УДК 616.127-005.8:615.276:615.451.1:582.711.712:599.323.4 https://doi.org/10.33250/19.01.055

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The impact of raspberry shoot extract on the histological structure of rat cardiac muscle under adrenaline-hydrocortisone-induced myocardial infarction

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Key words: histological structure, cardiac muscle, myocardial infarct, raspberry shoot extract, cardioprotection

Cardiovascular diseases are among the leading causes of morbidity and mortality worldwide. They are also the leading cause of disability, and their numbers are increasing worldwide [1].

According to the World Health Organization (WHO), 42.5% of all deaths in the European region each year are attributed to cardiovascular diseases [1, 2]. A 2019 STEPS study revealed that the mortality rate due to cardiovascular diseases in Ukraine was among the highest globally, accounting for 63% of deaths from non-communicable diseases [3]. From 2018 to 2022, 1,655,686 people in Ukraine died from diseases of the circulatory system, which averaged 64.86% of the total mortality during this period [4]. Deaths due to ischemic heart disease (IHD) accounted for 1,149,433 cases, or 45.03% of the total mortality during the same timeframe [4]. Therefore, effective and safe methods of prevention and pharmacotherapy for cardiovascular diseases, especially IHD, remain highly relevant.

In the treatment of cardiovascular diseases, including IHD, contemporary medicine and pharmacy face a critical challenge. Pharmacological interventions for IHD include synthetic and plant-based medicines, which, due to their multimodal effects on the pathogenesis of IHD, help reduce cytolytic processes, oxidative stress, and improve metabolic processes [5].

One promising agent with potential cardioprotective properties is the extract of raspberry shoots (*Rubus idaeus L.*), a rich source of biologically active compounds, particularly polyphenols [6–8].

Flavonoids (such as rutin, quercetin, catechins, tannins) and non-flavonoids (ellagic and gallic acids) exhibit protective properties, including antioxidant, cardioprotective, anti-inflammatory, and hepatoprotective activities [7, 8]. Our previous studies confirmed that raspberry shoots possess significant antioxidant activity due to their high content of catechins, hydroxycinnamic acid derivatives, and flavonoids [9, 10]. Inhibiting free radical oxidation processes is a key mechanism underlying the cardioprotective effects of these agents.

The purpose of this study – to evaluate the effects of raspberry shoot

extract and quercetin on the ultrastructure of the myocardium in rats under conditions of adrenaline-hydrocortisone-induced myocardial infarction [11]. Adrenaline damage to the myocardium is an important element in the pathogenesis of myocardial infarction in humans [12]. Despite the use of modern methods the treatment of myocardial infarction, is an issue of cardioprotection.

Materials and methods. The study was performed on 40 male albino rats (284.1 ± 5.32) g housed in ventilated conditions with standard feed and free access to food and water. The experiment was conducted in compliance with the requirements of the "European Convention on the Protection of Vertebrate Animals Used in Experiments and Other Scientific Purposes" [13, 14] and approved by bioethic comisson of the National University of Pharmacy (protocol No. 7 01.11.2024).

Experimental myocardial injury (myocardial infarction) was induced via subcutaneous injections of 0.1% adrenaline hydrochloride solution (1 mg/kg body weight) and 2.5% hydrocortisone acetate emulsion (12.5 mg/kg body weight), administered twice daily for one week [14]. The test compounds were administered intragastric for 14 days: 7 days prior to myocardial injury induction and 7 days during adrenaline and hydrocortisone treatment (therapeutic-prophylactic regimen) [11].

Raspberry shoot extract (RSE) of two-year-old raspberry shoots was obtained at the department of general chemistry and technology of the National university of pharmacy by assistant prof. O. Yu. Maslov and assistant prof. M. A. Komisarenko under the supervision of prof., doctor of pharmaceutical sciences A. M. Komisarenko and head of the department of general chemistry, prof., doctor of pharmaceutical sciences S. V. Kolisnyk.

The RSE contains the sum of catechins (epicatechin, (+)-catechin), the sum of flavonoids (rutin, quercetin), the sum of ellagitannins (sanguiin H-10 isomer 2 and 1) and ellagic acid, the sum of hydroxycinnamic acids (chlorogenic and caffeic acid), the sum of organic acids (citric acid) [9, 10].

Standardization of the RSE was carried out by spectrophotometric method, according to the content of the sum of catechins.

The study object was the cardiac muscle of rats from different groups: I – rats receiving the solvent (isotonic NaCl solution) – placebo control (IPC); II – rats after modeling adrenaline-hydrocortisone-induced myocardial infarction – pathology control (PC); III – rats after therapeutic-prophylactic intragastric administration of native raspberry shoot extract (RSE) at 2 ml/kg (in terms of catechin – 26.5 mg/ml); IV – rats after therapeutic-prophylactic administration of the reference drug – quercetin at 20.5 mg/kg (quercetin produced by PJSC NVC "Borshchahiv Chemical-Pharmaceutical Plant", Ukraine) [15].

After seven days of myocardial infarction development, the animals were euthanized to collect material for biochemical and histological analyses. The hearts were fixed in 10% formalin, dehydrated in ethanol, embedded in paraffin, and sectioned at 4 μm. The sections were stained with hematoxylin and eosin [16, 17] and examined under a Granum light microscope. Microphotographs were captured with a Granum DCM 310 digital camera and processed using Levenhuk 310 Toup View software.

To objectify the data obtained on the micropreparations, a semi-quantitative (score-based) assessment of the modeled pathological process and its correction by the studied compounds was performed. The scoring system described in the

literature [18, 19] was used as a basis. The following parameters were evaluated.

Presence of necrotic foci and duration of existence (fresh/long-lasting):

– 0 points – no sign;

– 0.5 points – isolated microcellular infiltrates at the sites of dead groups of cardiomyocytes;

– 1 point – 1–2 small foci, relatively "long-lasting" in existence;

– 2 points – no more than 4 small foci, relatively "long-lasting" in existence;

– 3 points – more than 5 foci of varying size and duration.

Maturity level of granulation tissue (infiltrate) replacing necrotic foci:

– 0 points – no sign;

– 0.5 points – lymphoid and isolated macrophage cells;

– 1 point – a relatively "dense" lympho-macrophage infiltrate;

– 2 points – lympho-macrophage infiltrate with immature fibroblasts;

– 3 points – infiltrate primarily containing young fibroblasts.

Ischemic manifestations (dilation and congestion of the capillary network and venous vessels, stasis, spasm of intramural arteries, vascular wall thickening):

– 0 points – no sign;

– 1 point – mild severity;

– 2 points – moderate severity;

– 3 points – significant severity.

Changes in the contractile apparatus of fibers/cardiomyocytes (myocytolysis, contracture):

– 0 points – no sign;

– 1 point – mild severity;

– 2 points – moderate severity;

– 3 points – significant severity.

For statistical analysis of the numerical data obtained, the non-parametric Wilcoxon-Mann-Whitney test was used [20].

Results and discussion. It was established that under conditions of adrenaline-hydrocortisone-induced myocardial infarction, the use of quercetin in a therapeutic-prophylactic regimen led to increase the survival rate of experimental animals by 88% administration. With the administration of RSE (raspberry shoot extract) at the studied dose, no mortality was observed, resulting in 100% survival of the animals.

Microscopic analysis of the myocardium in the placebo control (IPC) group revealed cardiomyocytes forming muscle fibers, which appeared as bundles oriented in various directions – longitudinally or circularly. The cardiac muscle fibers were of normal thickness, uniformly stained, and exhibited moderate anastomosis between them. The inter-fiber and inter-bundle spaces were moderately expressed. The connective tissue cellular elements within the inter-bundle and inter-fiber layers were sparse. Cardiomyocytes within the muscle fibers were arranged sequentially, one after another. The cardiomyocytes displayed well-defined normochromic nuclei with clear chromatin substance and visible nucleoli. The nuclei were of elongated or oval shape, normal in size and location. The transverse striations of the myofibrils were clearly visible. The inter-fiber stroma contained blood vessels of varying calibers. Small veins in the outer layers of the myocardium were engorged with blood. Small- and medium-caliber arteries were moderately filled with blood, had walls of normal thickness, and exhibited moderate vascular lumens. Capillaries showed normal blood filling (Figure 1).

In animals of the pathology control group (PC), 7 days after modeling adrenaline-hydrocortisone-induced myocardial infarction, significant microscopic changes were observed in the stromal-vascular-parenchymal components of the myocardium. The changes were most pronounced in the

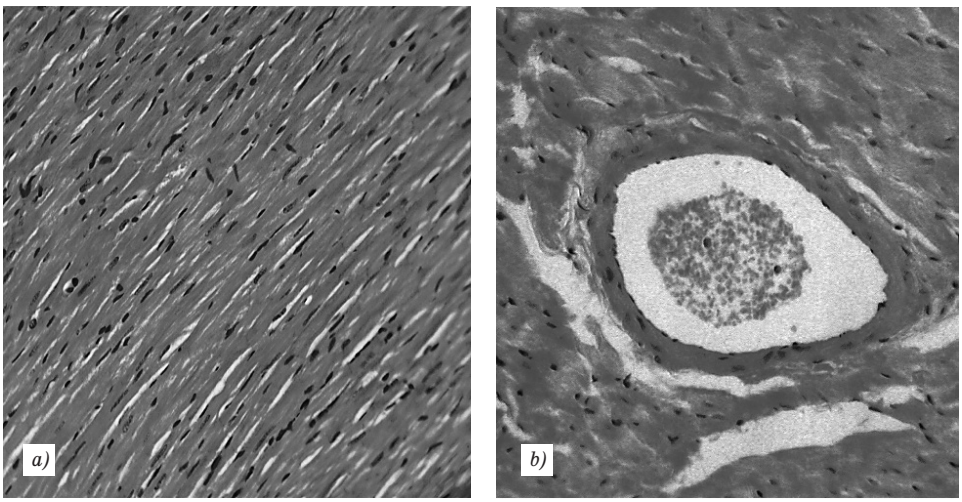

Figure 1. Myocardium of the left ventricle in rats receiving placebo (IPC). Normal condition: (a) cardiac muscle fibers; (b) intramural artery. Hematoxylin-eosin stain, x200

left ventricle, particularly in the mid-zones and the most functionally stressed areas, such as the papillary muscles.

Necrotic foci of cardiomyocytes were numerous and varied in size (volume), duration, and degree of "organization," reflecting the progression of regenerative processes. In the foci of necrosis that were "fresh," fibers appeared swollen, fragmented, and disorganized. Transverse striations of the myofibrils were absent. The cytoplasm of the fibers was weakly eosinophilic and homogeneous, with pyknotic nuclei that were faintly basophilic or absent.

In older necrotic foci, where fibers had undergone lysis, signs of granulation tissue formation were observed. Most commonly, lympho-macrophage infiltrates with varying amounts of immature fibroblasts were present (Figure 2).

All these changes occurred against a background of myocardial ischemia. Blood capillaries were often paralyzed, dilated, and congested with blood. Hemostasis was observed. Some small intramural arteries were in spasm, with a marked narrowing of their lumens. Occasionally, an increase in smooth muscle cells in the media layer was seen, leading to focal thickening of the vessel wall. Endothelial cells in the intima exhibited peg-like protrusions. Venous vessels were distinctly congested.

In some cardiomyocytes, nuclei were enlarged (possibly as a compensatory response), while others contained small, dark, pyknotic nuclei (Figure 3). All these findings are characteristic signs of myocardial ischemia.

In addition to necrosis of cardiomyocytes, zones of myofibril dissolution were observed in muscle cells, which are signs of intracellular myocytolysis. It was swollen, weakly bound the dye, and the transverse stippling was not determined. Quite often, such areas are numerous, and the changes can cover a number of parallel cells. The areas adjacent to such zones along the cell/fiber extension retained the usual staining pattern and intensity (Figure 4).

In addition to the signs of myocytolysis, changes in the myofibrillar apparatus of contractile cells were also

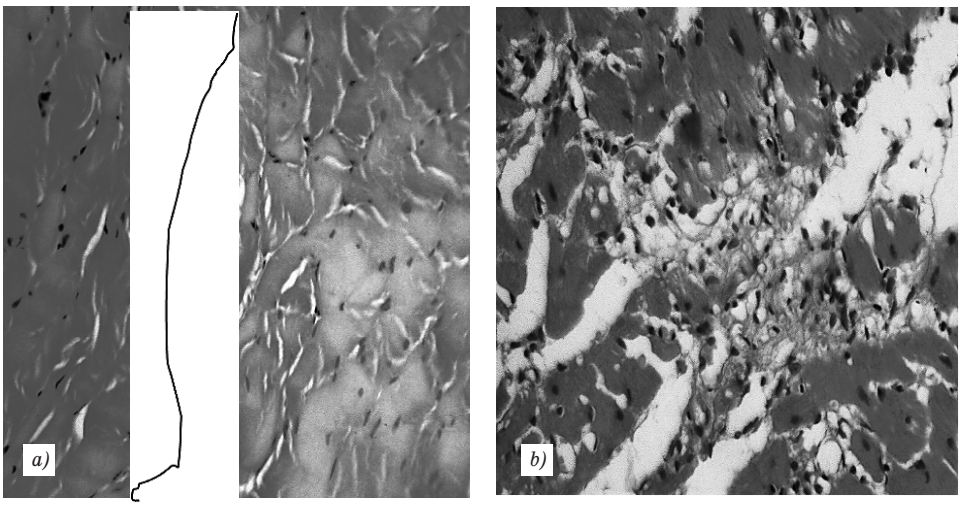

Figure 2. Myocardium of the left ventricle of rats with adrenaline-dependent infarction (PC): a – zone of "fresh" necrosis. The fibers are swollen, fragmented, disordered, and there is no transverse myofibrillar cross-section. The cytoplasm is weakly eosinophilic, homogeneous, pyknotic nuclei, weakly basophilic or absent. Remnants of stromal cells are visible between the fiber fragments; b – loose granulation tissue formed in the necrosis zone, the infiltrate contains lympho-macrophage cells with a slight admixture of immature fibroblasts. Hematoxylin-eosin. x200*

*Note. *Here and below, the data of histological studies are given on the 8th day after daily subcutaneous administration of 0.1% adrenaline hydrochloride solution and 2.5% hydrocortisone acetate emulsion.*

observed. They were mainly observed in small groups of cardiomyocytes in the papillary muscles, often near small vessels. Such cells were characterized by increased acidophilia, indeterminate myofibrillar cross-section, and sometimes pycnotic nuclei. This condition corresponds to the super-expressive contractility of myofibrils (Figure 5). Outside of the destruction zones, areas with tortuous fibers of different thicknesses were found in some places, and fiber edema was often observed. The myocardial stroma was focally infiltrated by macrophages and lymphocytes.

After administration of the comparison quercetin in the therapeutic and prophylactic regimen, the vast majority of rats had no or significantly reduced manifestations of ischemia (Figure 6).

The degree of severity of destruction zones is much less significant than in the control pathology, there are no " fresh" foci, and the organization of these foci is more pronounced (Figure 7).

The manifestations of myocytolysis were reduced, although there was some variability in this sign in the group as a whole. There were contractile changes of cells of different severity. At the same time, a compact and orderly distribution of muscle fiber bundles was visualized in large areas of the heart muscle.

The transverse cross-section of myofibrils and normal tintorial properties of the cardiomyocyte cytoplasm were quite clearly observed (Figure 8).

Visually, the condition of the left ventricular myocardium of rats after RSE administration improved positively. No signs of ischemia were found on the micrographs – intramural arteries without signs of spasm, the vascular

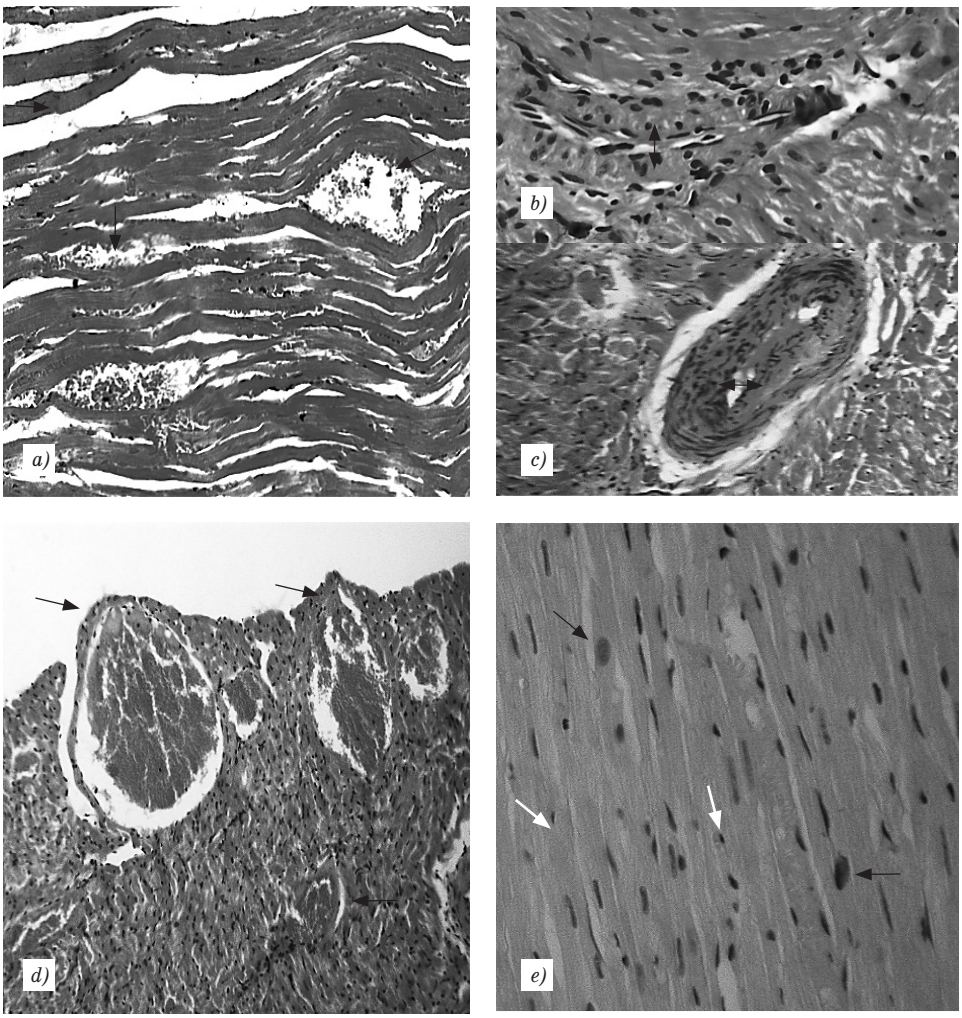

Figure 3. Myocardium of the left ventricle of rats with adrenaline-dependent infarction (PC): a – paretic dilated, full-blooded blood capillaries (x250); b–c – spasm with distinct lumen narrowing in the middle intramural arteries, thickening of the vessel wall (x250, 100); d – dilation, distinct full-bloodedness of venous vessels (x200); e – hypertrophy (black arrows) and pyknosis (white arrows) of the nuclei of some cardiomyocytes (x400). Hematoxylin-eosin

wall was not thickened. The condition of the capillaries was normal (Figure 9).

No "fresh" foci of necrosis were found, and those that did occur were small, few in number, and completely replaced by young fibroblasts (Figure 10).

Signs of myocytolysis are still visible, contractile changes of cells are minimal. Large areas of the myocardium looked intact (Figure 11).

In accordance with the tasks set, a semi-quantitative assessment of the severity of the pathological process and its correction by the studied compounds was performed. The results of the evaluation are shown in the Table.

As can be seen from the data presented in the table, both studied compounds in this experimental pathology showed cardioprotective effect.

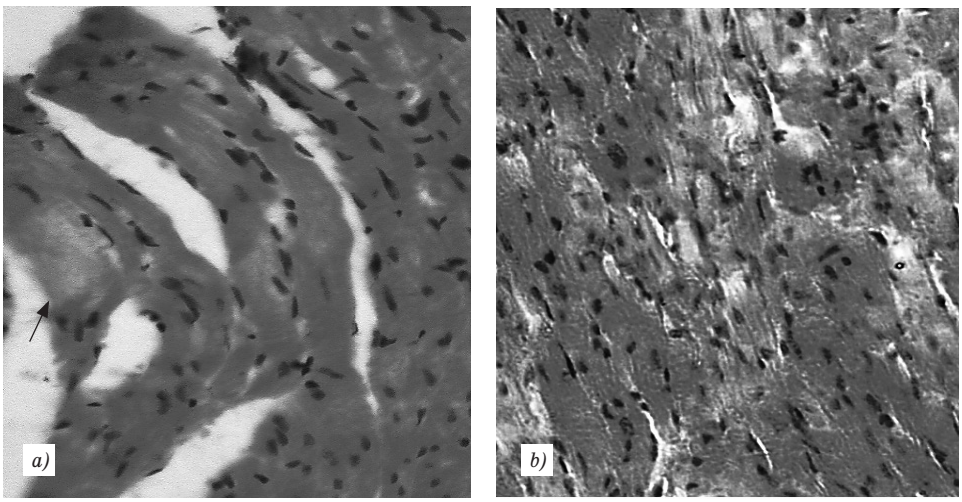

Figure 4. Myocardium of the left ventricle of rats with adrenaline-dependent infarction (PC). Myocytolysis manifestations of different size: a – local; b – diffuse. Hematoxylin-eosin stain. x250

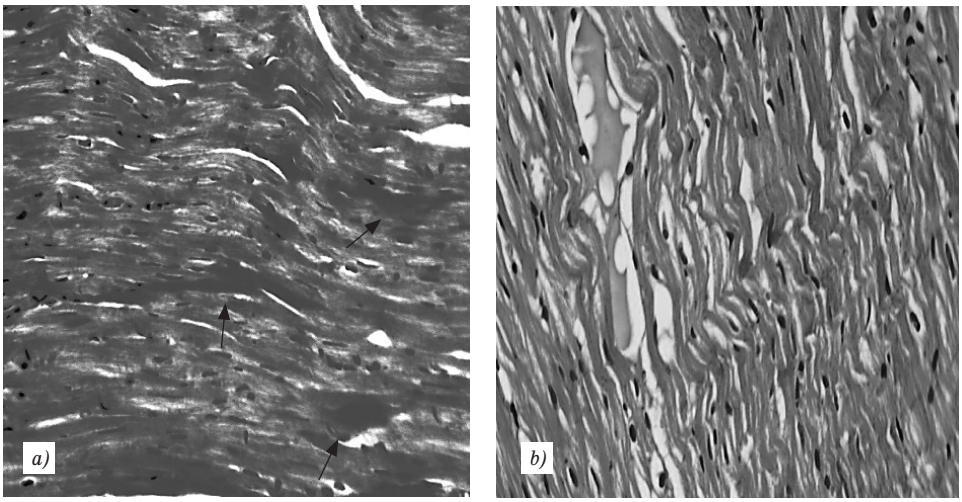

Figure 5. Myocardium of the left ventricle of rats with adrenaline-dependent infarction (PC): a – contractile changes in cardiomyocytes; b – tortuous fibers of different thickness. Hematoxylin-eosin. x200

According to light microscopy, the greatest activity was EPM. In our opinion, the high efficiency of the studied compounds is due to their antioxidant properties.

The cardioprotective properties of quercetin are well known. In addition to its antioxidant effect, it helps to limit the area of myocardial necrosis, prevents its reperfusion injury, improves myocardial function, cholesterol lowering, endothelial cell protection and reduces the severity of fibrotic changes in the myocardium [21–23].

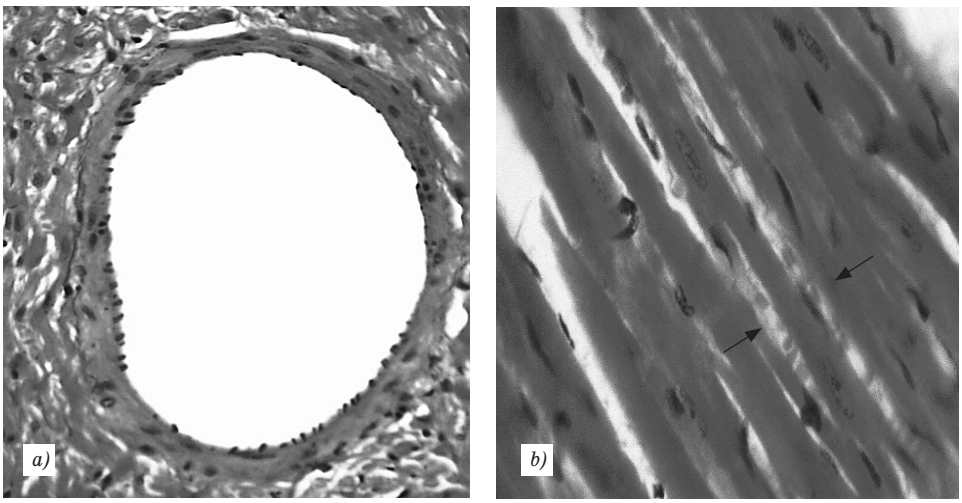

Figure 6. Myocardium of the left ventricle of rats treated with quercetin in the prophylactic and therapeutic regimen: a – intramural artery is not changed (x200); b – normal capillary blood filling (x400). Hematoxylin-eosin stain

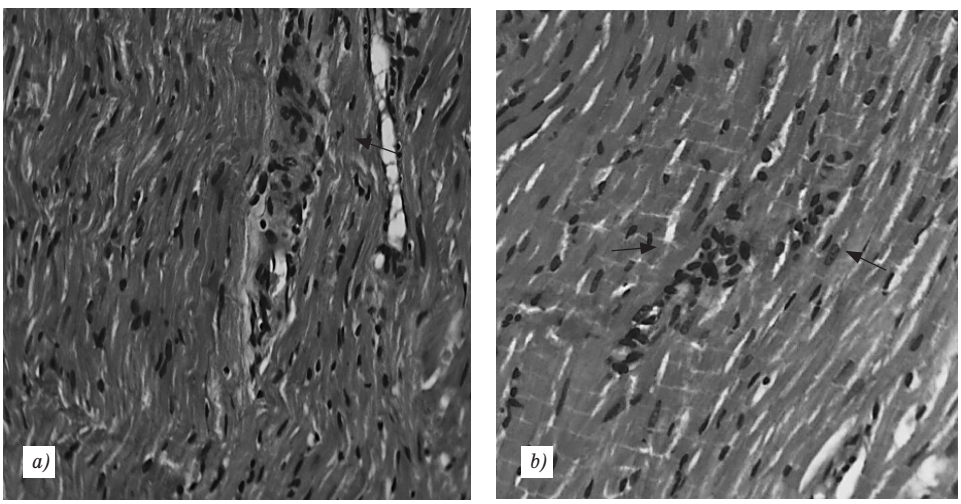

Figure 7. Myocardium of the left ventricle of rats treated with quercetin in the prophylactic and therapeutic regimen: a–b – infiltrates of different sizes with a predominance of young fibroblasts at the site of former cardiomyocyte necrosis. Hematoxylin-eosin. x250

The cardioprotective effects of catechins (main component of PSE) are also realized through antioxidant action [24, 25]. As is known, the main modulator of endothelial cell activity is nitric oxide (NO). Oxidative stress, leading to oxidative degradation of NO, is one of the most common mechanisms involved in the alteration of endothelial nitric oxide synthase (eNOS) – the eNOS/NO signaling pathway, which causes endothelial dysfunction. Reduced NO bioactivity causes vasoconstriction and can potentially lead to

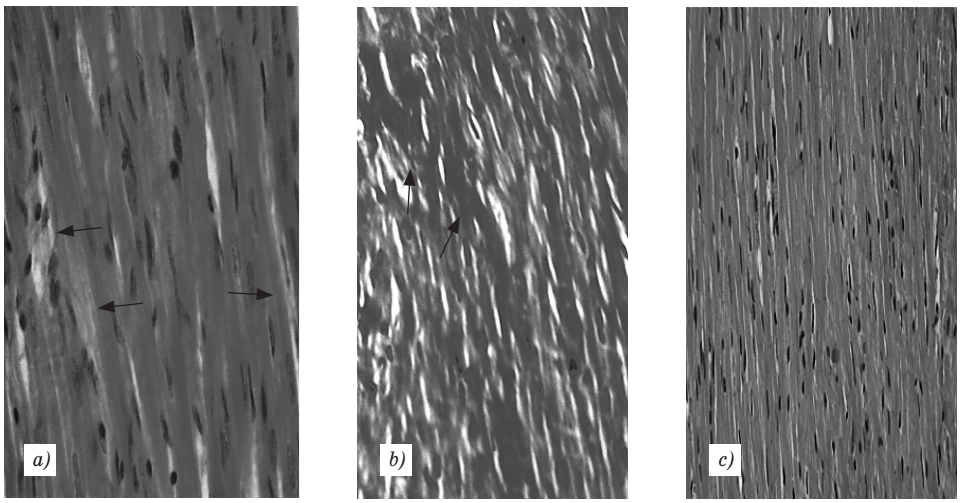

Figure 8. Myocardium of the left ventricle of rats treated with quercetin in the prophylactic and therapeutic regimen: a – small zones of myocytolysis (x250); b – contractile changes in fiber fragments (x200); c – normal myocardium (x200). Hematoxylin-eosin

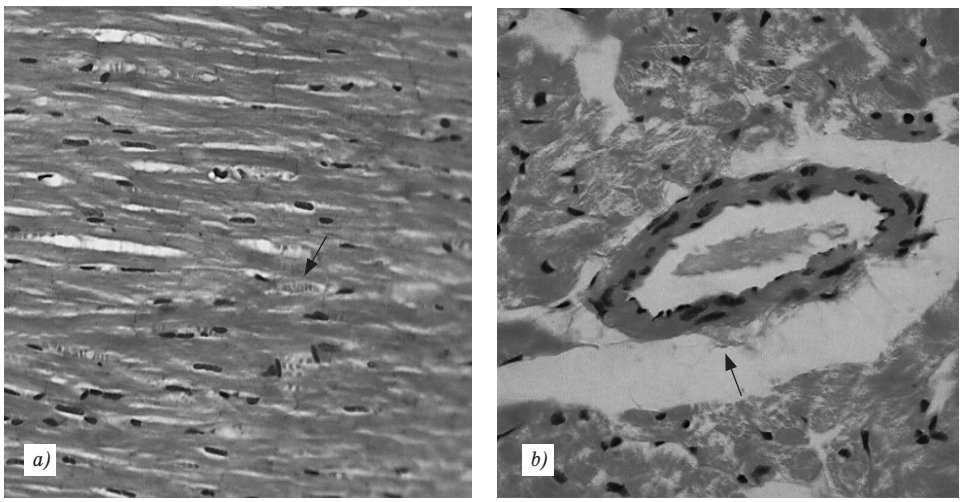

Figure 9. Myocardium of the left ventricle of rats treated with RSE in the prophylactic and therapeutic regimen: normal state of capillaries (a) and intramural artery (b). Hematoxylin-eosin. x200

ischemia. Catechins can also regulate metabolic processes by directly affecting mitochondria, which are responsible for cellular energy supply [25]. There is also evidence that catechins can stimulate eNOS, leading to a reduction in endothelial dysfunction.

In our opinion, the cardioprotective effect of RSE, which contains a number of polyphenols, including catechins, is also realized through these mechanisms.

The results obtained indicate the need for further in-depth studies of RSE as potential cardioprotective agent.

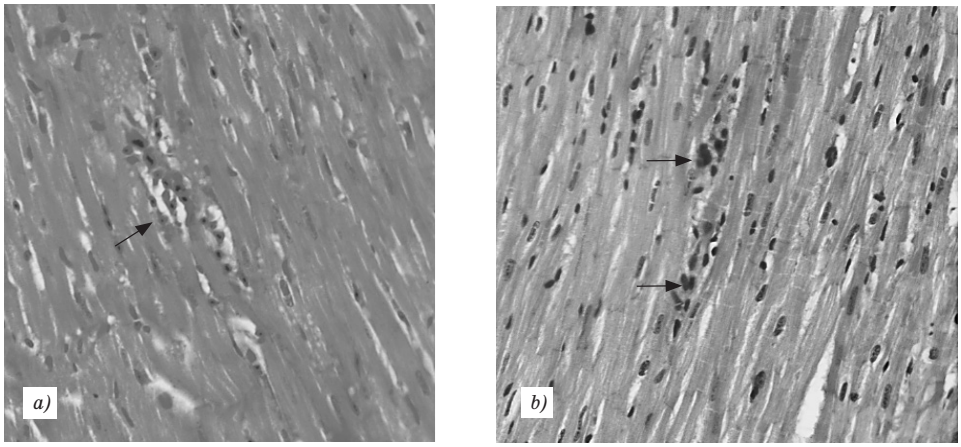

Figure 10. Myocardium of the left ventricle of rats treated with RSE in the prophylactic and therapeutic regimen: very small foci of former necrosis, completely replaced by granulations with a predominance of young fibroblasts (a–b). Hematoxylin-eosin stain, x200

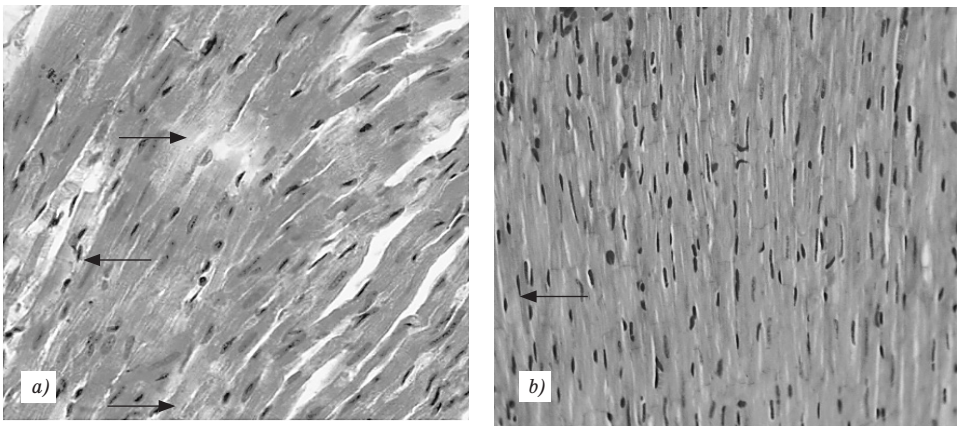

Figure 11. Myocardium of the left ventricle of rats treated with RSE in the prophylactic and therapeutic regimen: a – myocytolysis foci; b – normal fiber state. Hematoxylin-eosin. x200

Conclusions

1. After administration of 0.1% adrenaline hydrochloride solution and 2.5% hydrocortisone acetate emulsion in a course lasting for a week, severe ischemia developed in rats myocardium with necrosis areas of varying duration.
2. Prophylactic and therapeutic intragastric administration of the studied compounds (RSE and quercetin) had a beneficial effect on histological structure of myocardium, which was manifested in a decrease/absence of signs of ischemia, inhibition of cardiomyocyte alteration, acceleration of the organization of necrosis foci; positively correlated with the state of the contractile apparatus of the cells.
3. The data obtained indicate that the studied compounds have cardioprotective properties. In terms of cardioprotective effect, raspberry shoot extract was not inferior to the action of the comparator drug quercetin.

Table

Semi-quantitative assessment of the condition of the left ventricular heart muscle of rats with adrenaline-hydrocortisone-induced myocardial infarction and its correction by the studied compounds

Experimental grup	Signs of pathology, points			
	Presence of necrotic foci	**Maturity level**	**Ischemie manifestations**	**Changes in the contractile apparatus**
Placebo control (IPC)	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Pathology control (PC)	2,80 ± 0,20	1,30 ± 0,30	2,60 ± 0,245	2,60 ± 0,245
PC + quercetin	1,40 ± 0,245*	2,80 ± 0,20*	0,20 ± 0,20*	1,40 ± 0,245*
PC + RSE	1,20 ± 0,20*	3,0 ± 0*	0,20 ± 0,20*	1,60 ± 0,245*

*Note. *p ≤ 0.05 relative to the pathology control (PC).*

1. Flora G. D., Nayak M. K. A brief review of cardiovascular diseases, associated risk factors and current treatment regimes. *Curr. Pharm Des.* 2019. V. 25 (38). P. 4063–4084. https://doi: 10.2174/1381612825666190925163827.
2. Найпоширеніші серцево-судинні захворювання: як розпізнати та запобігти. Центр громадського здоров'я Міністерства охорони здоров'я України», 17.10.2024. URL: https://phc.org.ua/news/nayposhirenishi-sercevo-sudinni-zakhvoryuvannya-yak-rozpiznati-ta-zapobigti.
3. Захворювання серцево-судинної системи: фактори ризику та профілактика. URL: https://moz.gov.ua/article/health/zahvorjuvannja-sercevo-sudinnoi-sistemi-faktori-riziku-ta-profilaktika.
4. Смертність в Україні. URL: https://index.minfin.com.ua/ua/reference/people/deaths.
5. Фітотерапія в кардіології: навч. посібник. Ю. І. Корнієвський, О. В. Крайдашенко, М. П. Красько та ін. Запоріжжя : Вид-во ЗДМУ, 2017. 470 с.
6. Red raspberry (Rubus ideaus) supplementation mitigates the effects of a high-fat diet on brain and behavior in mice. A. N. Carey, G. I. Pintea, S. Van Leuven et al. *Nutr. Neuro.* 2019. P. 1–11. https://dx.doi. org/10.1080/1028415x.2019.1641284.
7. Simultaneous hydrolysis of ellagitannins and extraction of ellagic acid from defatted raspberry seeds using natural deep eutectic solvents (NADES). N. Teslić, F. Santos, F. Oliveira et al. *Antioxidants.* 2022. V. 11 (2). P. 254. https://dx.doi.org/10.3390/ antiox11020254.
8. Bobinaitė R., Viškelis P., Venskutonis P. R. Variation of total phenolics, anthocyanins, ellagic acid and radical scavenging capacity in various raspberry (*Rubus spp.*) cultivars. *Food Chem*. 2012. V. 132 (3). P. 1495–1501. https://dx.doi. org/10.1016/j.foodchem.2011.11.137.
9. Antioxidant activity of red raspberry shoots (Rubus idaeus L.) liquid extracts. O. Maslov, M. Komisarenko, D. Horopashna et al. *Herba Polonica.* 2023. V. 69 (4). P. 45–53. https://doi.org/10.5604/01.3001.0054.1658.
10. Evaluation of anti-inflammatory, antioxidant activities and molecular docking analysis of rubus idaeus leaf extract. O. Maslov et al. *Jordan Journal of Pharmaceutical Sciences.* 2024. V. 17, No. 1. P. 105–122. https://doi.org/10.35516/jjps.v17i1.1808.
11. Influence of the inoxaril on the energetic exchange of the cardiac muscle in experimental adrenalin hydrokortizon myocardium heart attack. D. V. Gaman, N. N. Kononenko, N. V. Ribalkin, V. V. Hnatiuk. *Український біофармацевтичний журнал.* 2012. № 3. С. 54–57.

12. Прихода І. В. Роль активації симпато-адреналової системи у розвитку гострої лівошлуночкової недостатності у хворих на гострий коронарний синдром без елевації сегмента ST. *Укр. терапевт. журнал*. 2006. № 3. С. 36–39.
13. Directive 2010/63/EU of the European Parliament and of the Council on the protection of animals used for scientific purposes. *Official Journal of the European Communities.* 2010. L. 256. P. 33–79.
14. Guide for the care and use of laboratory animals: eighth edition. Washington, D. C. : National Academies Press,2011. https://doi.org/10.17226/1291.
15. Вплив комбінації кверцетину з похідними глюкозаміну на перебіг доксорубіцинової кардіоміопатії у щурів. Ель Ааараж Ахмад, І. А. Зупанець, С. К. Шебеко, І. А. Отрішко. *Клініч. фармація.* 2012. Т. 16, № 3. С. 24–27.
16. Mondal S. K. Manual of histological techniques. 2nd ed. Jaypee Brothers Medical Publishers Pvt. Ltd.; New Delhi, India : 2019. 296 p.
17. Morphological characteristics of rat's heart at experimental myocardium necrosis. T. V. Shkand, N. A. Chizh, O. V. Naumova, B. P. Sandomirsky. *Морфологія*. 2013. Т. VII, № 2. С. 84–89.
18. Adrenaline-induced damage to the myocardium in rats with genetically determined arterial hypertension. A. L. Markel' et al. *Biulleten' eksperimental'noi biologii i meditsiny*.1985. V. 99, № 3. P. 356–358.
19. Morphological changes in the conditions of adrenaline myocardialdystrophy against the background of the introduction of the compound PC-66 and amiodarone to rats. O. V. Dzhyhaliuk, D. A. Lysenko, D. G. Smolko et al. *Reports of Morphology*. 2020. V. 26, No. 1. P. 48–53.
20. Надрага Б. О., Ященко А. М., Луцик О. Д. Морфофункціональні особливості стінки серця щура при експериментальному інфаркті міокарда. *Морфологія*. 2019. V. 13 (1). P. 32–37.
21. Перспективи вивчення застосування препаратів кверцетину в лікуванні COVID-19. І. А. Зупанець, О. А. Голубовська, А. В. Шкурба та ін. *Укр. мед. часопис.* 2020. № 2 (136). Т. 1 – III/IV. С. 75–78. https://doi.org/10.32471/umj.1680-3051.136.177136.
22. Cardioprotective effect of the quercetin on cardiovascular remodeling and atherosclerosis in rodents fed a high-fat diet: a systematic review. D. A. Espírito-Santo et al. *Chem. Biol. Interact*. 2023. V. 384. P. 110700. https://doi.org/10.1016/j.cbi.2023.110700.
23. Research progress of quercetin in cardiovascular disease. W. Zhang, Y. Zheng, F. et al. *Front. Cardiovasc Med.* 2023. V. 10. P. 1203713. https://doi.org/10.3389/fcvm.2023.1203713.
24. Daniel R. Mangels, Emile R. Mohler catechins as potential mediators of cardiovascular health. *Arterioscler. Thromb. Vasc. Biol*. 2017. V. 37. P. 757–763. https://doi.org/10.1161/ATVBAHA.117.309048.
25. Preventive Effects of Catechins on Cardiovascular Disease. X. Q. Chen, T. Hu, Y. Han et al. *Molecules*. 2016. V. 21 (12). P. 1759. https://doi: 10.3390/molecules21121759.

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The impact of raspberry shoot extract on the histological structure of rat cardiac muscle under adrenaline-hydrocortisone-induced myocardial infarction

Cardiovascular diseases are among the leading causes of morbidity and mortality worldwide. They are also the leading cause of disability, and their numbers are increasing worldwide. In the treatment of cardiovascular diseases, including ischemic heart disease (IHD), contemporary medicine and pharmacy face a critical challenge. Pharmacological interventions for IHD include synthetic and plant-based medicines, which, due to their multimodal effects on the pathogenesis of IHD, help reduce cytolytic processes, oxidative stress, and improve metabolic processes.

One promising agent with potential cardioprotective properties is the extract of raspberry shoots (*Rubus idaeus L.*), a rich source of biologically active compounds, particularly polyphenols.

The purpose of this study was to evaluate the effects of raspberry shoot extract and quercetin on the ultrastructure of the myocardium in rats under conditions of adrenaline-hydrocortisone-induced myocardial infarction.

After administration of 0.1% adrenaline hydrochloride solution and 2.5% hydrocortisone acetate emulsion in a course lasting for a week, severe ischemia developed in rats myocardium with necrosis areas of varying duration.

Prophylactic and therapeutic administration of the of raspberry shoot extract and quercetin had a beneficial effect on histological structure of myocardium, which was manifested in a decrease/absence of signs of ischemia, inhibition of cardiomyocyte alteration, acceleration of the organization of necrosis foci; positively correlated with the state of the contractile apparatus of cells.

The data obtained indicate that the studied raspberry shoot extract has cardioprotective properties. In terms of cardioprotective effect, raspberry shoot extract was not inferior to the action of the comparator drug quercetin.

Key words: histological structure, cardiac muscle, myocardial infarct, raspberry shoot extract, cardioprotection

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Вплив екстракту пагонів малини на гістологічну структуру серцевого м'яза щурів за адреналін-гідрокортизонового інфаркту міокарда

Серцево-судинні хвороби є однією з основних причин захворюваності та смертності в усьому світі. Вони також є основною причиною інвалідності, і їхня кількість зростає в усьому світі. У лікуванні серцево-судинних захворювань, зокрема ішемічної хвороби серця (ІХС), сучасна медицина та фармація стикаються з критичним завданням. Медикаментозна терапія при ІХС включає як синтетичні, так і рослинні препарати, які завдяки мультимодальному впливу на патогенез ІХС сприяють зниженню цитолітичних процесів, окисного стресу та покращанню метаболічних процесів.

Одним із перспективних засобів із потенційними кардіопротекторними властивостями є екстракт пагонів малини (*Rubus idaeus L.*) – багатого джерела біологічно активних сполук, зокрема поліфенолів.

Мета дослідження – оцінити вплив екстракту пагонів малини та кверцетину на ультраструктуру міокарда щурів за умов адреналін-гідрокортизон-індукованого інфаркту міокарда.

Встановлено, що після введення 0,1 % розчину адреналіну гідрохлориду та 2,5 % емульсії гідрокортизону ацетату протягом тижня в щурів розвивається важка ішемія міокарда з зонами некрозу різної тривалості існування.

Застосування екстракту пагонів малини та кверцетину в лікувально-профілактичному режимі сприятливо впливає на гістологічну структуру міокарда експериментальних тварин, що проявляється зменшенням/відсутністю ознак ішемії, гальмуванням альтерації кардіоміоцитів, прискоренням організації вогнищ некрозу; та позитивно корелює зі станом скорочувального апарату клітин.

Отримані дані свідчать про те, що екстракт пагонів малини має кардіопротекторні властивості. За кардіопротекторною дією екстракт пагонів малини не поступається дії препарату порівняння кверцетину.

Ключові слова: гістологічна структура, експериментальний інфаркт міокарда, серцевий м'яз, щури, екстракт пагонів малини, кверцетин, кардіопротекція

Надійшла: 25 грудня 2024 р.

Прийнята до друку: 19 лютого 2025 р.

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