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Resveratrol's Renal Defense: Activating HSP70 Expression for Kidney Protection in Uremic Rats

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Abstract

The serum creatinine and urea nitrogen levels were detected by Automatic Biochemical Analyzer. The pathological changes of renal tissues and the renal interstitial fibrosis were analyzed by hematoxylin-eosin and Masson, respectively. The expression of HSP70 protein in renal tissues was detected by immunohistochemistry. The expression of HSP70 and NF-κB pathway-related proteins were detected by Western blot. To further validate the protective role of resveratrol through activating HSP70 in uremic rats, HSP70 activator and HSP70 inhibitor group were used. Results. In the model group, the levels of Cr and BUN in serum were significantly increased, and the renal interstitial collagen deposition was also obviously increased. Compared with the model group, the levels of Cr and BUN in different doses of resveratrol groups were remarkably declined, and the renal interstitial collagen deposition was declined . Resveratrol also significantly improved the renal tissue lesions when compared with the model group. In renal tissues, different doses of resveratrol treatment remarkably raised HSP70 and p-IκBα expression and also remarkably declined the level of p-P65 protein. Meanwhile, the effect of 17-AAG was similar to 20 mg/kg resveratrol on NF-κB pathway-related proteins expression. After the added MKT-077 in the resveratrol treatment group, the levels of HSP70 and p-IκBα in the renal tissue were remarkably declined; however, the levels of p-P65 protein was remarkably raised. Conclusion. Resveratrol played a protective role on the kidney of uremic rats through activating HSP70 expression.

Keywords: Resveratrol; Kidney protection; HSP70 expression; Chronic kidney disease; Oxidative stress; Heat shock proteins

Introduction

Chronic kidney disease is a global health concern, affecting millions of people worldwide. One of the most severe complications of CKD is uremia, a condition characterized by the accumulation of toxins and waste products in the bloodstream due to impaired kidney function. Uremia can lead to kidney damage, inflammation, oxidative stress, and ultimately, organ failure. In recent years, researchers have turned their attention to natural compounds with potential therapeutic effects on renal health. One such compound is resveratrol, a polyphenol found in red grapes, berries, and various plants. Emerging evidence suggests that resveratrol may offer significant protection against kidney damage in uremic rats through the activation of Heat Shock Protein 70 expression [1, 2]. This dire condition sets the stage for a cascade of renal malfunctions, including inflammation, oxidative stress, and the ominous threat of organ failure. In the quest for innovative therapies, the spotlight has turned towards natural compounds that hold the potential to extend a lifeline to renal health. Among these contenders, resveratrol, a potent polyphenol found in nature's bounty of red grapes, berries, and an array of plants, emerges as a compelling candidate. Recent scientific inquiries have unveiled a remarkable facet of resveratrol's arsenal – its capacity to bestow robust protection against kidney impairment in uremic rats through the orchestrated activation of Heat Shock Protein 70 expression.

Heat Shock Proteins, an ancient and vital class of proteins, offer a safeguarding embrace to cells grappling with the rigors of stress and adversity. With a choreography of precision, these proteins rally the cellular troops to a defense posture, offering a robust shield against the onslaught of oxidative stress, inflammation, and cellular trauma. Among the cast of HSPs, HSP70 emerges as a sentinel of cell survival, adeptly orchestrating repair mechanisms, assuaging protein aggregation, and orchestrating cellular revival in the crucible of stress. Its potential to rewrite the script of renal health has led researchers to contemplate its role in mitigating kidney damage, underscoring its candidacy as an object of therapeutic interest [3].

Resveratrol, celebrated for its antioxidant prowess, anti-inflammatory might, and whispers of anti-aging mystique, has etched its name on the scroll of natural wonders. Its reputation as a herald of wellbeing extends to cardiovascular fortitude, neuroprotection, and even the containment of certain malignancies. As science and medicine continue their pas de deux, resveratrol's entrée into the arena of kidney health has sparked intrigue and anticipation.

The role of heat shock proteins

Heat Shock Proteins are a group of highly conserved proteins that play a crucial role in cellular protection and repair mechanisms. These proteins are induced in response to various stressors, including oxidative stress, inflammation, and cellular damage. Among them, HSP70 has garnered particular attention for its ability to modulate cell survival, prevent protein aggregation, and facilitate cellular recovery under stressful conditions. Given its potential protective role, researchers have explored the impact of HSP70 in mitigating kidney damage, making it an intriguing target for potential therapeutic interventions [4].

Resveratrol and kidney health

Resveratrol has gained popularity as a potential health-promoting compound, largely due to its antioxidant, anti-inflammatory, and anti-aging properties. Numerous studies have indicated that resveratrol can confer protection against various diseases, including cardiovascular

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disorders, neurodegenerative conditions, and certain types of cancer. More recently, researchers have investigated its potential in safeguarding kidney health [5].

Uremic rats and resveratrol intervention

A study published in the journal "Kidney & Blood Pressure Research" explored the potential of resveratrol to protect the kidneys of uremic rats by activating HSP70 expression. Uremia was induced in laboratory rats through surgical removal of a portion of their kidney tissue, simulating the conditions observed in advanced CKD patients. The rats were then treated with resveratrol, and the effects on kidney function and histology were assessed [6].

Key findings

The study's results were promising. Rats treated with resveratrol exhibited improved kidney function compared to the untreated group. This improvement was attributed to the activation of HSP70, which played a pivotal role in preventing cellular damage and inflammation. Resveratrol's antioxidant properties were also believed to contribute to its protective effects, as oxidative stress is a major driver of kidney injury in uremic conditions [].

Mechanisms of action

Resveratrol's activation of HSP70 involves intricate cellular signaling pathways. It is suggested that resveratrol triggers the activation of specific genes involved in the HSP70 response, leading to increased expression of the protein. This, in turn, enhances the cellular stress response, reduces cellular damage, and promotes kidney cell survival.

Discussion

In mice, however, it has been shown that resveratrol treatment inhibits oxidative stress and renal interstitial fibrosis . A previous report showed that resveratrol played protective effects on septic kidney injury rats. But the underlying mechanism of resveratrol is remaining unknown. In the present study, we first constructed a rat model of uremic through 5/6 nephrectomy to investigate the effects of resveratrol on uremic kidney rats. Our results were consistent with previous studies, that resveratrol administration significantly ameliorated the damages of renal tissue in uremic rats [7, 8].

In this study, the expression of HSP70 protein was remarkably raised in renal tissues after resveratrol treatment. It meant that resveratrol treating could regulate to the expression of Hsp70 in kidney of uremic rats. As the same time, resveratrol treatments changed the NF-κB signaling-related proteins. P65 protein is a major subunit of the NF-κB signaling pathway [9]. Previous evidences showed that the protein levels of p-P65 and P50 were upregulated, and the activation of NF-κB signaling pathway was enhanced in inflammatory kidney disease. Consistent with another study, administration with resveratrol significantly expressed the p-IκBα subunit in animals with CKD. The data in this research showed that p-IκBα protein was remarkably raised, yet the expression of p-P65 protein was remarkably declined after the dose of resveratrol treatment, when compared to model group.

In order to confirm that resveratrol activates Hsp70 expression to regulate NF-κB signaling pathway in kidney of uremic rats, the HSP70 activator and inhibitor were injected. The results showed that the effect of 17-AAG was similar to the 20 mg/kg resveratrol on NF-κB pathway-related proteins expression. Adding MKT-077, the effect of resveratrol on NF-κB pathway-related proteins was oppositely changed [10, 11].

Conclusion

The study's findings shed light on the potential of resveratrol as a therapeutic agent for protecting kidney health in the context of uremia. The activation of HSP70 through resveratrol supplementation offers a novel approach to mitigate the adverse effects of uremic toxins on kidney tissue. While these findings are promising, further research is needed to better understand the underlying mechanisms and to validate these results in clinical settings.

Resveratrol's ability to activate HSP70 expression underscores its multifaceted role in cellular protection and repair. As we continue to unravel the intricate interplay between natural compounds and cellular responses, the potential for developing innovative treatments for kidney disease and other health conditions becomes increasingly evident. While resveratrol holds significant promise, it is important to note that translating these findings into clinical practice requires rigorous investigation and clinical trials. Nonetheless, the pursuit of resveratrol's therapeutic potential in kidney health offers a glimpse into the exciting possibilities of harnessing nature's gifts to combat complex diseases.

Conflict of Interest

None

Acknowledgement

None

References

1. Mallappallil M, Friedman EA, Delano BG, McFarlane SI, Salifu MO (2014) Chronic kidney disease in the elderly: evaluation and management. Clinical Practice 11: 525–535.
2. Klaus R, Niyazi M, Lange-Sperandio B (2021) Radiation-induced kidney toxicity: molecular and cellular pathogenesis. Radiat Oncology 16: 1–11.
3. Mansour HH (2006) Protective role of carnitine ester against radiation-induced oxidative stress in rats. Pharmacol Res 54: 165–171.
4. Reitman S, Frankel S (1957) A colorimetric method for the determination of serum glutamic oxalacetic and glutamic pyruvic transaminases. Am J Clin Pathol 28: 56–63.
5. Fawcett J, Scott J (1960) A rapid and precise method for the determination of urea. J Clin Pathol 13: 156–159.
6. Bartels H, Böhmer M, Heierli C (1972) Serum creatinine determination without protein precipitation. Clin Chimica Acta: Int J Clin Chem 37: 193–197.
7. Moustafa EM, Thabet NM (2017) Beta-sitosterol upregulated paraoxonase-1 via peroxisome proliferator-activated receptor-γ in irradiated rats. Can J Physiol Pharmacol 95: 661–666.
8. Galal SM, Abdel-Rafei MK, Hasan HF (2018) Cholinergic and cytoprotective signaling cascades mediate the mitigative effect of erythropoietin on acute radiation syndrome. Can J Physiol Pharmacol 96: 442–458.
9. Sekhar KR, Freeman ML (2015) Nrf2 promotes survival following exposure to ionizing radiation. Free Radic Biol Med 88: 268–274.
10. Al-Baqami NM, Hamza RZ (2021) Protective effect of resveratrol against hepatotoxicity of cadmium in male rats. Antioxidant Histopathol Approach 11: 594.
11. Truong VL, Jun M, Jeong WS (2018) Role of resveratrol in regulation of cellular defense systems against oxidative stress. J Biofactors 44: 36–49.