Translational Research Urology

Home Page: www.transresurology.com

Original Article

Investigating the Anti Urinary Tract Infection Effect of Cornu's Mas Extract in the Rat

Fateme Guitynavard[1], Hedieh Moradi Tabriz[2], Ali Samadi[3], Seyed Aboozar Jazayeri[4], Mehdi Fasihi Ramandi[1], Akram Mirzaei[1], Mahdi Khoshchehreh[5], Vahid Abedi [1*]

[1]*Urology Research Center, Tehran University of Medical Sciences, Tehran, Iran*

[2] *Department of Pathology, Sina Hospital, Tehran University of Medical Sciences, Tehran, Iran*

[3]*Department of Genetics and Molecular Medicine, Faculty of Medicine, Zanjan University of Medical Sciences, Zanjan, Iran*

[4]*Tehran University of Medical Sciences, Tehran, Iran*

[5]*Department of Pathology, University of California, Los Angeles, USA*

HIGHLIGHTS

- The *Cornus mas* extract can be a gifted potential substitute for antibiotics in treating UTI in rat models.
- The *Cornus mas* has anti-inflammatory effects in bladder.
- Urinary tract infection (UTI) usually requires antibiotics for treatment and occasionally herbal medicine.

ARTICLE INFO

Receive Date: 30 June 2021
Accept Date: 03 July 2021
Avaliable online: 11 July 2021
DOI: 10.22034/TRU.2021.292974.1071

***Corresponding author:**
Vahid Abedi
Tel: (+9821) 6634 8560
Fax: (+9821) 6634 8561
Email: drvahidabedi@gmail.com
Mailing Address: Urology Research Center (URC), Sina Hospital, Hassan Abad Sq., Tehran,Iran.

ABSTRACT

Introduction
Urinary tract infection (UTI) is a common bacterial infection and usually requires antibiotics for treatment. But the antibiotic resistance is always a serious concern. So, developing some alternative medication strategies such as herbal medicine is an extreme need. Several studies have confirmed the prophylactic and also therapeutic effects of a variety of anthocyanin-containing berries for UTIs. *Cornus mas* which is native to Southern Europe and Southwestern Asia is also rich in anthocyanin but its effect on UTI has been not yet studied. This study aims to evaluate the effect of *Cornus mas* extract in treating UTI in rat models**.**

Methods
After inducing UTI in 18 Wistar rats, they were sub-grouped into three groups: control group, nitrofurantoin treated group (case I) and *Cornus mas* treated group (case II). After seven days of treatment, the UTI indicators like fever, microscopic analysis of urine, and pathological examination of the bladder were investigated.

Results
Actually, UTI indicators were resolved after treatment in both treated groups (nitrofurantoin and case II). Comparison of the results between the control group and the other three groups confirmed the development of UTI in the rat model. Clinical, laboratory and pathologic results proposed that the *Cornus mas* extract effects in treating UTI are not inferior to that of nitrofurantoin.

Conclusions
In addition to its anti-inflammatory effects, *Cornus mas* extract can be a gifted potential substitute for antibiotics in treating UTI in rat models.

Keywords: Cystitis; Urinary Tract Infection; Cornus Mas; Animal Model

Introduction

Urinary tract infections (UTIs) are common bacterial infections (1). Escherichia coli (*E.coli*) is the most common uropathogenic (80%) isolated in acute urinary tract infections (2). Some risk factors increase the risk of UTI and interstitial cystitides like kidney stones and urogenital malignancies (3-5). Several antibiotics such as nitrofurantoin, trimethoprim-sulfamethoxazole, and fluoroquinolones are considered for the treatment of UTI (3, 6). There are some complications like *E. coli* resistance

to the antibiotic that can consequence in chronic untreated cystitis. It can be considered especially for trimethoprim (alone and in combination with sulfamethoxazole) and fluoroquinolones with resistance rates of 15–45% and 10–20%, respectively (7). So there is an extreme interest to find a suitable herbal medicine component which can take the place of antibiotic in UTI treatment (8). Several studies indicated that some berries such as cranberry, contain anthocyanins, as an effective anti-cystitis component, so can treat UTI (9-11). *Cornus mas* or cornelian cherry is a bear edible fruit that is native to Southern Europe and Southwestern Asia. In Iran, *Cornus mas* grows in Arasbaran (East Azerbaijan, Iran) and its antioxidant capacity, total anthocyanins, total phenols, ascorbic acid, and total flavonoids of several selected cornelian cherry genotypes have been investigated (12). It is shown that anthocyanins present in *Cornus mas*, are delphinidin 3-O-β-galactopyranoside (I), cyanidin 3-O-β-galactopyranoside (II), and pelargonidin 3-O-β-galactopyranoside (III) (13-15). Several studies showed the benefits of anthocyanins as the main component of *Cornus mas* in treatment of several conditions like cardiovascular diseases, atherosclerosis, inflammation, and cancers (16-19). Despite several reported efficacies for berries family in UTI, the potential effects of *Cornus mas* in treating UTI has not been studied yet. In the present study we investigated the role of *Cornus mas* extract in treatment of bacterial cystitis in rat models.

Methods

All experimental procedures were performed following institutional guidelines for animal studies of Tehran University of Medical Sciences and the protocol was approved by the Tehran University of Medical Sciences ethical committee (*IR.TUMS.SINAHOSPITAL.REC.1399.021*). Female Wistar rats (150–300 g) were individually housed and maintained under an inverted 12-h light/dark cycle (lights on at 17:00 h), the temperature of 22 ± 2°C, and humidity of 22%. Water and standard rodent diet were provided ad libitum. The present study was designed to use the minimum number of the rat. In this study, 24 Wistar rats that were infected by *E. coli* were allocated into the four groups based on the intervention: control (infected with *E. coli*), normal, treated with an antibiotic (case I), and treated with *Cornus mas* extract (case II). Wistar rats were kept in 4 cages in 6 columns. All the rats were female at 3 to 4 weeks of age. All rats were housed in plastic cages sized 32 × 19 × 17 cm3 and maintained in a controlled environment for five days before any intervention. Initially, all four groups were stained yellow for ease of detection. The control group was identified by their yellow waist; the normal group was identified by their yellow abdomen; group 3 was identified by their yellow hands; group 4 was identified by their yellow feet. One mouse from each group was sacrificed by carbon dioxide (CO2) and was sent for microscopic analysis of urine and pathologic examination of the bladder wall. Two days before the treatment initiation, 0/1 ml Ketamine 5% was injected intraperitoneally with an insulin needle (Needle size: <21 Ga). After 10 minutes, the rats became numb, then the E. coli (0.5 McFarland) was injected through the urethra with a gavage syringe to catch cystitis. The antibiogram was performed to confirm the sensitivity of *E. coli* to nitrofurantoin and to determine the concentration of nitrofurantoin. To confirm the presence of cystitis, after 24 hours one mouse from each group was randomly chosen and immediately sacrificed by carbon dioxide (CO2). Rat's bladder tissues were sent to the pathology department for examination. A urine test was performed to confirm the urinary tract infection.

Fever, stool loosening, hematuria, and urine color change were observed as the cystitis indicator. One of the most common observations after *E. coli* infection was hair loss in rats. To compare the effect of *Cornus mas* extract with nitrofurantoin in the treatment of bacterial cystitis, after infection confirmation, treatment was started by gavage of the nitrofurantoin and *Cornus mas* for the two target groups for 7 days (Figure 1).

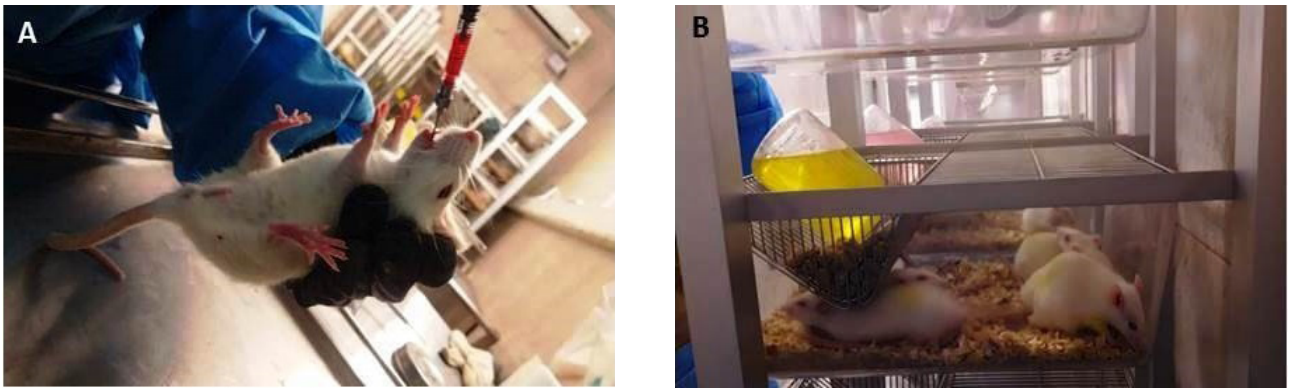

Figure 1. Both *Cornus mas* and Nitrofurantoin were gavages (A), and mixed for daily consumption through their drinking water (B).

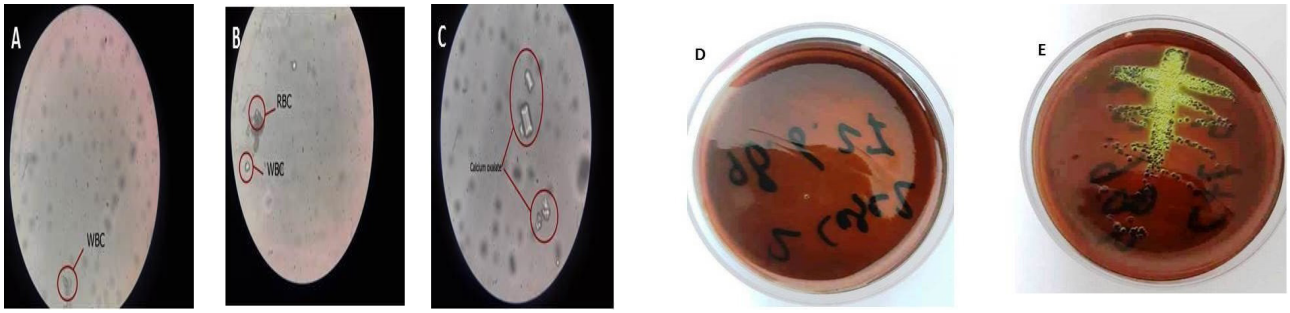

Figure 2. Confirmation result of cystitis. Microscopic analysis of urine indicates the presence of RBS (B) and calcium oxalate crystals (C) in the infected rat in comparison to the non-infected ones (A). Microbial testing confirmed the presence of E. coli in infected groups (E) in comparison with non-infected rats (D).

Table1. Several temperatures of the normal group (with no intervention and no infection) over seven days

Normal	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
1	36.5	36	37	37	36.5	36.5	36
2	37.2	36.5	36.8	37.2	36	37	35.6
3	36	36	37	37	36.2	36.5	37
4	37	36	37.5	37	36.5	36	37
5	37	36	37	37	37	37	36.7

Table 2. Several temperatures of Cornus mas group over seven days

Coronus mas' treatment	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
1	38.5	37.7	38.5	37.5	37	37	37.5
2	38	38	38	37	37.2	37.5	37
3	38	38	38.4	38.5	38	37	38
4	38	38	38.2	37.5	37.5	37.5	37
5	38	38.5	38	38.5	36.5	36.5	37

Table 3. Several temperatures of antibiotic group over seven days

Antibiotic treatment	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
1	38.2	38	39	37.5	36.5	37	37
2	38.4	38	38	38	37	37.5	37
3	38	38.5	38	38.5	37.5	37	37
4	38.2	37.2	38.5	38.8	37	37.5	36.5
5	38.1	38.3	38.1	39	37.5	37.5	37

Table 4. Several temperatures of the control group (infected with E. coli with no treatment) over seven days

Control	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
1	38	38	38.7	38	38.5	38.5	38.5
2	38.3	38	38.5	38	38	38.5	38.5
3	38	38.5	38	38.7	38.5	38.5	38.5
4	38	38.8	38	38	38	39	38
5	38.5	39	38	38	38.5	38	38

On the first day before injection, the body temperature of all 3 groups of infected rats was measured. The mean body temperature of rats control, case I and case II on the first day of injection were 36.85 ° C, 38.1 ° C, and 38.5° C, respectively.

For the case I group, half of the nitrofurantoin (500mg) tablet was dissolved in 15 ml distilled water and about 500 microliters (=8.5mg/kg) gavage once a day into the pharynx of rats. In addition, one and a half pills were dissolved daily in the rat's water flask for daily consumption through drinking water.

For the case II group, 15ml of *Cornus mas* extract dissolved in 500cc water and 500 microliters of it were gavage into the rat's pharynx every day (once a day). Additionally, 15mg of *Cornus mas* with 500 ml water were mixed for daily consumption through their drinking water.

The same procedure was done for the control group but just with normal slain.

Results

Our findings showed that after the injection of *E. coli* cystitis successfully developed in the rat. Microscopic analysis of urine, microbial *E. coli* test, and pathologic examination all confirmed that target rats in three target groups are infected correctly (Figure 2). All infected rats experienced hematuria, fever, stool loosening, urine color change to light pink, and opaque urine that were all considered as cystitis indicators.

The body temperature of all rats was measured by thermometer under the mouse arm for 3 minutes and charted before and after infection and also during seven days of treatment (Tables 1–4). Chart of body temperature indicates an increase in temperature after infection.

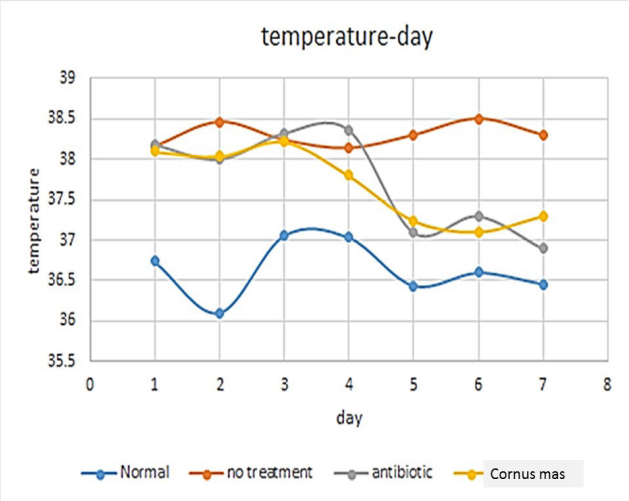

Figure 3. The temperature change of all four groups over seven days

Table 5. Means of temperature in all groups over seven days

Group name	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Mean total
Normal	36.8	36.1	37.0	37.0	36.4	36.6	36.4	36.6
Control	38.2	38.4	38.2	38.1	38.3	38.5	38.3	38.3
Antibiotic	38.2	38	38.3	38.3	37.1	37.3	36.9	37.7
Cranberry	38.1	38.0	38.2	37.8	37.2	37.1	37.3	37.7

In the three infected groups the fever can be seen compared to the normal group and after treatment the body temperature decrease in both treatment groups versus the control group which is infected but not treated (Table 5). Treatment with *Cornus mas* and Nitrofurantoin decreases the body temperature day by day (Figure 3).

Two days after *E.coli* injection to the rat bladder in three groups of control, case I, and case II the performed histopathological analysis confirmed their cystitis (Figure 4). At the end of the 7th day of treatment, rats were sacrificed and their bladders were sent for pathologic exam to check the inflammation (Figure 4). At the end of the 7th day of treatment, the problem of hematuria was resolved in both cases I and case II groups. *Coronus mas* and nitrofurantoin, both could treat bacterial cystitis but the temperature in the *Cornus mas* treated group reduced faster.

The therapeutic effect of *Cornus mas* on bacterial cystitis was also confirmed pathologically.

Pathologic examination of the rat's bladder wall reported no significant inflammation or another abnormal urothelial finding in the control group but severe acute inflammation compatible with bacterial cystitis in the control group.

For *Coronus mas* treated group, reports were suggestive of mild edema and mild epithelial reactive changes but no significant inflammation was detected.

For the nitrofurantoin treated group, results showed mild edema and mild epithelial reactive change but no significant inflammation was reported.

According to the results of the pathology examination, it can be claimed that treatment with *Cornus mas* has a non-inferior efficacy in treating bacterial cystitis in comparison to that of nitrofurantoin.

Discussion

Antimicrobial resistance has remained one of the most important challenges in treating UTI, so developing alternative drugs is an extreme need. Herbal medicine can potentially propose important medication for uncomplicated recurrent UTI with both prophylactic and therapeutic effects (20). Several indications for the Anti-inflammatory and antimicrobial effects of anthocyanin extracted from berries have been suggested (10). RG Jepson, et al, in 2007 represent some beneficial effects of cranberries and blueberries in UTI prevention through a systematic review study (21). They showed that symptomatic UTIs over 12 months, particularly in women with recurrent UTIs can be treated with cranberry. Based on the EAU guidelines on urological infections 2019 cranberry is suggested in the prevention of recurrent UTI (22). Limited studies have suggested that cranberry is useful in reducing the rate of lower UTIs in women (23, 24). However, a meta-analysis including 24 studies and comprising 4,473 participants showed that current cranberry products did not significantly reduce the occurrence of symptomatic UTI for women with recurrent UTIs (25). Based on the EAU guidelines on urological infections 2019, daily consumption of cranberry is not recommended in the prevention of UTI (22).

Cornus mas is an Iranian's native plant containing anthocyanin, so its extract potentially has anti-infection properties. Our results confirmed the therapeutic efficacy of *Cornus mas* which is not inferior to nitrofurantoin. Similarly, in 2015 A Milenković-Anđelković and his colleagues showed the anthocyanin content and its bioactivity in cornelian cherry (Cornus mas) (23).

There are some recommendations over the anthocyanin

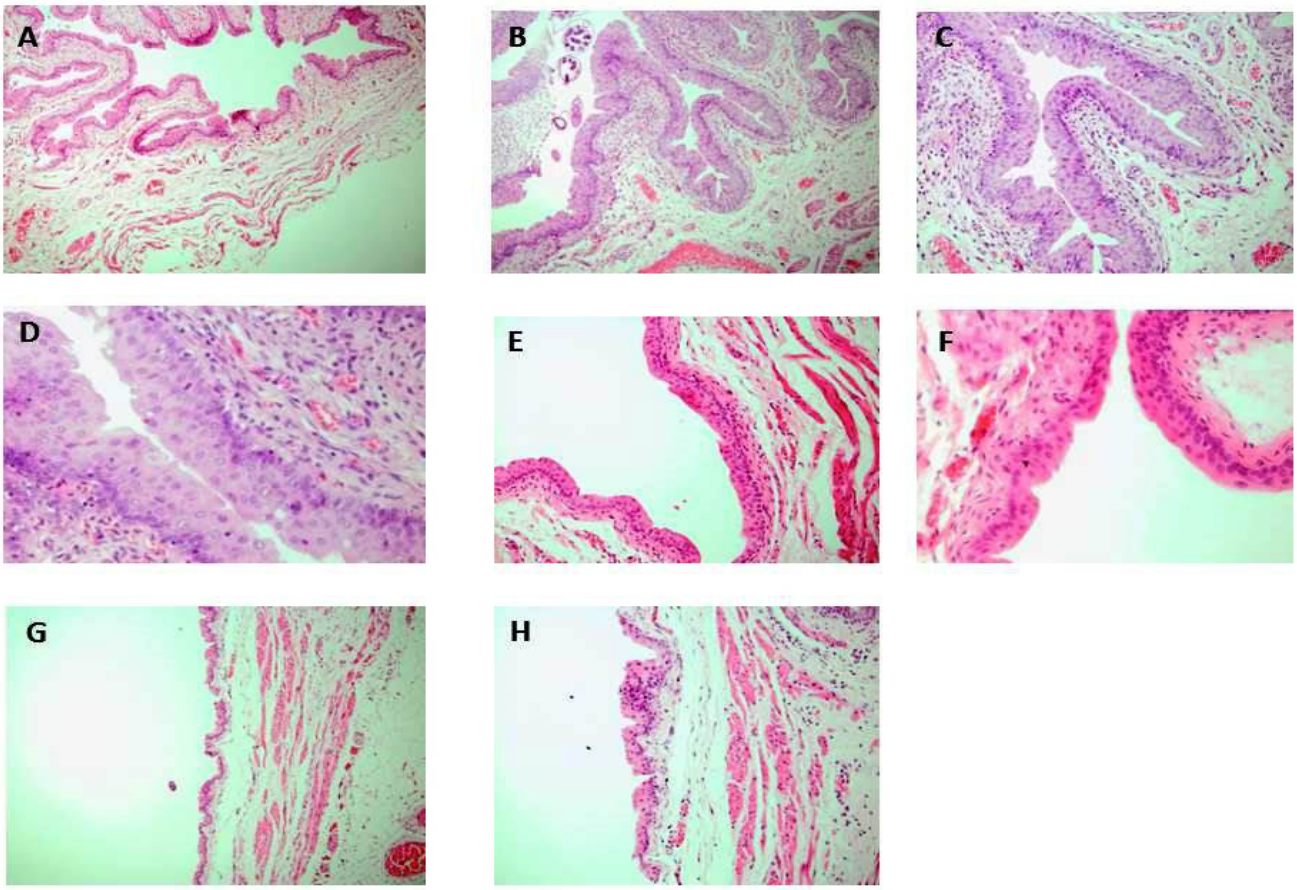

Figure 4. Pathological result of rat's urothelial mucosa. A) Normal bladder tissue (no infection and no treatment) 10X Magnification, no significant inflammation or urothelial abnormal findings can be seen. Bladder urothelium in the control group, infected with E.coli, with severe acute inflammation compatible with bacterial cystitis (B, C, and D referred to 10X/20X/40X). Coronus mas treated group (E: 10 X, F: 20X) with mild edema and mild urothelial reactive change but no significant inflammation. Nitrofurantoin treated group with mild edema and mild urothelial reactive change but no significant inflammation (G (10X), H (20X)).

including berries ingestion to decline the incidence of UTIs, predominantly in patients with recurrent urinary tract infections (26). It can decrease the administration of antibiotics as well, which could be beneficial since antibiotics can direct to the worldwide emergence of antibiotic-resistant microorganisms. The anthocyanin including berries metabolites might be organic acids such as hippuric acid which act as an antimicrobial via acidifying the urine (27, 28). Our results showed the consumption of *Cornus mas* successfully decreased rat's mean core temperature similar to the nitrofurantoin group. However, the rat core temperature in the cranberry group had started to decrease earlier. Our study results showed that the *Cornus mas* treated groups' mean temperature started to decrease on day 3 while the nitrofurantoin effects were revealed after 4 days. However, in both groups (case I and case II) the mean temperature returned to normal by 7th day.

Several studies on different animal models assessed the prophylactic effect of anthocyanin including berries. A study on the rat model of UTI reported that anthocyanin can decrease bacterial counts in the bladder however it cannot resolve the infection. They recommended cranberry might be useful as an adjuvant for antibiotic treatment (27).

Based on our results, pathology reports for the *Cornus mas* treated group were consistent with that of antibiotic-treated group; in both significant decrease of inflammation in comparison to baseline and control group were seen. In traditional medicine, the *Cornus mas* is suggested for the treatment of diarrhea, inflammatory bowel disease, fever (29).

Ibrahim et al reported similar results with cranberry (25). They found that cranberry methanol extracts were effective in treating *E Coli* induced UTI in rats compared to gentamicin.

However, in a study on Spinal cord injured dogs with UTI, the authors found no significant prophylactic effect for cranberry, which might be a result of insufficient cranberry extract dose in dog models (30).

Due to these controversies about the prophylactic and therapeutic effects of anthocyanin-rich fruit/extract, and

also the necessity of preventing bacterial resistance, it is wise to conduct further well-designed RCTs.

Conclusions

Our findings indicated that *Cornus mas* as an Iranian anthocyanin-containing fruit can be a useful substitute for antibiotics as an effective treatment of urinary tract infection.

Authors' contributions

All authors contributed equally.

Acknowledgments

Special thanks to Sina hospital to facilitate the gathering of data, Tehran University of Medical Sciences, Tehran, Iran.

Conflict of interest

All authors claim that they do not have any conflict of interest.

Funding

There was no founding.

Ethics statement

All experimental procedures were performed following institutional guidelines for animal studies of Tehran University of Medical Sciences and the protocol was approved by the Tehran University of Medical Sciences ethical committee (*IR.TUMS.SINAHOSPITAL.REC.1399.021*.)

Data availability

Data will be provided by the corresponding author on request.

Abbreviations

CO2	Carbon dioxide
E. Coli	Escherichia coli
UTIs	Urinary tract infections

References

1. Foxman B. The epidemiology of urinary tract infection. Nature Reviews Urology. 2010;7(12):653.
2. Hoberman A, Chao H-P, Keller DM, Hickey R, Davis HW, Ellis D. Prevalence of urinary tract infection in febrile infants. The Journal of pediatrics. 1993;123(1):17-23.
3. Aghamir SMK, Hamidi M, Salavati A, Mohammadi A, Farahmand H, Meysamie AP, et al. Is antibiotic prophylaxis necessary in patients undergoing ureterolithotripsy? Acta Medica Iranica. 2011:513-6.
4. Aghamir SMK, Heshmat R, Ebrahimi M, Khatami F. Liquid biopsy: the unique test for chasing the genetics of solid tumors. Epigenetics insights. 2020;13:2516865720904052.
5. Aghamir SMK, Heshmat R, Ebrahimi M, Ketabchi SE, Dizaji SP, Khatami F. The impact of succinate dehydrogenase gene (SDH) mutations in renal cell carcinoma (RCC): A systematic review. OncoTargets and therapy. 2019;12:7929.
6. Hooton TM. Uncomplicated urinary tract infection. New England Journal of Medicine. 2012;366(11):1028-37.
7. Sundqvist M, Kahlmeter G. Uncomplicated and community acquired urinary tract infections: aetiology and resistence. Urogenital Infections. 2010:72-81.
8. Flower A, Wang LQ, Lewith G, Liu JP, Li Q. Chinese herbal medicine for treating recurrent urinary tract infections in women. Cochrane Database of Systematic Reviews. 2015(6).
9. Micali S, Isgro G, Bianchi G, Miceli N, Calapai G, Navarra M. Cranberry and recurrent cystitis: more than marketing? Critical reviews in food science and nutrition. 2014;54(8):1063-75.
10. Hisano M, Bruschini H, Nicodemo AC, Srougi M. Cranberries and lower urinary tract infection prevention. Clinics. 2012;67(6):661-8.
11. Khatami F, Guitynavard F. Cornus Mas and Urinary Tract Infections Treatment. Translational Research Urology. 2020;2(1):9-11.
12. Hassanpour H, Yousef H, Jafar H, Mohammad A. Antioxidant capacity and phytochemical properties of cornelian cherry (Cornus mas L.) genotypes in Iran. Scientia Horticulturae. 2011;129(3):459-63.
13. Seeram NP, Schutzki R, Chandra A, Nair MG. Characterization, quantification, and bioactivities of anthocyanins in Cornus species. Journal of agricultural and food chemistry. 2002;50(9):2519-23.
14. Kucharska AZ, Szumny A, Sokół-Łętowska A, Piórecki N, Klymenko SV. Iridoids and anthocyanins in cornelian cherry (Cornus mas L.) cultivars. Journal of Food Composition and Analysis. 2015;40:95-102.
15. Narouie B, Mirzaei A. Efficacy of Additional Solifenacin Succinate Therapy in Females with Urinary Tract Infection. Translational Research Urology. 2019;1(1):40-2.
16. Sozański T, Kucharska AZ, Rapak A, Szumny D, Trocha M, Merwid-Ląd A, et al. Iridoid–loganic acid versus anthocyanins from the Cornus mas fruits (cornelian cherry): common and different effects on diet-induced atherosclerosis, PPARs expression and inflammation. Atherosclerosis. 2016;254:151-60.
17. Yilmaz KU, Ercisli S, Zengin Y, Sengul M, Kafkas EY. Preliminary characterisation of cornelian cherry (Cornus mas L.) genotypes for their physico-chemical properties. Food Chemistry. 2009;114(2):408-12.
18. Radbeh Z, Asefi N, Hamishehkar H, Roufegarinejad L, Pezeshki A. Novel carriers ensuring enhanced anti-cancer activity of Cornus mas (cornelian cherry) bioactive compounds. Biomedicine & Pharmacotherapy. 2020;125:109906.
19. Yilmaz S, Alpa Ş, Nisari M, ŞEKER KARATOPRAK G, ÜLGER H, ERTEKİN T. Examining the antitumoral effect of cornelian cherry (Cornus mas) in ehrlich ascites tumor-induced mice. 2019.
20. Yu C, Yang B. Traditional Chinese Medicine. Female Urinary Tract Infections in Clinical Practice: Springer; 2020. p. 61-7.
21. Jepson RG, Craig JC. A systematic review of the evidence for cranberries and blueberries in UTI prevention. Molecular nutrition & food research. 2007;51(6):738-45.
22. Bonkat G, Pickard R, Bartoletti R, Bruyère F, Geerlings S, Wa-

genlehner F. EAU Guidelines on Urological Infections, 2019. Google Scholar. 2015:33.
23. Milenković-Anđelković A, Radovanović B, Anđelković M, Radovanović A, Nikolić V, Ranđelović V. The anthocyanin content and bioactivity of cornelian cherry (Cornus mas) and wild blackberry (Rubus fruticosus): Fruit extracts from the Vlasina region. Advanced technologies. 2015;4(2):26-31.
24. Jepson RG, Williams G, Craig JC. Cranberries for preventing urinary tract infections. Cochrane database of systematic reviews. 2012(10).
25. Jepson RG, Williams G, Craig JC. Cranberries for preventing urinary tract infections. The Cochrane database of systematic reviews. 2012;10(10):Cd001321.
26. Luís Â, Domingues F, Pereira L. Can cranberries contribute to reduce the incidence of urinary tract infections? A systematic review with meta-analysis and trial sequential analysis of clinical trials. The Journal of urology. 2017;198(3):614-21.
27. Jensen HD, Struve C, Christensen SB, Krogfelt KA. Cranberry juice and combinations of its organic acids are effective against experimental urinary tract infection. Frontiers in microbiology. 2017;8:542.
28. Jafari Shahdani MR, Fattahi B, Mohseni MG, Aghamir SMK. Comparison of Mini-perc and Retrograde Intrarenal Surgery in Residual Stone Fragments with Hounsfield Unit after Percutaneous Nephrolithotomy. Translational Research Urology. 2021;3(2):40-4.
29. Asgary S, Kelishadi R, Rafieian-Kopaei M, Najafi S, Najafi M, Sahebkar A. Investigation of the lipid-modifying and antiinflammatory effects of Cornus mas L. supplementation on dyslipidemic children and adolescents. Pediatric cardiology. 2013;34(7):1729-35.
30. Olby N, Vaden S, Williams K, Griffith E, Harris T, Mariani C, et al. Effect of cranberry extract on the frequency of bacteriuria in dogs with acute thoracolumbar disk herniation: A randomized controlled clinical trial. Journal of veterinary internal medicine. 2017;31(1):60-8.

Author (s) biosketches

Guitynavard F, Assistant Professor**,** Urology Research Center,Sina Hospital, Tehran University of Medical Sciences, Tehran, Iran.
Email: f_guitynavard@ymail.com

Moradi Tabriz H, Assistant Professor**,** Department of Pathology, Sina Hospital, Tehran University of Medical Sciences, Tehran, Iran
Email: hmoradi@tums.ac.ir

Samadi A, MD**,** Department of Genetics and Molecular Medicine, Faculty of Medicine, Zanjan University of Medical Science, Zanjan, Iran
Email: a.samadi99@yahoo.com

Jazayeri SA, PhD, Tehran University of Medical Sciences, Tehran, Iran.
Email: aboozarjazayeri@yahoo.com

Fasihi Ramandi M, Associate Professore, Molecular Biology Research Center, Baqiyatallah University of Medical Sciences, Tehran, Iran.
Email: fasihi.m@bmsu.ac.ir

Mirzaei A, PhD, Urology Research Center, Tehran University of Medical Sciences, Tehran, Iran.
Email: mirzaee.scholar@gmail.com

Khoshchehreh M, MD, Department of Pathology, University of California, Los Angeles, USA
Email: mkhoshchehreh@mednet.ucla.edu

Abedi V, Assistant Professor**,** Urology Research Center,Sina Hospital, Tehran University of Medical Sciences, Tehran, Iran.
Email:drvahidabedi@gmail.com

How to cite this article
Guitynavard F, Moradi tabriz H, Samadi A, Jazayeri SA, Fasihi Ramandi M, Mirzaei A, Khoshchehreh M,Abedi V. Investigating the Anti Urinary Tract Infection Effect of Cornu's Mas Extract in the Rat. Translational Research in Urology. 2021 July;3(2): 67-73.
DOI: 10.22034/TRU.2021.292974.1071
URL: https://www.transresurology.com/article_132945.html