78; 95% confidence interval, 17.21–48.36) was significantly higher than that of the control group (65.41; 95% confidence interval, 49.84–80.98) (p=0.009). The histopathological scores showed a significant difference between the groups in respect of epithelial formation, inflammation, and fibrosis development. No epithelial tissue formation was observed in the control group (90%), and more incomplete re-epithelization and focal epidermal hyperplasia were observed in the treatment group (60%). Fibrosis development was mild and weak (70%) in the control group and was evaluated as severe and intense (60%) in the treatment group. Perivascular edema was mild (50%) and vascularity was immature (60% – an indicator of neovascularization) in the treatment group. These histopathological results showed that the treatment group inflammation phase was completed and the proliferation phase started, as well as the effectiveness of the use of caper oil on epithelization, angiogenesis, and fibrosis, which are important histopathological parameters in the evaluation of wound healing compared to the control group.

CONCLUSION: From the results of this study, it was concluded that COSO significantly enhances the healing of full-thickness skin wounds and this effect is primarily related to its anti-inflammatory effect.

Keywords: Anti-inflammatory; *Capparis ovata* seed oil; skin; traumatic; wound healing.

Cite this article as: Celepli S, Çolak B, Aydemir Sezer Ü, Celepli P, Bigat İ, Duymuş ME, et al. The effects of *Capparis ovata* seed oil on the healing of traumatic skin wounds. Ulus Travma Acil Cerrahi Derg 2022;28:1205-1213.

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Ulus Travma Acil Cerrahi Derg 2022;28(9):1205-1213 DOI: 10.14744/tjtes.2021.31526 Submitted: 05.04.2021 Accepted: 22.06.2021

INTRODUCTION

The integrity of healthy skin plays a crucial role in maintaining the physiological homeostasis of the human body, providing protection against mechanical forces and infections, fluid imbalance, and thermal irregularity.[1] Severe acute and chronic wounds such as burns, mechanical trauma including surgical procedures, leg ulcers due to decreased circulation, congenital skin diseases, and skin ulcers pose a great challenge for surgeons.[2] A small incision normally heals within days through tight regulation of cell migration and appropriate levels of inflammation, innervation, and angiogenesis.[3]

Activation of polymorphonuclear leukocytes (PMNLs) migrating to the wound site in the early phase of injury results in the production of cytotoxic reactive oxygen species (ROS) which play an important role in inflammatory processes as mediators of injury.[4] Toxic by-products of xanthine oxidase, including hydrogen peroxide (H_2O_2) and hydroxyl radical (OH), directly damage skin structures.[5] OH scavengers have been shown to inhibit pro-inflammatory cytokine production in a dose-dependent manner.[6] Both enzymatic and non-enzymatic antioxidants such as desferrioxamine, allopurinol, N-acetylcysteine, and caffeic acid phenethyl ester have antioxidant activity against ROS and reactive nitrogen species, and may be biochemical substances that could be used in the treatment of burn patients.[7]

Control of the inflammation phase during the wound healing process in the skin will increase the quality of wound healing. Various medical materials and products have been researched and applied for this purpose.[8] There is a wide range of materials currently in use, some of which are natural products.[9] Herbal products are potential agents for wound healing, which are highly preferred because of their widespread availability, non-toxicity, lack of undesirable side effects, and effectiveness as raw preparations.[10] Over recent decades, there has been increasing interest in fruits and vegetables, rich in polyphenols, which contribute to human health.[11] Polyphenols have been shown to have some potential beneficial effects on human health. Flavonoids are powerful antioxidants, which can accelerate the wound healing process by inhibiting the release of inflammatory mediators.[12]

Capparis ovata belongs to the Capparidaceae family and is a perennial shrub plant found in the Mediterranean basin. There are more than 350 species of *Capparis* growing naturally in many different regions around the world. The previous chemical studies have reported the presence of alkaloids, lipids, polyphenols, flavonoids, and glucosinolates in the plant. *Capparis* extract has also been reported to be rich in antioxidants such as α-tocopherol, γ-tocopherol, and sitosterol, as well as flavonoids such as kaempferol, rutoside quercetin, and quercetin derivatives.[13] Conventionally, in Turkey, the flower buds, root, bark, and fruits of *C. ovata* Desf. are used for their analgesic, anti-inflammatory, anti-rheumatism, tonic, and diuretic effects.[14]

However, a limited number of studies have examined the effects of seed oil of *Capparis* (from *Capparis spinosa*) on wound healing.[15] In addition, *Capparis* oil used in these studies was obtained using extraction methods using different solvents. To the best of our knowledge, there is no study in literature of caper oil obtained from any caper derivative using the cold press method. In this study, for the 1st time, *C. ovata* seed oil (COSO) was obtained from seeds using the cold press method and its effects on wound healing were examined.[16]

Thus, the aim of this study was to examine the effect on wound healing of COSO, which is known to have antioxidant, anti-inflammatory, and antibacterial properties.

MATERIALS AND METHODS

C. ovata seeds were obtained from Aşçı Murat Kapari Co. Ltd. Caper oil was obtained as a result of cold-press processing of the seeds. The seeds were stored at room temperature and protected from sunlight until used in the experiments.

In the study, 20 Wistar albino female rats, each weighing 300–350 g, were used. The rats were obtained from Selçuk University Experimental Medicine Research Center. The animals were housed in stainless steel cages in a room at a constant temperature of 22°C with a 12 h dark-light cycle, and a standard pellet diet and free access to drinking water. The rats were fasted for 12 h before the intervention. The procedures in these experimental studies were carried out in accordance with the National Guidelines for the Use and Care of Laboratory Animals and were approved by the Selcuk University Experimental Medicine Research Center Ethics Committee.

The rats were randomly divided into two groups of 10 animals each. Anesthesia of 50 mg/kg ketamine (Pfizer, Turkey) and 5 mg/kg Rompun (Bayer, Turkey) was used. The operation areas were shaved and disinfected with povidone-iodine, then a 2×1 cm rectangular incision was made in the midline of the back area and a standard full-thickness skin defect was created, including the panniculus carnosus. In both groups, after cleaning the wounds with saline daily, no active substance other than saline was applied to the control group, while 1 cc/day caper oil was applied to the wounds of the rats in the treatment group. All wounds were monitored for 14 days and no complications developed during this period. On the post-operative 14th day, the rats were reanesthetized and wound area measurements were made. Then, excision was performed to include 1 cm of intact tissue around the wound, which remained unhealed, and samples were taken for histopathological examination.

Evaluation of Wound Areas

The wound areas were drawn on acetate paper on the day, the wound was created (day 0) and on post-operative day 14. After scanning the drawings, the surface areas were calculated using a scientific image processing program (ImageJ,

Version 1.45, National Institutes of Health, Bethesda) and the reduction in wound areas was statistically compared between the groups.

Histopathological Evaluation

Skin tissue samples taken from the rats were fixed in 10% formaldehyde solution for 2 days, followed by ethanol dehydration (50%, 75%, 96%, and 100%, respectively) and xylene transparency, and then embedded in paraffin. Sections 4 µm in thickness were taken from the paraffin embedded tissues using a Leica RM 2125 RT microtome. The tissue sections were stained with hematoxylin and eosin (H&E) and Masson trichrome. Epithelialization and inflammation/inflammatory granulation tissue in the H&E stained sections, and the presence of fibrosis/healing in H&E and trichrome stained sections were evaluated using a semi-quantitative scoring system. The epithelialization, inflammation, and fibrosis scores scoring systems are given in Tables 1–3. Histopathological examination was evaluated with OLYMPUS brand, BX51TF model × 4, × 10, × 20 lenses.

Statistical Analysis

All statistical analyses were performed with JAMOVI software (Version 1.6.7, https://www.jamovi.org). Numerical variables were expressed as mean±standard deviation values, and categorical variables as number (n) and percentage (%). An analysis of covariance was conducted to compare the effectiveness of the study groups while controlling for baseline measures of wound areas. Levene's homogeneity of variances test and normality checks were carried out and the assumptions were met. The analysis results were given as estimated mean (95% confidence interval – CI). Chi-square tests were used to examine the association between the study groups and the epithelialization, inflammation, and fibrosis scores. P<0.05 was considered statistically significant.

RESULTS

None of the rats died during the study period. At the end of the study, the rats were not sacrificed and care was continued in the Experimental Medicine Center Laboratory under appropriate conditions.

The results of the covariance analysis performed to compare the changes in the wound areas at the end of 14 days in the control group and the treatment group according to the initial wound measurements are given in Table 4. The results obtained showed that after 14 days, the improvement in the treatment group (32.78; 95% confidence interval – CI, 17.21–48.36) was significantly higher than that of the control group (65.41; 95% CI, 49.84–80.98) (p=0.009) (Table 4).

Table 1. Epithelialization scoring system

Score	Epithelial formation
0	No epithelialization, surface ulcer
1	Incomplete re-epithelialization, focal epidermal hyperplasia
2	Complete re-epithelization

Table 2. Inflammation scoring system

Score	Inflammation development
0	None
1	Few lymphocytes, plasma cells and giant cells in the dermis
2	Vascular proliferation, plasma cells, eosinophils, neutrophils and giant cells in the dermis
3	Numerous inflammatory cells, vascular proliferation, micro-abscess formation

Table 3. Fibrosis scoring system

Score	Fibrosis development
0	None
1	Mild severe, weak
2	Moderately severe
3	Severe, intense

The histopathological scores of the rats in both groups and the comparisons between the groups are given in Table 4. According to the results obtained, a significant difference was found between the groups in respect of epithelial formation, inflammation, and fibrosis development. No epithelial tissue formation was observed in the control group (90%), and more incomplete re-epithelization and focal epidermal hyperplasia were observed in the treatment group (60%). A small number of lymphocytes, plasma cells, and giant cell inflammation development in the dermis were observed in the treatment group (60%), and vascular proliferation, plasma cells, eosinophils, PMNLs, and giant cell inflammation were detected in the control group (50%). Fibrosis development was mild and weak (70%) in the control group and was evaluated as severe and intense (60%) in the treatment group. Perivascular edema was mild (50%) and vascularity was immature (60% – an indicator of neovascularization) in the treatment group (Table 4). The histopathological images and explanations are given in Figures 1–4.

DISCUSSION

In the inflammatory phase that begins following hemostasis in skin injuries, PMNLs migrate to the local injury site, and release ROS and nitric oxide, facilitate the breakdown of foreign organisms, and initiate phagocytosis of pathogens. ROS

Table 4. Comparison of the results by groups

	Control (n=10)	Treatment (n=10)	p-value
Measurement of area (mm^2) (mean±SD)			.009
Baseline	196.68±26.77	170.09±23.20	
14th day	66.21±22.80	31.89±19.36	
Estimated mean (95% CI) for 14th day	65.41 (49.84–80.98)	32.78 (17.21–48.36)	
Epithelialization scores, n (%)			.007
No epithelizalization, surface ulcer	9 (90)	2 (20)	
Incomplete re-epithelialization, focal epidermal hyperplasia	1 (10)	6 (60)	
Complete re-epithelialization	0 (0)	2 (20)	
Inflammation scores, n (%)			.021
None	–	–	
Few lymphocytes, plasma cells and giant cells in the dermis	1 (10)	6 (60)	
Vascular proliferation, plasma cells, eosinophils, neutrophils and giant cells in the dermis	5 (50)	4 (40)	
Numerous inflammatory cells, vascular proliferation, microabscess formation	4 (40)	0 (0)	
Fibrosis scores, n (%)			.001
None	–	–	
Mild severe, weak	7 (70)	0 (0)	
Moderately severe	3 (30)	4 (40)	
Severe, intense	0 (0)	6 (60)	
Vascularity, n (%)			.003
Highly mature	3 (30)	0 (0)	
Mature	6 (60)	1 (10)	
Immature	1 (10)	6 (60)	
Highly immature	0 (0)	3 (30)	
Perivascular edema, n (%)			.025
Normal	0 (0)	3 (30)	
Mild	2 (20)	5 (50)	
Moderate	3 (30)	2 (20)	
Severe	5 (50)	0 (0)	

n: Number; CI: Confidence interval; SD: Standard deviation.

are produced by activated keratinocytes and immune cells.[17,18] Excessive production of free radicals causes injuries and oxidative stress causing harmful cytotoxic effects, which disrupt wound healing.[19] The intensity of inflammation and the time it takes to resolve are critical to prevent or at least limit damage to normal skin tissue.[20] A faulty inflammatory phase causes defects in fibroblast migration, collagen synthesis, and wound contraction.[21]

Angiogenesis has an important effect on many physiological and pathological processes such as wound healing, chronic inflammation, and embryonic development.[22] The dual function of angiogenesis is to supply oxygen and essential nutrients to the lesion area and to accelerate granulation tissue formation.[23] In hypoxic and acidotic conditions and in the presence of endotoxin, not only does oxygen decrease but white blood cells are also activated, leading to ROS production.[24]

Wound dressings, foams, or gels containing synthetic medications, topical antibiotics, and other healing agents are used to heal wounds.[25] These agents can be extremely costly to the patient due to prolonged treatment. Recently, the use of herbs to improve health and alleviate disease has emerged due to their lower toxicity and cost. Vegetable oils have been found to have many positive physiological benefits. The application of herbal oil may allow the skin to retain moisture, causing transepidermal water loss values to decrease. In ad-

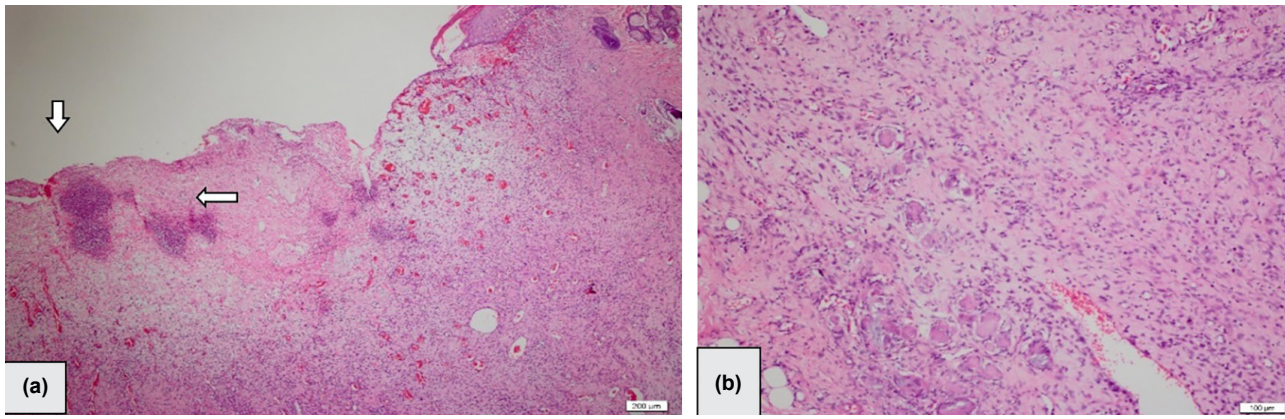

Figure 1. (a) In the control group, a view of the ulcerated epidermis, epithelization is not observed. Numerous inflammation cells and microabscess formation (arrow) are observed. **(b)** In addition to foreign body, phagocytosed histiocytic multinuclear giant cells (arrow) accompanied by mild fibrosis, inflammatory granulation tissue consisting of a small number of lymphocytes and plasma cells is observed (hematoxylin and eosin, × 40, × 100).

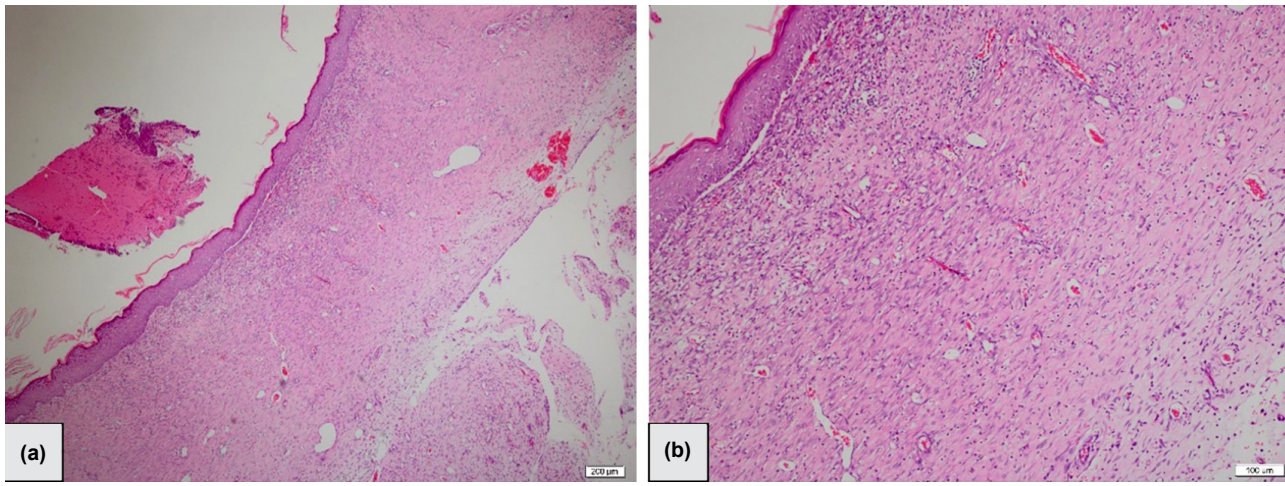

Figure 2. (a, b) In the treatment group, complete re-epithelialization, epidermal hyperplasia, few inflammatory cells, and dense fibrosis/healing findings are observed (hematoxylin and eosin, × 40, × 100).

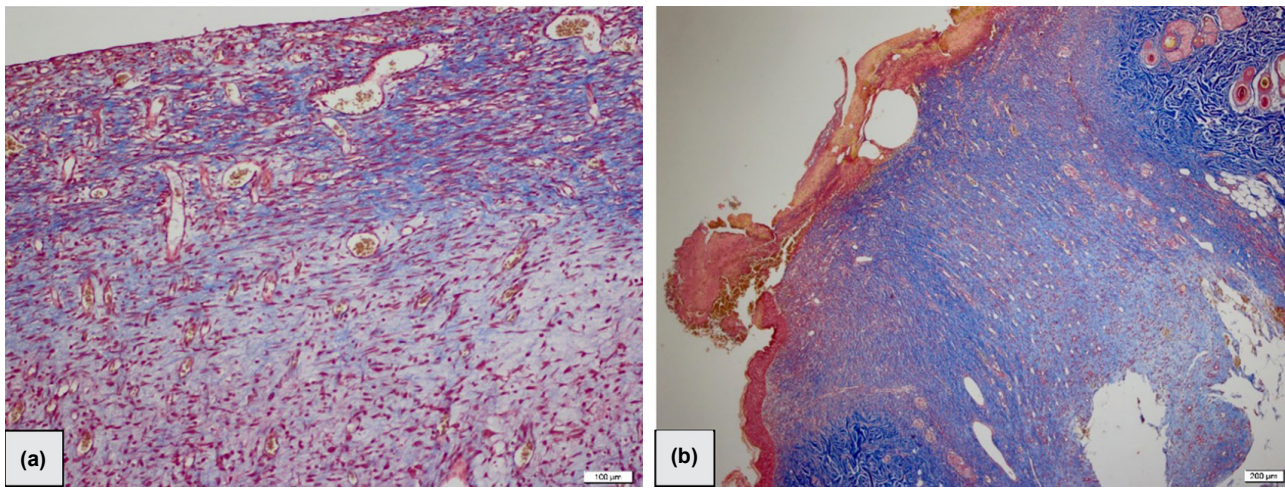

Figure 3. Collagen-type fibrosis development is observed as blue-colored fibrils. **(a)** Mild fibrosis development in the control group (Masson trichrome, × 100). **(b)** Moderate-severe fibrosis development is observed in the treatment group (Masson trichrome 3, × 40).

dition, topical products have the advantage of higher bioavailability in the skin and a localized effect rather than systemic effects.[26]

In the folk medicine of Turkey and in other countries, caper flower buds, fruit, roots, and seeds are used as antirheumatic, tonic, expectorant, spasmodic, diuretic, and

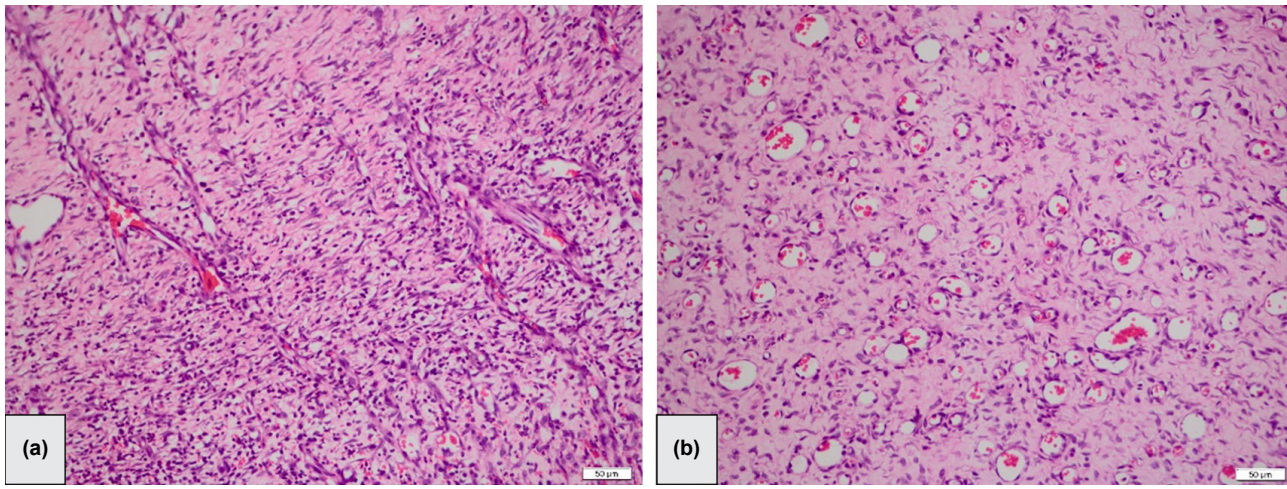

Figure 4. (a) Vasculogenesis: In the control group, mature large vessel structures. **(b)** In the treatment group, many immature small vessel structures are observed (Hematoxylin and eosin, × 200).

analgesics.[27] Although the *Capparis* genus has 80 species, only *Crassula ovata* and *C. spinosa* grow in Turkey with a vast natural spread and are consumed in abundance.[28] The flavonoids of glucosinolates, alkaloids, and phenolics are found in Capparaceae family members. There are differences in phytochemical composition in components from different plant parts, each of which exhibit various pharmacological effects.[29] Methanol extract of *Capparis* species, including *C. ovata*, has shown remarkable antioxidant and free radical scavenging activity in various *in vitro* models, and it has been suggested that this extract could be used to treat pathological diseases based on oxidative stress.[30] *C. spinosa* L. and *Capparis* decidua Edgew have also been studied for analgesic and anti-inflammatory activities, and both have been found to have anti-inflammatory effects.[31,32] Rutin, a phenolic compound found in the fruits of *C. ovata* var. palaestina, has been shown to have important antioxidant, antimicrobial, and anti-inflammatory effects.[33,34]

Bektas et al.[14] investigated the possible anti-inflammatory effects of methanol extracts prepared from the flower buds and fruits of *C. ovata*, and reported that these extracts showed significant anti-inflammatory activity. As *C. ovata* extract is known to contain flavonoids, tannins, and alkaloids, it was stated in that study that these compounds may be responsible for the observed anti-inflammatory effects of *C. ovata* fruits and buds. The study concluded that *C. ovata* could potentially be used as a therapeutic agent for inflammatory diseases. In another study to isolate and elucidate the secondary metabolites responsible for the anti-inflammatory effect of *C. ovata* extracts, triterpenoids isolated from *C. ovata* were found to be moderately potent anti-inflammatory compounds, and these secondary metabolites were considered to be promising therapeutic agents in the treatment of autoimmune diseases.[35] In a study conducted by Taşkın et al.[36] to evaluate the *in vitro* (anti-urease, antioxidant, and anticholinesterase) and *in vivo* (anti-inflammatory) biological activities of caper (*C. ovata* var. canescens), it was shown that although caper has a strong biological activity, it should be taken with caution because of the excess cadmium and iron it contains.

Butanol extract of *C. ovata*, obtained from fermented water extract, is used as an alternative and complementary treatment for multiple sclerosis (MS) in Anatolia because of the anti-neuroinflammatory effect.[37] The potential therapeutic activity of a natural plant steroid, Stigmast-5,22-dien-3b-ol myristate from *C. ovata*, has been tested and found to be a highly promising agent for MS treatment.[38] Nazıroğlu et al.[39] studied the effects of *C. ovata* on lipid peroxidation, antioxidant levels, and electroencephalography recordings in epileptic rats stimulated with pentylenetetrazole (PTZ). In that study, it was stated that *C. ovata* provided protection against PTZ-induced brain oxidative toxicity by supporting the antioxidant redox system.

The results of the present study showed that COSO significantly increased wound healing in full-thickness skin defects in rats. When the results were evaluated statistically, the wound closure rates were determined to be statistically significantly better in the treatment group compared to the control group. In the histopathological examination performed to explain this increase in wound healing, the inflammation scores of the pathological specimens in the treatment group were observed to be statistically significantly lower. The previous detailed studies have reported disruption in the inflammation stage, which is one of the most important stages of wound healing, or that this stage lasts longer than the expected physiological process, which then negatively affects wound healing.[19,20] In the present study, after 14 days of follow-up, there were seen to be fewer inflammatory cells in the treatment group and fibrosis was more prominent. These results indicated that the inflammation phase was completed and the proliferation phase had started in the treatment group earlier than in the control group. These findings can be accepted as an indicator of more positive progress in the proliferation

phase compared to the control group. These results coincide with the wound healing phases which have been described in detail, and it was concluded that the anti-inflammatory effect of caper oil, which has also been shown in previous studies, played a role in this phase not exceeding the physiological process. Therefore, the anti-inflammatory effect of caper oil can also be considered to be effective in controlling the release of ROS which are released into the environment by inflammatory cells migrating to the wound area, and adversely affect wound healing when they reach high levels. In addition, histopathologically, it was shown that epithelization in the treatment group was better developed compared to the control group, as a result of the suitable environment provided in the wound environment.

These results obtained in the present study were in accordance with the results of previous wound healing studies performed using Capri extract.[10,15,16] To investigate the wound healing activity of *C. ovata* var. palaestina fruit extract in mice, *C. ovata* var. palaestina fruit methanol extract-loaded gel formulation was used and was reported to not only show significant antioxidant activity but also antimicrobial activity. In the high-performance liquid chromatography study, the extract was found to have rutin, and rich phenolic and flavonoid contents. It was concluded from the study results that the extract has antioxidant and antimicrobial effects and can, therefore, make a valuable contribution to wound healing. In that study, the *Capparis* extract was also found to be effective on epithelialization, angiogenesis, and granulation tissue thickness, the main parameters important in the evaluation of wound healing, similar to the results of the present study.[15]

Alwan and Ghani[16] investigated the histological effects of another extract, *C. spinosa*, on incisional cutaneous wounds in diabetic rats. Diabetes was induced with a peritoneal injection of a single dose of alloxan (150 mg/kg). Full thickness, 1.5 cm long surgical incisional wounds were created in the cheek skin of the rats. A flavonoid-rich extract of *C. spinosa* was applied daily on the wounds at a dose of 200 mg/kg, and the wounds were evaluated on days 3 and 7. The percentage of wound contraction increased over time in the groups treated with topical *C. spinosa* extract application. The histopathological inflammation indexes were found to be lowest in the groups treated with *C. spinosa* extract and these results were attributed to the anti-inflammatory effects of *C. spinosa*. The epithelial thickness of the skin incisions was recorded at the lowest value on day 3 in all the groups and it was then observed to be increased on day 7 in *C. spinosa* treated groups. These results were consistent with the histopathological findings of the present study.

Conclusion

From the results of this study, it was concluded that caper oil significantly enhances the healing of full-thickness skin wounds and this effect is primarily related to its anti-inflammatory effect. Further studies of *Capparis* oil obtained by different methods will make a significant contribution to the current literature on the subject of accelerated wound healing.

Ethics Committee Approval: This study was approved by the Selcuk University Experimental Medicine Application and Research Center Animal Experiments Ethics Committee (Date: 25.10.2019, Decision No: 2019-49).

Peer-review: Internally peer-reviewed.

Authorship Contributions: Concept: S.C.; Design: K.K., M.Ş.; Supervision: S.C.; Materials: Ü.A.S.; Data: M.E.D., B.Ç., K.K.; Analysis: P.C., S.H., M.K.K.; Literature search: İ.B.; Writing: S.C., İ.B.; Critical revision: K.K., M.Ş.

Conflict of Interest: None declared.

Financial Disclosure: The authors declared that this study has received no financial support.

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DENEYSEL ÇALIŞMA - *ÖZ*

Capparis ovata tohumu yağının travmatik cilt yaralarının iyileşmesi üzerine etkisi

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AMAÇ: *Capparis ovata*, alkaloidler, lipitler, polifenoller ve flavonoidler içerir. Ayrıca antioksidanlar bakımından da zengindir. Türkiye'de geleneksel olarak *Capparis ovata*'nın çiçek tomurcukları, kökü, kabuğu ve meyveleri; analjezik, anti-enflamatuvar, anti-romatizmal, tonik ve idrar söktürücü etkileri için kullanılmaktadır. Bu çalışmanın amacı, antioksidan, anti-enflamatuvar ve antibakteriyel özelliklere sahip olduğu bilinen *Capparis ovata* tohumu yağının yara iyileşmesi üzerindeki etkisini incelemektir.

GEREÇ VE YÖNTEM: Çalışmada 20 adet Wistar-Albino dişi sıçan rastgele olarak 10'ar hayvanlık iki gruba ayrıldı. Sıçanların arka bölgesinde standart bir tam kalınlıkta deri defekti oluşturuldu. Her iki grupta da yaralar günlük olarak serum fizyolojik ile temizlendikten sonra kontrol grubuna serum fizyolojik dışında etken madde uygulanmazken, çalışma grubundaki sıçanların yaralarına 1 cc/gün *Capparis ovata* tohumu yağı uygulandı. Ameliyat sonrası 14. günde sıçanlara tekrar anestezi uygulandı ve yara alanı ölçümleri yapıldı. Daha sonra iyileşmeden kalan yara ve çevresindeki bir santimetrelik sağlam dokuyu içerecek şekilde eksizyon yapıldı ve histopatolojik inceleme için örnekler alındı.

BULGULAR: Yara alanlarındaki değişiklikler, 14 gün sonra kapari yağı ile tedavi edilen gruptaki iyileşmenin (32.78; %95 güven aralığı, 17.21–48.36) kontrol grubuna (65.41; %95 güven aralığı, 49.84–80.98) göre belirgin olarak daha iyi olduğu saptandı (p=0.009). Histopatolojik skorlar, epitel oluşumu, enflamasyon ve fibrozis gelişimi açısından gruplar arasında anlamlı farklılık gösterdi. Kontrol grubunda epitel dokusu oluşumu görülmezken (%90), tedavi grubunda daha fazla re-epitelizasyon ve fokal epidermal hiperplazi (%60) gözlendi. Tedavi grubunda az sayıda lenfosit, plazma hücresi ve dermiste dev hücre enflamasyonu gelişimi (%60), kontrol grubunda ise vasküler proliferasyon, plazma hücreleri, eozinofiller, nötrofiller ve dev hücre enflamasyonu tespit edilmiştir (%50). Kontrol grubunda fibrozis gelişimi hafif ve zayıf (%70), tedavi grubunda ise şiddetli ve yoğun (%60) olarak değerlendirildi. Tedavi grubunda perivasküler ödemin hafif derecede olduğu (%50) ve neovaskülarizasyon göstergesi olarak immatür vaskülarite (%60) bulunduğu gözlendi. Bu histopatolojik sonuçlar, kontrol grubuna göre tedavi grubunda enflamasyon aşamasının tamamlandığını ve proliferasyon aşamasının başladığını göstermesinin yanı sıra kapari yağı kullanımının yara iyileşmesinin değerlendirilmesinde önemli histopatolojik parametreler olan epitelizasyon, anjiyogenez ve fibrozis üzerinde olan etkinliğini kanıtlamıştır.

TARTIŞMA: Bu çalışmanın sonuçlarından, *Caparis ovata* tohumu yağının tam kalınlıktaki deri yaralarının iyileşmesini önemli ölçüde artırdığı ve bu etkinin öncelikle anti-enflamatuvar etkisiyle ilişkili olduğu sonucuna varıldı.

Anahtar sözcükler: Anti-enflamatuvar; cilt; kapari yağı; travmatik; yara iyileşmesi.

Ulus Travma Acil Cerrahi Derg 2022;28(9):1205-1213 doi: 10.14744/tjtes.2021.31526