Comparative study of the impact of phytocomposition extract on some blood characteristics of irradiated rats

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ABSTRACT

We studied the radioprotective properties of the extracts of phytocomposition consisting of common St. John’s wort (Hypericum perforatum), pot marigold (Calendula officinalis L.) and dandelion (Taraxacum officinale) and the harmel (Peganum harmala) extract in the radiation-exposed Wistar rats. It was detected that when exposed to the ionizing radiation with dose of 6.9 Gray, blood sedimentation rate for rats decreased significantly. The blood clotting time increased almost in two times. When the animals were treated with the phytocomposition extract before radiation, the normal blood sedimentation rate and blood clotting time were observed. It also promoted preservation of the normal blood homeostasis. In contrast to the phytocomposition, the Peganum harmala extract did not demonstrate any significant radioprotective activities in the studied physiological parameters of the blood system

Key words: extract, phytocomposition, radiation, radioprotective properties, pot marigold, dandelion, blood

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INTRODUCTION

The ionizing radiation of natural and/or anthropogenic origin is considered as one of the most common which has a detrimental effect on the life processes of organisms in the modern world. This factor contributes to the occurrence of deep pathological changes in the most vulnerable and important for the well-being physiological systems one of which is the blood. The blood system at all life organization levels performs an exclusive function that unifies all types of physiological systems into one. Possessing with a high reactivity, the blood is quickly involved into the responses to the action physiological and extreme environmental factors providing the maintenance of homeostasis [1, 2, 3, 4]. The interest of many researchers to this problem is due also by the fact that in recent years the level of radiation has increased significantly and the search for possible natural or synthetic compounds having protective and recovery properties in relation to the pathological changes is one of the most vital [5, 6, 7]. The quantitative and qualitative analysis of the blood pattern allows to estimating in general terms such its functions as providing gas exchange between the blood and air, providing immunity and blood clotting, providing nutrients to the body cells, and regulating the creative relationships and homeostatic function.

In terms of the functional assessment the focus is set on the quantitative characteristics of blood – the number of red blood cells, white blood cells, platelets, determination of hemoglobin and erythrocyte sedimentation rate (ESR). The white blood cells are involved into the immune processes [8] and play an important role in the microvascular resistance creation.

In recent years, the interest to the studies of plant extracts and ecdysteroids having a range of positive properties in lack of any side effects on the animals and humans, has increased significantly. It is shown that the plant extracts have the adaptogenic, anabolic, immunomodulatory
and immunocorrecting, antioxidant and antiradical, antibacterial and anti-inflammatory influences which improves the blood rheological properties [9, 10]. It is known that the dysteroids affect the cell proliferation of vertebrates [11] that is of great importance in the development of anemia of different origin. Our early studies concerned radioprotective effect of extracts obtained from some medicinal plants of Azerbaijan and the results have been published in various scientific journals [12, 13, 14, 15, 16, 17].

This research is aimed at the comparative study and detection of the radioprotective properties for the extracts of harmel (Peganum harmala) and phytocompositions of common St. John’s wort (Hypericum perforatum), pot marigold (Calendula officinalis L.) and dandelion (Taraxacum officinale) spread in the regions of Azerbaijan.

RESEARCH PROCEDURES
The sexual matured male 5-6-month-age Wistar rats with the average mass of 150-180 g were used in the experiments. The animals were divided into four groups: 1) intact (control without exposure) – 12 rats; 2) group exposed to the ionizing radiation – 15 rats; 3) group getting ionizing radiation plus extract of harmel (Peganum harmala) – 15 rats; 4) group getting ionizing radiation plus extract of the phytocomposition of common St. John’s wort (Hypericum perforatum), pot marigold (Calendula officinalis L.) and dandelion (Taraxacum officinale) – 15 rats. The extraction was carried out from an alcohol solution in boiling at reflux ball-bearing condenser. Evaporation of solvent was carried out in vacuum in a rotary evaporator at 30-40° C until obtaining of pappy residue.

The experiments were carried out as follows: 15 min after the intraperitoneal injection of 5ml of 0.1% solution of the harmel extract and the extract of phytocomposition of common St. John’s wort, pot marigold and dandelion the animals were exposed to the ionizing radiation. The irradiation was carried out at the X-ray unit RUM-17, voltage was 18 kV, current was 15 mA, the KFR focus (distance from the source of radiation) was 3 cm, the strength of the dose was 0.86 Gray/sec, the total dose was 6.9 Gray/sec. Using the appropriate modern techniques the quantitative blood indicators were analyzed: blood sedimentation rate (BSR) mm/s, hemoglobin level mg/%, blood clotting time, number of erythrocytes and leukocytes in 1 mm³ – in the intact and experimental animals after 24 h of relief. During the experiment, the general status of animals was evaluated and the animals’ death time was recorded since the introduction of extract in all the observed groups.

RESULTS AND DISCUSSION
The extracts used in our studies are produced from the plants which are widespread in our country and for a long time were used in the folk medicine by the local communities. The perennial herbaceous plant harmel contains a significant amount of alkaloids – derivatives of quinazoline and indole. First, the harmaline substance is extracted in a pure form from the mixture of alkaloids. It is found that among alkaloids, contained in the seeds, 50-95% belong to harmaline, the harmine predominates in the roots (67-74% of total contents), and in grass the bulk mass is composed by peganine (78% of total alkaloids). The raw materials are used for preparing deoxypeganine hydrochloride possessing with anticholinesterase activity. The preparation has been used at disorders of the peripheral nervous system as the narcotic, antispastic, sedative and antiemetic drug [18].

The use of the lethal doses of ionizing radiation in the control group contributed to the development of morpho-functional deficiency of the whole blood composition complicated by the damages of some vital organs and systems that resulted in a significant mortality (3 animals) already for the 1st day. No cases of animal death were observed in the control series during the observation period. The results obtained from the blood analysis for the experimental animals are shown in the table.
As one can see from the table, the quantitative blood characteristics in the group of animals “control + radiation” were significantly different from the same in the intact animals not exposed to the radiation. Thus, it was detected that under the impact of ionizing radiation the blood sedimentation rate in animals decreased significantly. In addition, it was detected that the blood clotting time in the radiation-exposed animals increased almost by over two times. Some increase, though statistically insignificant, in the number of leukocytes and erythrocytes can be associated to toxic effect of the ionizing radiation leading to mobilization of blood system resources.

The absolutely different pattern of blood quantitative indicators is observed if the animals were treated with plant extracts before exposition to radiation. It appeared that 0.1% solution of the phytocomposition extract completely preserves the blood homeostasis where the optimum blood sedimentation rate is observed. It is known that the phytocomposition extract contains different essential oils, β-sitosterol, vitamins C and E, flavonoids, macro- and microelements and other iologically active substances. Such biochemical composition of the extract can promote plasma stabilization that in turn preserves the stability of the cellular elements of the blood system.

The results of our studies demonstrate that in contrast to the phytocomposition extract the 0.1% solution of *Peganum harmala* extract does not have any significant radioprotective activities in the studied physiological parameters of the blood system. In one day after the exposure to radiation under the injection of this plant extract the blood sedimentation rate in the experimental animals is somehow closer to the standard, but is still less evident than under the phytocomposition extract injection. Other blood parameters when exposed to the ionizing radiation under the injection of *Peganum harmala* extract to the animals, change in the same way. The obtained results concern fundamental issue of survival of organisms when exposed to the extreme factors and have the practical importance in the prevention of their negative consequences.

**CONCLUSIONS**

The data obtained by us evidence the prospective use of extracts of phytocomposition consisting of common St. John’s wort (*Hypericum perforatum*), pot marigold (*Calendula officinalis* L.), dandelion (*Taraxacum officinale*) and the extract of *Peganum harmala*, radiation dose – 6.9 Gray

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