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# EXPLORING THE MODIFICATION OF CONSTANT ACTION OF NATURAL RADIATION COMBINED WITH TECHNOGENIC. STUDY OF THE INFLUENCE OF BEE BREAD

***Abstract:*** *This study aimed to address immune system abnormalities in a population residing in an area characterized by continuous low-intensity natural radiation combined with anthropogenic radiation exposure. A group of volunteers, representative of the conditionally healthy population, received a dietary intervention supplemented with bee bread. The investigation focused on modulating the cellular component of non-specific resistance and immune system functionality. Following the course of bee pollen supplementation, the main study group exhibited significant improvements, including the restoration of neutrophil levels responsible for phagocytosis and inflammatory response. Additionally, there was a notable reduction in the frequency and severity of overt and covert immune deficiencies. These findings highlight the potential of bee bread (BB) as an adjunct therapeutic intervention for enhancing the immune system in populations exposed to radiation-related challenges. The study contributes to our understanding of strategies for mitigating immune system impairments in radiation-exposed individuals.*

***Keywords:*** *natural low-intensity ionizing radiation, cellular component of the immune system, non-specific resistance, immune system, restoration, bee bread.*

# ПОШУК МОДИФІКАЦІЇ ПОСТІЙНОЇ ДІЇ ПРИРОДНОЇ РАДІАЦІЇ КОМБІНОВАНОЇ З ТЕХНОГЕННОЮ. ДОСЛІДЖЕННЯ ВПЛИВУ БДЖОЛИНОГО ОБНІЖЖЯ

***Анотація*** *З метою корекції виявлених порушень системи імунітету в умовно здорового населення, що мешкає на території з постійною дією низькоінтенсивної природної радіації, комбінованої з техногенними радіаційними впливами, групі волонтерів додатково до харчового раціону було введено бджолине обніжжя курсом. Проведені дослідження виявили ознаки відновлення клітинної ланки неспецифічної резистентності та імунної системи. Це проявлялось в основній групі обстежених після курсу бджолиного обніжжя тенденцією до відновлення до рівня норми вмісту нейтрофілів, відповідальних за фагоцитоз та запалення, а також вірогідним зниженням частоти виявлення та рівня важкості наявної та скритої недостатності імунної системи.*

***Ключові слова:*** *природна низькоінтенсивна іонізуюча радіація, клітинна ланка системи імунітету, неспецифічна резистентність, імунна система, відновлення, бджолине обніжжя*

**Introduction**

In regions characterized by the coexistence of natural and anthropogenic ionizing radiation, populations face the potential compounding and magnification of detrimental factors affecting their physiological well-being. The persistent and cumulative exposure to adverse biotic, abiotic, and sociocultural elements within the environment can engender a state of compromised adaptation mechanisms, disturbances in the intricate interplay of psychoneuroimmune regulation, a decline in organismal resilience, and the subsequent development of pathological manifestations [1–3]. The research conducted by our team unveiled substantial perturbations within the hematological and immune systems of the population residing in the region of Kirovohrad Oblast, with particular focus on the city of Kropyvnytskyi [4, 5]. Given the aforementioned outcomes, the development of radioprotective strategies aimed at safeguarding the inhabitants of Kropyvnytskyi and analogous regions subjected to the continuous impact of dual radiation stress emerges as a pressing imperative.

Currently, it is widely acknowledged that nutrition represents the most optimal and practically feasible approach to protect the body against the continuous effects of ionizing radiation[6, 7]. Enhancing organism functioning, improving adaptability, and overall quality of life can be achieved by enriching the population's diet with vitamins, micronutrients, a complex of enzymes and coenzymes, as well as plant and animal biologically active additives or their complexes [7-9]. In addition to a well-balanced diet, it is necessary to introduce into the body biologically active substances (BAS) that possess radioprotective properties. Particularly, BAS positively influences neuroimmune-endocrine regulation and expands the adaptive capabilities of the major organ systems [2, 9]. In this context, BB appears to be of interest. BB is a combination of flower pollen particles bound together and partially digested by bee saliva [2, 10]. It serves as a natural multivitamin with unique morphological properties, chemical composition, and therapeutic-preventive properties [2, 10-13]. Experimental animal studies have demonstrated the effectiveness of BB as a radioprotective BAS under prolonged irradiation [2, 14].

The objective of this study was to investigate the potential impact of BB on the immune system, specifically on the cellular component of non-specific resistance and the immune system as a whole.

A study was conducted to investigate the effect of BB on the content of key elements in the leukogram, which quantitatively reflects the status of the cellular component of non-specific resistance and the immune system. The study involved 58 apparently healthy women residing in Kropyvnytskyi. Among them, 23 women in the main group (MG) received a course of BB supplementation in addition to their regular diet. The BB course lasted for 60 days, with a daily dose of 2,5 grams administered on an empty stomach. The women in the control group (CG) did not receive BB supplementation. At the end of the BB course, blood samples were collected from both groups of women to analyze the content of key elements in the leukogram. The assessment of immune status was conducted using first-level immunological tests, adjusted according to the age of the participants, based on previous research [15-18]. During the study, the immune system parameters were evaluated based on the absolute content of leukocytes and their specific subsets, including myelocytes, metamyelocytes, stab neutrophils, segmented neutrophils, eosinophils, basophils, monocytes, lymphocytes, and natural killers. The investigation utilized a hematological analyzer at the Polyclinic Union of the City Council in Kropyvnytskyi for analyzing the samples. Subsequently, the data were processed and analyzed at the Department of Microbiology, Virology, Immunology, and Medical Biology of Donetsk National Medical University in Kramatorsk.

The obtained results were subjected to statistical analysis using variation statistics methods. The software package Statistic Windows (version 1) and relevant measurement programs were employed for data processing and analysis.

The conducted research showed the absence of a negative impact and the presence of positive changes regarding the indicators of the cellular branch of non-specific resistance and the immune system. This means that the use of BB therapy (BPT) in the bodies of conditionally healthy women has a beneficial effect on the functioning of their immune system.

Changes in leukogram indicators, such as an increase or decrease in specific types of leukocytes (e.g., neutrophils, eosinophils, monocytes, etc.), may indicate the body‘s immune response activity. In Figure 1 and Figure 2, the data on the content of leukocytes and the main elements of the leukogram reflecting the state of non-specific resistance and

immune system in conditionally healthy women (CHW) residing in Kropyvnytskyi, Kirovohrad region, after the course of BB is presented.

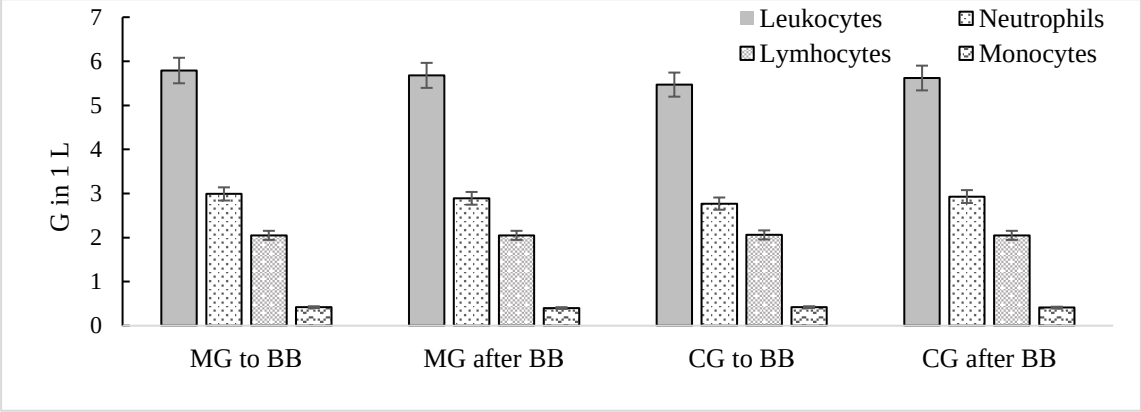


Figure 1. – The effect of bee bread (BB) supplementation on leukocyte, neutrophil, and lymphocyte counts in conditionally healthy women residing in Kropyvnytskyi, Kirovohrad region, for both the Main group (MG) and control group (CG).

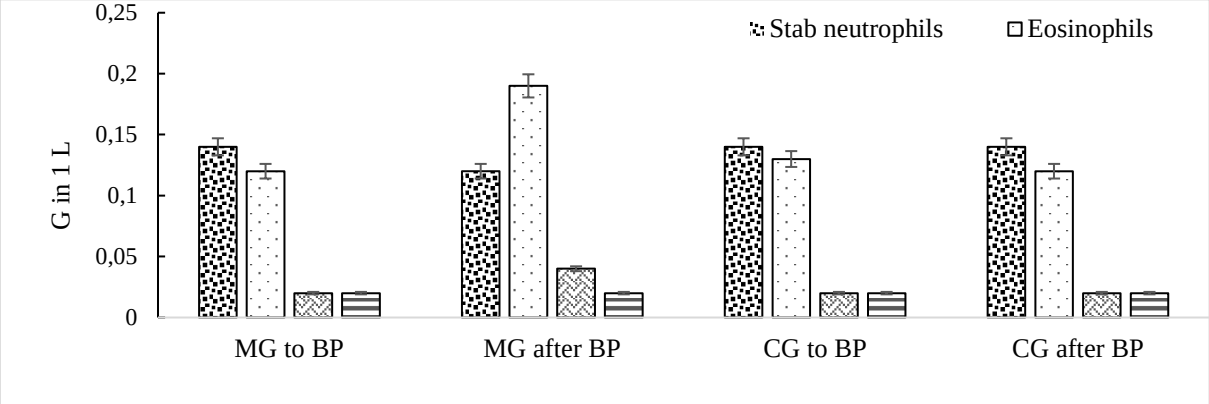


Figure 2. – The effect of bee bread(BB) supplementation on the counts of stab neutrophils, eosinophils, basophils, and natural killer cells in conditionally healthy women residing in Kropyvnytskyi, Kirovohrad Region, for both the main group (MG) and control croup (CG).

As seen from the data presented in Figures 1 and 2, there were minimal quantitative changes in the content of cells representing the cellular branch of non-specific resistance in individuals of the main group after the course of BB supplementation. Only a weak tendency towards changes in the content of leukocytes and leukogram elements, except for a portion of granulocytes, was observed. The content of stab neutrophils and segmented neutrophils, compared to the initial data of the MG and CG groups, as well as the reference values, did not show significant differences (P>0,05) during the period after consuming BB.

The content of stab neutrophils was within the normal range, on average, prior to the start of the therapy course in both the MG and CG groups. However, elevated levels of stab neutrophils were observed in 13,04±1,5% of individuals in the MG group and 12,0±1,29% of individuals in the CG group before the BB course. After the BB course, the content of stab neutrophils in the MG group did not exceed the normal range, while in 16,0±1,47% of individuals in the CG group, the content of stab neutrophils remained elevated.

According to the findings, there were no statistically significant differences in the mean content of segmented neutrophils between the MG and CG groups, both before and after the BB course. However, it is noteworthy that prior to the course, an elevated proportion of individuals in the MG group (43,48±2,15%) exhibited increased levels of segmented neutrophils, whereas, after the course, none of the individuals showed elevated levels. In contrast, the CG group maintained consistent levels of segmented neutrophils before and after the BB course, with values of 44,0±2,16% and 40,0±1,96%, respectively. These observations were made within an academic framework to analyze the impact of the BB intervention on the content of segmented neutrophils in the respective groups.

Prior to the BB course, basophils, which are not mandatory elements of the leukogram, were detected in 56,5±2,16% of individuals in the MG group and 56,0±1,98% of individuals in the CG group. The average content of basophils did not differ significantly between the MG and CG groups prior to the BB course. Elevated levels of basophils were observed in 13,04±1,46% of individuals in the MG group and 16,0±1,47% of individuals in the CG group. After the BB course, the frequency of individuals with elevated basophil levels did not change in both the MG and CG groups. However, in

the MG group, the content of basophils was twice as high as the baseline values in both groups and the values in the CG group after the BB course. These changes, however, did not reach statistical significance (P>0,05).

An exception among the granulocytes was observed with eosinophils, whose content significantly increased, on average, in individuals from the MG group after the BB course (P<0,05), compared to the baseline values and the CG group before and after the course. The content of eosinophils in the MG group after the BB course showed a tendency to increase compared to the average values of the CHW but remained within the normal range. The increase in eosinophil content after the BB course was detected in only 17,39±1,65% of individuals in the MG group and did not exceed the normal limits (0-0,45 G in 1L) [15-16].

Individually, it was observed that 13,04±1,46% of individuals in the MG group and 16,0±1,47% of individuals in the CG group exhibited elevated levels of monocytes, both prior to and following the BB course. However, when considering the average values, the overall content of monocytes in both the MG and CG groups did not demonstrate statistically significant variations before or after the administration of BB.

In the course of the study using routine methods, the average content of immune system cells, specifically lymphocytes, showed minimal changes in both the MG and CG groups, both prior to and following the BB course. In 30,43±2,0% of individuals in the MG group and 28,0±1,79% of individuals in the CG group, mild to moderate immune system deficiency was observed. Additional investigations, specifically the assessment of hidden immune deficiency [19], revealed that prior to the BB course, 26,07±1,68% of individuals in the MG group and 28,0±1,79% of individuals in the CG group also exhibited hidden immune deficiency. The combined occurrence of overt and hidden immune system deficiency in the MG group was 56,5±2,6%, while in the CG group, it was 56,0±1,90%. Following the BB course, the frequency of overt immune system deficiency in the MG group decreased to 13,04%, compared to baseline (P<0,05). The identified immune system deficiency in the MG group was of mild severity. The frequency of hidden immune system deficiency in the MG group remained unchanged. Thus, the cumulative frequency of overt and hidden immune system deficiency after the BB course in the MG group likely decreased to 43,48±2,1% (P<0,05). No changes were observed in the CG group.

The frequency of natural killer cells did not show any significant differences before and after the BB course, both in the MG and CG groups. However, in the MG group, the frequency of these cells likely decreased from 30,43±2,0% to 13,04% after the BB course. In contrast, in the CG group, the frequency of natural killer cells and their content after the BB course did not differ from the baseline data.

Thus, the conducted research has shown a positive impact of the BB course, manifested by a tendency towards restoring the cell content to normal levels, primarily neutrophils, which are responsible for phagocytosis and inflammation. Furthermore, there is a likely reduction in the frequency of detection of both overt and hidden immune system deficiencies and their manifestations.

**Conclusions:**

The course of bee bread administration has a positive impact on the cellular component of non-specific resistance, as evidenced by a tendency towards normalization of the indicators.

The course of bee bread administration positively affects the cellular component of the immune system, with a tendency towards its restoration and a decrease in the frequency and severity of both evident and hidden deficiencies in lymphocyte content.

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