**Effects of Caper (**Capparis Spinosa**) and Acetic Acid on Lipid Profile and Protein Concentration in the Serum of Albino Mice**

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**Abstract**

This study aimed to determine the effects of alcoholic and aqueous extracts of caper (**Capparis Spinosa**) and acetic acid on serum lipid profile and proteins levels in mice. Sixty adult mice with an average weight of 24±4 g grams were divided into four groups (15 mice for each). The first group (G1) was administrated daily with an oral dose of caper alcoholic extract (200 mg/kg) for 28 days. The second group (G2) was administrated daily with an oral dose of caper aqueous extract (200 mg/kg) for 28 days. The third group (G3) was administrated with a daily dose of 10% acetic acid (2 ml/kg) for 28 days. The fourth Group (G4) was administrated daily with distilled water for 28 days, as a control group. The levels of lipid profile parameters, blood urea, total protein, albumin, and globulin were determined. The results showed a significant reduction ($P \leq 0.05$) in cholesterol and triglyceride levels in mice that were treated with alcohol or aqueous extracts of caper compared with acetic acid-treated and control groups. On the other hands, the results showed a significant reduction ($P \leq 0.05$) of blood urea levels in mice that were treated with alcohol or aqueous extracts of caper compared with acetic acid-treated and control groups. While the results recorded non-significant differences in the levels of total protein, albumin, and globulin in the serum of mice of different treatment groups. From the results, it can be concluded that caper has protective effects via acting to improve the lipid profile and urea level in the blood of mice.

**Keywords:** Caper, Acetic acid, Lipid profile, Protein, Mice

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**تأثير نبات الكبار (**Capparis Spinosa**) وحامض الخليك على مستوى الدهون وتركيز البروتينات في مصل الفئران البيضاء**

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**خلاصة**

هدف هذه الدراسة إلى تقدير تأثير المستخلص الكحولي والمائي لنبات الكبار (**Capparis Spinosa**) وحامض الخليك على مستوى الدهون والبروتينات في مصل الفئران. تم تقسيم 60 فأر بالغ حيث كان وزنها 24

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Introduction

Obesity is a major endemic problem in the world, while coronary artery disease is still the leading cause of global death rates [1]. Atherosclerosis was estimated to be the biggest cause of mortality in world [2]. On the other hand, blood lipids are major risk factors for atherosclerosis and coronary heart disease. Cholesterol, phospholipids, and triglyceride are transported as lipoproteins to other tissues. The main constituents of lipoproteins are chylomicrons, low-density lipoproteins, and high-density lipoproteins [3]. In the liver, lipids are transformed to triacylglycerol then degraded to free fatty acid, while free cholesterol is transformed into very low-density lipoproteins with a variety of apoproteins [4].

Herbal drugs are a significant part of traditional therapy, including the medicinal plants and their bioactive components [5]. Herbal plants are the major source of potential substances with potent pharmacological effects [6, 7]. The Capparidaceae family contains some of the widespread wild aromatic foliage in the arid regions of Asia. Capparis spinosa has been well regarded in various countries as ‘Capers’ [8, 9]. C. spinosa has been revealed to have many bioactivities, such as those of antioxidant, antifungal, antihapatotoxic, anti-inflammatory, antiallergic, and antihistaminic impacts. Also, it is considered as antidiabetic, chondroprotective, hypolipidemic, diuretic, antihypertensive, and antibacterial [10-17]. Acetic acid is a short-chain fatty acid which was reported to exert enhancement roles in the digestion and metabolism processes [18]. An earlier study suggested that acetic acid stimulates the metabolic cascade, contributing to increase lipid oxidation and decrease lipid formation in BRL-3A cells [18]. Another study showed that mice treated with acetic acid had increased lipid oxidation and decreased hepatic triglyceride concentration [19].

Therefore, the present study was conducted to explore the role of caper and acetic acid on the lipid and protein profiles in mice.

Materials and methods

Animals and experimental design

This study was conducted on 60 adult mice with an average weight of 24±4 g grams. Animals were housed in separate cages under the controlled condition of temperature 25±1°C. The standard laboratory ration was given to the control and experimental groups of animals. Mice were divided into four groups (15 mice for each). Mice of the first group (G1) were administrated daily with an oral dose of 200 mg/kg caper (alcohol extract) for 28 days. Mice of the second group (G2) were administrated daily with an oral dose of 200 mg/kg caper (aqueous extract) for 28 days [20, 21]. Mice of the third group (G3) were administrated daily with an oral dose of 2 ml/kg day acetic acid (10%) [22] for 28 days. Mice of the fourth Group (G4) received an oral dosage of 0.1 ml distilled water daily for 28 days, as a control group.

Plant preparation and extraction

Fresh flower of caper were collected from Haditha city, west Iraq. The flower fruits were dried at room temperature, grinded by an electrical grinder to a fine powder, and soaked in distilled water and
ethanol solution (70%) in two containers for three days with continuous shaking. The distilled water and ethanol were filtered by a filter paper and then evaporated by rotary evaporator until dried [23,24].

**Blood samples collection and measurement of parameters**

After 28 days of the experiments, animals were weighed by a sensitive balance and the blood samples were collected via cardiac puncture. The spectrophotometric methods kits (Biolabo, France) were used to measure the levels of cholesterol, triglyceride, urea, total protein, albumin, and globulin in the serum [25].

**Statistical analysis**

Data are illustrated as mean and standard error. The method of one-way ANOVA was applied by using SPSS-25. The least significant differences were used to determine the significant differences between different groups [26].

**Results and discussion**

The results of the current study, as listed in Table-1 and Figure-1, showed a significant (P ≤0.05) decrease in the level of blood cholesterol in the groups administrated with caper (alcohol extract) compared with the other treated groups and the control. The results revealed a significant reduction (P ≤0.05) in the levels of cholesterol and triglyceride of mice treated with alcohol or aqueous extracts of caper compared with acetic acid-treated group and the control. Table-1 shows a significant reduction (P ≤0.05) in the level of blood urea in mice treated with aqueous and alcoholic extracts of caper compared with other treated groups, acetic acid-treated group, and the control group. The results of protein levels, that are illustrated in Table-2 and Figure-2, showed non-significant differences in the levels of total protein, albumin, and globulin in the serum of mice among the different treated groups. Several researchers have found that antioxidants inhibit or maintain the normal lipid profile [27]. Many medicinal plants have antioxidant activities; for example, *C. Spinosa* was reported to have valuable compounds with antioxidant properties [28, 29]. Therefore, the results of the current study supported the protective effects of caper and recorded an improvement in the blood profile. These results agreed with those of earlier studies [30, 31], which recorded that the aqueous extract of caper reduced the levels of blood lipid profile components. Several reasons can explain these results; caper contains many components, such as flavonoids, tocopherols, carotenoids, phenols, polyphenols, glucosinolates, and alkaloid [9 , 32]. It also contains quercetin, rutin, and kaempferol, that have antioxidant and protective effects [33, 34, 35]. On the other hand, caper has anti-oxidant, antimicrobial, cardiovascular, chondroprotective, anti-diabetic, and hypolipidemic activities [31,36]. In addition, the results of protein levels in the current study recorded increased total protein and globulin concentrations, which revealed an improvement of animals’ health and immunity. This might be because caper has components that exert protective roles via acting as anti-inflammatory, anti-histaminic, anti-cytotoxic, immune stimulator, and anti-hepatotoxic [31, 37].

**Conclusions**

From the result of the present study, it can be concluded that caper, especially the alcoholic extract, has hepatoprotective effects and acts to improve the lipid profile and urea level in the blood, ultimately improving the mice health.

**Table 1-** Effects of caper (aqueous and alcoholic extract) as well as acetic acid on blood lipid profile and urea of albino mice

| Treated groups Parameters | Caper alcoholic Extract G1 | Caper aqueous extract G2 | Acetic acid 10% G3 | Control G4 |
|---------------------------|-----------------------------|--------------------------|-------------------|-----------|
| Cholesterol Mg/dl B       | 135.50±8.99                 | 147.50±6.62              | 161.25±6.19       | 156.25±7.31 |
| Triglyceride Mg/dl B      | 77.48±2.83                  | 82.87±1.92               | 88.68±4.01        | 92.61±2.21 |
| Urea Mg/dl B              | 40.55±6.36                  | 44.61±8.90               | 68.12±9.71        | 65.25±1.69 |

The different letters in the raw refer to the significant differences among treatments (p<0.05).
Figure 1- Effects of aqueous and alcoholic extracts of caper on serum lipid and urea concentrations in albino mice

Table 2-Effects of caper aqueous and alcoholic extract as well as acetic acid on protein levels in the serum of albino mice.

| Treated groups Parameters | Caper alcohol extract G1 | Caper aqueous extract G2 | Acetic acid 10% G3 | Control G4 |
|---------------------------|--------------------------|--------------------------|-------------------|-----------|
| Total protein g/l         | 5.65±0.35                | 5.46±0.43                | 6.05±0.33         | 5.42±0.18 |
| Albumin g/l               | 3.67±0.22                | 3.83±0.24                | 4.15±0.22         | 3.87±0.16 |
| Globulin g/l              | 1.97±0.34                | 1.62±0.22                | 1.89±0.30         | 1.64±0.33 |

Figure 2- Effects of the aqueous and alcoholic extracts of caper on serum protein concentrations in albino mice

References
1. Javed, A., Jumean, M., Murad, M.H., Okorodudu, D., Kumar, S., Somers, V.K., Sochor, O. and Lopez-Jimenez, F. 2015. Diagnostic performance of body mass index to identify obesity as
defined by body adiposity in children and adolescents: a systematic review and meta-analysis. Pediatr. Obes. 10:234–244. https://doi.org/10.1111/jupo.242

2. Organization, W. H. 2000. Obesity: preventing and managing the global epidemic. (World Health Organization).

3. Zheng, G., Zhang, Z., Corbin, I. and Chen, J. 2011. High-density lipoprotein-like peptide-phospholipid scaffold (’hpps’) nanoparticles. https://patents.google.com/patent/US2011020242A1/en

4. Maxfield, F. R. and Tabas, I. 2005. Role of cholesterol and lipid organization in disease. Nature 438:612–621. https://www.nature.com/articles/nature04399

5. Acharya, D.and Shrivastava, A. 2008. Indigenous herbal medicines. (Aavishkar Publishers, Distributors. ISBN978-8-7910-252-7.

6. Kalantari, H., Nazari, Z., Keliddar, A., Forouozandeh, H. and Kalantar, M. 2014. Study of the protective effect of liverovl against liver toxicity caused by bromobenzene in mice. Iran. J. Pharm. Sci. 10:11–20. doi: 10.17795/jjppp-37240.

7. Javad-Mousavi, S. A. et al. 2016. Protective effect of Berberis vulgaris fruit extract against Paraquat-induced pulmonary fibrosis in rats. Biomed. Pharmacother. 81 :329–336. https://doi.org /10.1016 /j.biopharma.2016.04.027

8. Azaizeh, H., Fulder, S., Khalil, K. and Said, O. 2003. Ethnobotanical knowledge of local Arab practitioners in the Middle Eastern region. Fitoterapia, 74:98–108. ttps://doi.org /10.1016 /S0367 -326X(02)00285-X

9. Tiili, N. lili, N., Elfalleh, W., Saadaoui, E., Khaldi, A., Triki, S. and Nasri, N. 2011. The caper (Capparis L.): Ethnopharmacology, phytochemical and pharmacological properties. Fitoterapia 82:93–101. https://doi.org/10.1016/j.fitote.2010.09.006

10. Benjelloun, W. 1997. Phytotherapy of hypertension and diabetes in oriental Morocco. J. Ethnopharmacol. 58:45–54. https://doi.org/10.1016/S0378-8741(97)00077-9

11. Ali-Shtayeh, M. S. & Abu Ghdeib, S. I. 1999. Antifungal activity of plant extracts against dermatophytes. Mycoses 42:665–672. https://doi.org/10.1046/j.1439-0507.1999.00499.x

12. Trombetta, D., Occhiuto, F., Perri, D., Puglia, C., Santagati, N.A., Pasquale, A.D., Saija, A. and Bonina, F. 2005. Antiallergic and antihistaminic effect of two extracts of Capparis spinosa L. flowering buds. Phyther. Res. An Int. J. Devoted to Pharmacol. Toxicol. Eval. Nat. Prod. Deriv. 19:29–33. https://doi.org/10.1002/j.f.tiote.201591

13. Germeno M.P., De Pasquale, R., D’angelo, V., Catania, S., Silvari, V. and Costa, C. 2002. Evaluation of extracts and isolated fraction from Capparis spinosa L. buds as an antioxidant source. J. Agric. Food Chem. 50:1168–1171. https://doi.org/10.1021/jf010678d

14. Panico, A.M., Cardile, V., Garufi, F., Puglia, C., Bonina, F. and Ronisivsalle, G. 2005. Protective effect of Capparis spinosa on chondrocytes. Life Sci. 77:2479–2488. https://doi.org /10.1016 /j.lifs.2004.12.051

15. Manikandaselvi, S., Brindha, P. and Vadivel, V. 2018. Pharmacognostic and Pharmacological Studies on Flower Buds of Capparis spinosa L. Int. J. Pharm. Qual. Assur. 9:246–252.

16. Oudah, S. K., Al-Salih, R. M. H., Gusar, S. H. & Roomi, A. B. 2019. Study of The Role of Polyphenolic Extract of Capparis Spinosa L. Leaves as Acute Toxicity and Antibacterial Agent. Plant Arch. 19:3821–3829. http://www.plantarchives.org/19-2/3821-3829%20(5710).pdf

17. Shaker, A. A., Thaker, A. A. and Hussain, A. B. 2018. The effects of capparis spinosa ethanol extracts on humoral immune responses in mice treated with aflatoxin B1. Al-Anbar J. Vet. Sci. 11:37–49. https://doi.org/10.37940/AJVS.2018.11.2.13

18. Li, L., He, M., Xiao, H., Liu, X., Wang, K. and Zhang, Y. 2018. Acetic acid influences BRL-3A cell lipid metabolism via the AMPK signalling pathway. Cellular Physiology and Biochemistry. 45(5): 2021-2030. DOI: 10.1159/000487980.

19. Kondo, T., Kishi, M., Fushimi, T. and Kaga, T. 2009 Acetic acid upregulates the expression of genes for fatty acid oxidation enzymes in liver to suppress body fat accumulation. J Agric Food Chem. 57:5982-5986.

20. Meddour, A., Yahia, M. and Hambaba, L. 2019. Safety evaluation and analgesic studies of defatted methanol extract of Capparis spinosa L.(Capparidaceae) fruits and roots bark in albino wistar rats. J. Biol. Res. della Soc. Ital. di Biol. Sper. 92. https://www. pagepressjournals.org/index.php/jbr/art...
Alrawi et al. Iraqi Journal of Science, 2021, Vol. 62, No. 7, pp: 2163-2168

21. Kalantar, M., Goudarzi, M., Khodayar, M.J., Babaei, J., Forouzandeh, H., Bakhtiar, N. and Alidadi, H. 2016. Protective effects of the hydroalcoholic extract of Capparis spinosa L. against cyclophosphamide-induced nephrotoxicity in mice. Jundishapur J. Nat. Pharm. Prod. 11. DOI: 10.17795/jjpp-37240

22. Beh, B.K., Mohamad, N.E., Yeap, S.K., Ky, H., Boo, S.Y., Chua, J.Y.H., Tan, S.W., Ho, W.Y., Sharifuddin, S.A., Long, K. and Alitheen, N.B. 2017. Anti-obesity and anti-inflammatory effects of synthetic acetic acid vinegar and Nipa vinegar on high-fat-diet-induced obese mice. Sci. Rep. 7: 1–9. https://doi.org/10.1038/s41598-017-06235-7

23. Kalantari, alantari, H., Jalali, M., Jalali, A., Mahdavinia, M., Salimi, A., Juhasz, B., Tosaki, A. and Gesztelyi, R. 2011. Protective effect of Cassia fistula fruit extract against bromobenzene-induced liver injury in mice. Hum. Exp. Toxicol. 30:1039–1044. https://doi.org/10.1177/ 0960327 110386256

24. Salimi, A., Motaharitabar, E., Goudarzi, M., Rezaie, A. and Kalantari, H. 2014. Toxicity evaluation of microemulsion (nano size) of sour cherry kernel extract for the oral bioavailability enhancement. Jundishapur J. Nat. Pharm. Prod. 9:16. doi: 10.17795/jjppp-14370

25. Tietz, N. W. 1999. Clinical guide to laboratory test. Saunders Co.

26. Snedecor GWC, William G. 1989. Statistical Methods/George W. Snedecor And William G. Cochran.

27. Al-jowari A. K. A. S. 2011. Protective Effect of Vitamin E on Acetaminophen–Induced Hyperlipidemia In Female Rabbits. Iraqi J. of Sc., 52(3):300-305. https://www.iasj.net/iasj?funct=article&alid=31814.

28. Alrawi, S. T. J. 2016. The Effect of Nitrate on some Biochemical Parameters of Rabbits and Ameliorate its Effect by Using Vitamin E and Rosemary (Rosmarinus Officinalis). Am. J. Anim. Vet. Sci. 11:145–150. DOI: 10.3844/ajavssp.2016.145.150.

29. Yousuf, H. A., Al-Zubaidi, F. S., & Yousif, W. H. 2014. Study of the interaction effect between parsley petrolsulin crispum and cadmium on lipid profile, lipid peroxidation and catalase activity of albino mice males' liver and kidney. Iraqi J. of Sc.,55(2): 711-721 https://www.iasj.net/iasj?funct=article&alid=91924.

30. Matthäus, B. and Özcan, M. 2005. Glucosinolates and fatty acid, sterol, and tocopherol composition of seed oils from Capparis spinosa Var. spinosa and Capparis ovata Desf. Var. canescens (Coss.) Heywood. J. Agric. Food Chem. 53:7136–7141. https://doi.org/ 10.1021/ jj051019u

31. Edouks, M., Lemhadi, A. and Michel, J.-B. 2005. Hypolipidemic activity of aqueous extract of Capparis spinosa L. in normal and diabetic rats. J. Ethnopharmacol. 98:345–350. https://doi.org/10.1016/j.jep.2005.01.053

32. Brevard, H., Brambilla, M., Chaintreau, A., Marion, J.-P. and Diserens, H. 1992. Occurrence of elemental sulphur in capers (Capparis spinosa L.) and first investigation of the flavour profile. Flavour Fragr. J. 7:313–321. https://doi.org/10.1002/ffj.2730070605

33. Ramezani, Z., Aghel, N. and Keyghobadi, H. 2008. Rutin from different parts of Capparis spinosa growing wild in Khuzestan/Iran. Pak. J. Biol. Sci. 11:768–772. DOI: 10.3923/pjbs.2008.768.772

34. Moghaddasian, B., Eradatmand, A. D. and Alaghemand, A. 2013. Simultaneous determination of rutin and quercetin in different parts of Capparis spinosa. Bull Env. Pharmacol Life Sci 2:35–38. http://www.bepls.com/jan_2013/9/pdf

35. Kianersi, F., Abdollahi, M. R., Mirzaie-asl, A., Dastan, D. and Rasheed, F. 2020. Biosynthesis of rutin changes in Capparis spinosa due to altered expression of its pathway genes under elicitors’ supplementation. Plant Cell, Tissue Organ Cult. 1–13. https://doi.org/10.1007/s11240-020-01823-4

36. Sonmezdag, A. S., Kelebek, H. and Selli, S. 2019. Characterization of Aroma-Active Compounds, Phenolics, and Antioxidant Properties in Fresh and Fermented Capers (Capparis spinosa) by GC-MS-Olfactometry and LC-DAD-ESI-MS/MS. J. Food Sci. 84:2449–2457. https://doi.org/ 10.1111/1750-3841.14777

37. Inocencio, C., Alcaraz, F., Calderón, F., Obón, C. and Rivera, D. 2002. The use of floral characters in Capparis sect. Capparis to determine the botanical and geographical origin of capers. Eur. Food Res. Technol. 214:335–339. https://doi.org/10.1007/s00217-001-0465-y