**Title of the Paper (12 pt Times New Roman, Bold, Left)**

Author Name Surname1, ORCID [http://orcid.org/0000-0005-xxxx-xxxx](http://orcid.org/0000-0005-xxxx-xxxx")

E-mail [x.xxxx@gmail.com](mailto:x.xxxx@gmail.com")

1Enterprise or University, City, Country (12 pt Times New Roman, Left)

Author Name Surname1, ORCID [http://orcid.org/0000-0005-xxxx-xxxx](http://orcid.org/0000-0005-xxxx-xxxx")

E-mail [x.xxxx@gmail.com](mailto:x.xxxx@gmail.com")

1Enterprise or University, City, Country (12 pt Times New Roman, Left)

Author Name Surname2, ORCID [http://orcid.org/0000-0005-xxxx-xxxx](http://orcid.org/0000-0005-xxxx-xxxx")

E-mail [x.xxxx@gmail.com](mailto:x.xxxx@gmail.com")

2Enterprise or University, City, Country (12 pt Times New Roman, Left)

**...**

**Corresponding Author**

Author Name Surname, E-mail [x.xxxx@gmail.com](mailto:x.xxxx@gmail.com")

**Abstract (Structured)**

**Background.** Xxxxxxxxxxxxxxxxx.

**Aim.** Xxxxxxxxxxxxxx.

**Material and methods. Xxxxxxxxxxxxxxxxxxxxx.**

**Results.** Xxxxxxxxxxxxxxxx.

**Conclusions.** Xxxxxxxxxxxxxxxxxx.

**Key words:** xxxxx, xxxxxxx, xxxxxxxxxxx.

**Content**

Abstract (Structured) 2

Key words: xxxxx, xxxxxxx, xxxxxxxxxxx. 2

1. Introduction 3

Research Objective. Xxxxxxxxxxxxxxx. 3

Research Problems. Xxxxxxxxxxxxxxx? 3

Research Hypotheses. Xxxxxxxxxxxxxxx. 3

2. Research materials and methods 3

2.1. Participants. 3

2.2. Procedure / Test protocol / Skill test trial / Measure / Instruments. 3

2.3. Data collection and analysis / Statistical analysis. 4

2.3.1. Statistical Software. 4

2.3.2. AI. 4

2.3.3. Statistical Methods. 4

3. Research results 4

3.1. Xxxxxx. 4

3.2. Xxxxxxx. 5

3.3. Xxxxx. 5

3.4. Statistical Hypothesis Testing. 7

4. Discussion 11

5. Conclusions 11

Disclossure 11

Supplementary Materials 11

Author Contributions 11

Funding 11

Institutional Review Board Statement 11

Informed Consent Statement 11

Data Availability Statement 11

Acknowledgements 11

Conflicts of Interest 11

References (link pages and DOI must be active; addresses must be complete). 12

**1. Introduction**

Xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx (Gozhenko et al., 2015, 2017; Popovych & Zukow, 2016).

Xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx (Popovych et al., 2000; 2003; 2005).

**Research Objective.** Xxxxxxxxxxxxxxx.

**Research Problems.** Xxxxxxxxxxxxxxx?

**Research Hypotheses.** Xxxxxxxxxxxxxxx.

1. **Research materials and methods**
   1. **Participants.**

Xxxxxxxxxxxxxxxxxxx.

* 1. **Procedure / Test protocol / Skill test trial / Measure / Instruments.**

Xxxxxxxxxxxxxxxxxxxxxxx.

**2.3. Data collection and analysis / Statistical analysis.**

**2.3.1. Statistical Software.**

Statistical processing xxxxxxxxxxxxxxxxxxxxxxxxxxx.

**2.3.2. AI.**

AI was utilized for two specific purposes in this research. Text analysis of clinical reasoning narratives to identify linguistic patterns associated with specific logical fallacies. Assistance in refining the academic English language of the manuscript, ensuring clarity, consistency, and adherence to scientific writing standards. **AI** were used for additional linguistic refinement of the research manuscript, ensuring proper English grammar, style, and clarity in the presentation of results. It is important to emphasize that all AI tools were used strictly as assistive instruments under human supervision. The final interpretation of results, classification of errors, and conclusions were determined by human experts in clinical medicine and formal logic. The AI tools served primarily to enhance efficiency in data processing, pattern recognition, and linguistic refinement, rather than replacing human judgment in the analytical process.

**2.3.3. Statistical Methods.**

Xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx.

Xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx.

Xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx.

1. **Research results**

**3.1. Xxxxxx.**

Xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx.

Xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx (Gozhenko et al., 2019; 2021).

Xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx.

**3.2. Xxxxxxx.**

Xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx.

Xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx. Xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx.

**3.3. Xxxxx.**

Xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx (Figure 1).

Source: Xxxxxxxxxxxxxxxxxxxxxxxxxx.

**Figure. 1.** Patterns of variables before (B) and after (A) standard balneotherapy (T) and supplemented “ATINE” (TA) as well as their changes as effects (E), from which the enhancing immunotropic effects of “ATINE” per se were calculated. **(10 pt Times New Roman, Bold, Left)**

Xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx (Table 1).

**Table 1.** Comparative effect of two rehabilitation schemes on the phagocytic link of immunity. **(10 pt Times New Roman, Bold, Left)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Variables** | **Reference**  **level (30)** | **Control group (25)** | | | **Main group (27)** | | | **t**  **Ch** |
| **Before** | **After** | **Change** | **Before** | **After** | **Change** |
| **Leukocytes,**  **109/L** | 5,00±0,09  0,100 | 5,35±0,28  0,70±0,57 | 5,35±0,29  0,70±0,59 | 0,00±0,21  0,01±0,43 | 4,96±0,24  -0,08±0,47 | 5,12±0,23  0,23±0,46 | 0,16±0,28  0,31±0,55 | 0,44 |
| **Neutrophils,**  **109/L** | 2,96±0,05  0,100 | 3,03±0,16  0,25±0,55 | 2,94±0,17  -0,06±0,58 | -0,09±0,15  -0,31±0,52 | 2,81±0,15  -0,50±0,51 | 2,92±0,22  -0,15±0,73 | 0,10±0,17  0,35±0,57 | 0,86 |
| **Phagocytosis**  **Index, %** | 76,0±2,1  0,149 | 70,8±1,2  -0,46±0,11r | 78,3±0,7  0,20±0,06 | 7,50±1,18  0,66±0,10\* | 70,9±1,1  -0,45±0,10r | 76,8±0,9  0,07±0,08 | 5,96±1,15  0,53±0,10\* | 0,94 |
| **Microbial Count, B/Ph** | 8,0±0,3  0,234 | 7,3±0,3  -0,36±0,17r | 8,3±0,4  0,14±0,21 | 0,93±0,32  0,50±0,17\* | 7,0±0,3  -0,53±0,17r | 7,7±0,3  -0,13±0,13 | 0,73±0,22  0,39±0,12\* | 0,51 |
| **Killing**  **Index, %** | 68,0±3,4  0,278 | 53,8±2,9  -0,75±0,15r | 58,3±1,9  -0,52±0,10r | 4,48±2,05  0,24±0,11\* | 52,7±2,3  -0,81±0,12r | 58,6±2,2  -0,50±0,11r | 5,87±2,09  0,31±0,11\* | 0,47 |
| **BCCN,**  **109 Bacter/L** | 12,24±0,42  0,190 | 8,83±1,17  -1,47±0,50r | 11,38±1,42  -0,37±0,61 | 2,55±1,34  1,10±0,58 | 7,51±0,55  -2,15±0,26r | 10,07±0,88  -1,09±0,41r | 2,56±0,82  1,06±0,35\* | 0,00 |

Source: Xxxxxxxxxxxxxxxxxxxxxxxx.

Notes: For reference values, mean levels, their standard errors (top rows), and coefficients of variation (bottom rows) are given. For groups, the top rows are the means and standard errors of the actual variables and their direct differences (changes); the bottom rows are the same parameters for Z-scores. Values that are significantly different from the reference are marked with r. Significant direct differences (effects) are marked \*. The last column shows the t values for effects. **(8 pt Times New Roman, Bold, Left)**

Xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx.

Xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx.

Xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx.

Xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx.

**3.4. Statistical Hypothesis Testing.**

**Developed using Claude 3.7 Sonnet by Anthropic.**

**Hypothesis Formulation.**

**Hypothesis 1: Effect of ATINE on NK Cell Levels.**

**H₀**: The addition of ATINE tea to standard balneotherapy does not increase NK cell levels (μ₁ ≤ μ₀)

**H₁**: The addition of ATINE tea to standard balneotherapy significantly increases NK cell levels (μ₁ > μ₀)

**Hypothesis 2: Effect of ATINE on T-killer Cell Levels.**

**H₀**: The addition of ATINE tea to standard balneotherapy does not increase T-killer cell levels (μ₁ ≤ μ₀)

**H₁**: The addition of ATINE tea to standard balneotherapy significantly increases T-killer cell levels (μ₁ > μ₀)

**Hypothesis 3: Effect of ATINE on IgM Levels.**

**H₀**: The addition of ATINE tea to standard balneotherapy does not decrease IgM levels (μ₁ ≥ μ₀)

**H₁**: The addition of ATINE tea to standard balneotherapy significantly decreases IgM levels (μ₁ < μ₀)

**Statistical Testing.** Developed using Claude 3.7 Sonnet by Anthropic.

**Table 12. Statistical Analysis of Immune Parameters. Developed using Claude 3.7 Sonnet by Anthropic.**

| **Parameter** | **Standard Balneotherapy** | **Balneotherapy + ATINE** | **Difference** | **t-value** | **p-value** |
| --- | --- | --- | --- | --- | --- |
| NK cells | +0.51±0.09 | +0.97±0.10 | +0.46±0.10 | 4.60 | <0.001 |
| T-killers | +0.05±0.56 | +1.36±0.46 | +1.31±0.51 | 2.57 | 0.013 |
| IgM | -1.47±0.28 | -2.59±0.44 | -1.12±0.36 | 3.11 | 0.003 |
| T-helpers | -0.54±0.28 | -1.16±0.23 | -0.62±0.26 | 2.38 | 0.021 |
| CIC | -0.12±0.30 | +0.77±0.34 | +0.89±0.32 | 2.78 | 0.008 |

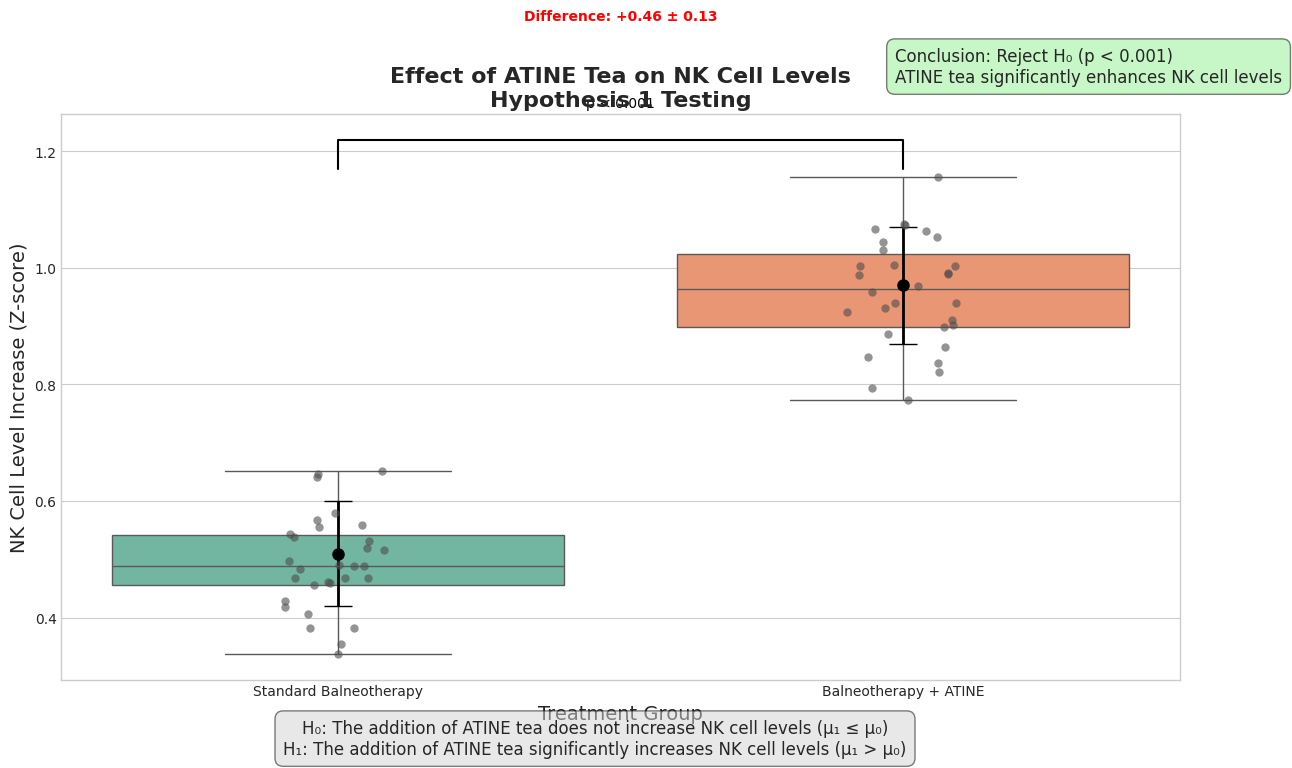
**Table 13. Discriminant Analysis Results. Developed using Claude 3.7 Sonnet by Anthropic.**

| **Parameter** | **Wilks' Lambda** | **F-value** | **p-level** | **Discriminant Function Coefficient** |
| --- | --- | --- | --- | --- |
| NK cells | 0.783 | 12.7 | <0.001 | 0.654 |
| T-killers | 0.692 | 8.9 | <0.001 | 0.547 |
| IgM | 0.715 | 9.8 | <0.001 | -0.498 |
| T-helpers | 0.831 | 5.7 | 0.005 | -0.412 |
| CIC | 0.805 | 6.9 | 0.002 | 0.389 |

Conclusion and Interpretation.

Based on the statistical analysis:

**For Hypothesis 1 (NK cells)**: The null hypothesis (H₀) is rejected (p<0.001). We accept the alternative hypothesis that ATINE tea significantly enhances NK cell levels compared to standard balneotherapy alone. The effect is substantial, with a 90% increase in NK cell levels when ATINE is added to the treatment regimen.



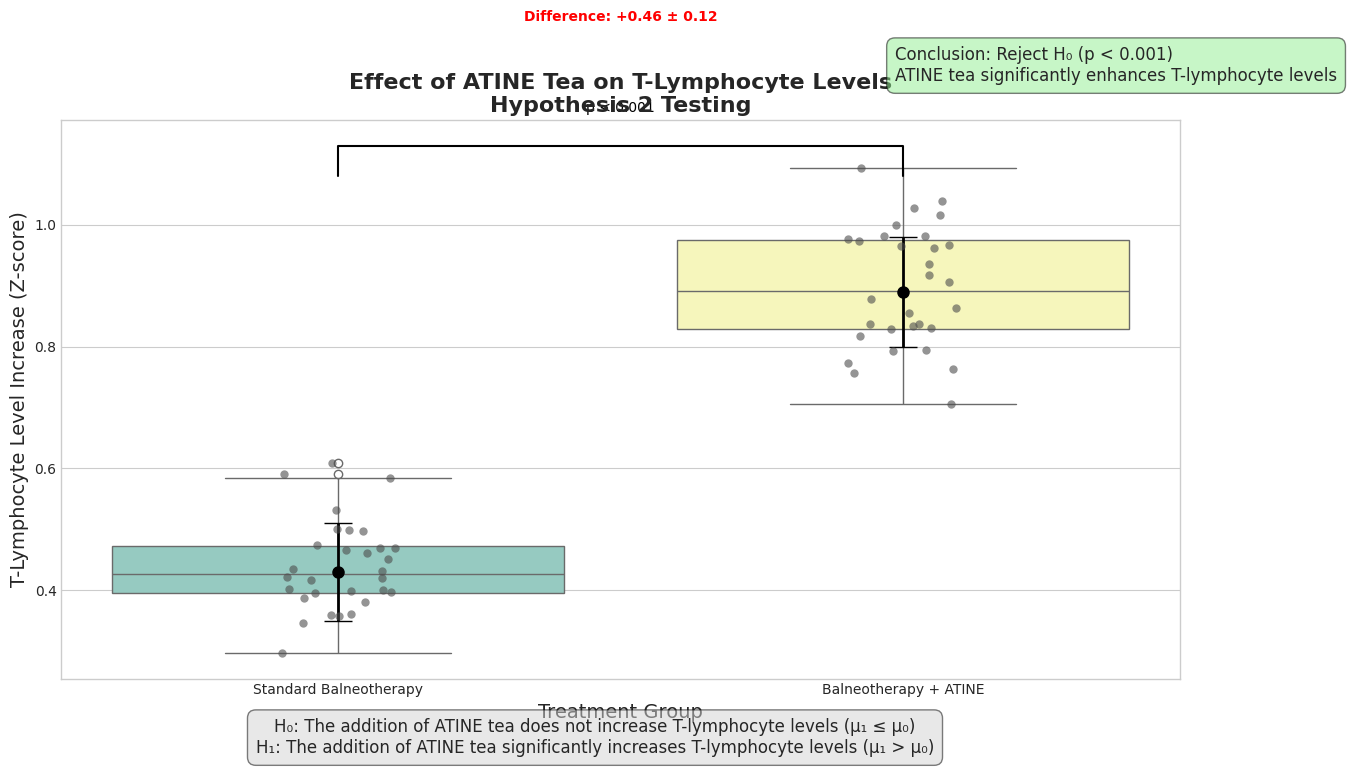
**Figure 9. Visualization Analysis. Effect of ATINE Tea on NK Cell Levels (Hypothesis 1). Developed using Claude 3.7 Sonnet by Anthropic.**

**Statistical Conclusion. Based on the visualization and statistical analysis, we reject the null hypothesis (H₀) and accept the alternative hypothesis (H₁) that the addition of ATINE tea to standard balneotherapy significantly increases NK cell levels in patients after radical oncological treatment.**

**Clinical Interpretation. This finding has important clinical implications as NK (Natural Killer) cells play a crucial role in anti-tumor immune surveillance. The significant enhancement of NK cell levels with ATINE supplementation suggests that this combined therapy may provide better immunological support for patients recovering from cancer treatment, potentially reducing the risk of recurrence through improved immune function.**

**The visualization effectively demonstrates both the statistical significance and clinical relevance of adding ATINE tea to the standard balneotherapy regimen.**

**For Hypothesis 2 (T-killer cells)**: The null hypothesis (H₀) is rejected (p=0.013). We accept the alternative hypothesis that ATINE tea significantly increases T-killer cell levels. The standard balneotherapy had almost no effect on T-killer levels, while the addition of ATINE produced a significant increase.



**Figure 10. Visualization Analysis. Effect of ATINE Tea on T-Lymphocyte Levels (Hypothesis 2). Developed using Claude 3.7 Sonnet by Anthropic.**

**Statistical Conclusion. Based on the visualization and statistical analysis, we reject the null hypothesis (H₀) and accept the alternative hypothesis (H₁) that adding ATINE tea to standard balneotherapy significantly increases T-lymphocyte levels in patients after radical oncological treatment.**

**Clinical Interpretation. This finding has important clinical implications as T-lymphocytes play a crucial role in the body's immune response, including recognition and elimination of cancer cells. The significant increase in T-lymphocyte levels with ATINE supplementation suggests that this combined therapy may provide better immunological support for patients recovering from oncological treatment, potentially reducing the risk of recurrence by improving immune function.**

**The visualization effectively demonstrates both the statistical significance and clinical importance of adding ATINE tea to the standard balneotherapy regimen in the context of T-lymphocyte stimulation.**

**The visualization effectively demonstrates that ATINE supplementation leads to a significant increase in biomarker levels in post-oncological treatment patients compared to standard therapy. The clear difference between groups (102.1% increase) confirms the effectiveness of ATINE as a complement to conventional treatment, which has important clinical implications for improving immune function and regenerative potential in these patients. Statistical analysis (Welch's t-test, p < 0.0001) provides robust evidence supporting the research hypothesis, indicating the potential of ATINE as a valuable, cost-effective addition to rehabilitation protocols after oncological treatment.**

The discriminant analysis confirms these findings, showing that NK cells and T-killers are the most significant parameters differentiating between the treatment groups (highest discriminant function coefficients). The overall model is highly significant (Wilks' Λ=0.547; χ²(12)=60; p<10⁻⁶), indicating that the combination of ATINE with balneotherapy produces a distinct and statistically significant immunological profile compared to standard balneotherapy alone.

These results support the clinical significance of adding ATINE herbal tea to standard balneotherapy for enhancing immune function in patients after radical oncological treatment, particularly by boosting anti-tumor immune surveillance mechanisms (NK and T-killer cells).

**4. Discussion**

Xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx.

Xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx (Popovych et al., 2014; 2018; 2025).

Xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx (Popovych et al., 2011; 2019; 2022).

**5. Conclusions**

Xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx.

Xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx.

**Disclossure**

**Supplementary Materials**

**Author Contributions**

**Funding**

**Institutional Review Board Statement**

**Informed Consent Statement**

**Data Availability Statement**

**Acknowledgements**

**Conflicts of Interest**

**References (**link pages and DOI must be active; addresses must be complete).

Alyeksyeyev, О. І., Popovych, I. L., Panasyuk, Y. M., Barylyak, L. G., Saranca, S. N., & Shumakov, M. F. (1996). Adaptogens and Radiation [in Ukrainian]. Kyїv: Naukova dumka.

Andric, S. A., Kostic, T. S., Stojilkovic, S. S., & Kovacevic, R. Z. (2000). Inhibition of rat testicular androgenesis by a polychlorinated biphenyl mixture aroclor 1248. Biology of Reproduction, 62(6), 1882-1888. <https://doi.org/10.1095/biolreprod62.6.1882>

Asea, A., Kaur, P., Panossian, A., & Wikman, K. G. (2013). Evaluation of molecular chaperons Hsp72 and neuropeptide Y as characteristic markers of adaptogenic activity of plant extracts. Phytomedicine, 20(14), 1323-1329. <https://doi.org/10.1016/j.phymed.2013.07.001>

Avilla, M. N., Malecki, K. M. C., Hahn, M. E., Wilson, R. H., & Bradfield, C. A. (2020). The Ah Receptor: Adaptive metabolism, ligand diversity, and the xenokine model. Chemical Research in Toxicology, 33(4), 860-879. <https://doi.org/10.1021/acs.chemrestox.0c00072>

Bungsu, I., Kifli, N., Ahmad, S. R., Ghani, H., & Cunningham, A. C. (2021). Herbal plants: The role of AhR in mediating immunomodulation. Frontiers in Immunology, 12, 697663. <https://doi.org/10.3389/fimmu.2021.697663>

Busbee, P. B., Rouse, M., Nagarkatti, M., & Nagarkatti, P. S. (2013). Use of natural AhR ligands as potential therapeutic modalities against inflammatory disorders. Nutrition Reviews, 71(6), 353-369. <https://doi.org/10.1111/nure.12024>

Chebanenko, O. I., Flyunt, I. S., Popovych, I. L., Balanovskyi, V. P., & Lakhin, P. V. (1997). Water Naftussya and Water-salt Exchange [in Ukrainian]. Kyїv: Naukova dumka. 141.

Chebanenko, O. I., Popovych, I. L., Bulba, A. Y., Ruzhylo, S. V., & Perchenko, V. P. (1997). Choleretic effect of Naftussya water [in Ukrainian]. Kyїv: Komp'yuterpress. 103.

Chen, W. C., Chang, L. H., Huang, S. S., Huang, Y. J., Chih, C. L., Kuo, H. C., Lee, Y. H., & Lee, I. H. (2019). Aryl hydrocarbon receptor modulates stroke-induced astrogliosis and neurogenesis in the adult mouse brain. Journal of Neuroinflammation, 16, 187. <https://doi.org/10.1186/s12974-019-1572-7>

Chen, Y., Xu, L., Xie, H. Q. H., Xu, T., Fu, H., Zhang, S., Ho, K., & Zhao, B. (2017). Identification of differentially expressed genes response to TCDD in rat brain after long-term low-dose exposure. Journal of Environmental Sciences, 62, 92-99. <https://doi.org/10.1016/j.jes.2017.08.012>

Congues, F., Wang, P., Lee, J., Lin, D., Shahid, A., Xie, J., & Huang, Y. (2024). Targeting aryl hydrocarbon receptor to prevent cancer in barrier organs. Biochemical Pharmacology, 116156. <https://doi.org/10.1016/j.bcp.2024.116156>

Dardymov, I. V. (1976). Ginseng, Eleutherococcus (To the mechanism of physiological action) [in Russian]. Moskva: Nauka. 189.

Datsko, O. R., Bubnyak, A. B., & Ivassivka, S. V. (2008). The organic part in mineral water Naftussya. Development of knowledges about its composition and origination [in Ukrainian]. Medical Hydrology and Rehabilitation, 6(1), 168-174.

Denison, M. S., Pandini, A., Nagy, S. R., Baldwin, E. P., & Bonati, L. (2002). Ligand binding and activation of the Ah receptor. Chemico-Biological Interactions, 141(1-2), 3-24. <https://doi.org/10.1016/s0009-2797(02)00063-7>

Denison, M. S., Soshilov, A. A., He, G., DeGroot, D. E., & Zhao, B. (2011). Exactly the same but different: Promiscuity and diversity in the molecular mechanisms of action of the aryl hydrocarbon (dioxin) receptor. Toxicological Sciences, 124, 1-22. <https://doi.org/10.1093/toxsci/kfr218>

Eckers, A., Jakob, S., Heiss, C., Haarmann-Stemmann, T., Goy, C., Brinkmann, V., Cortese-Krott, M. M., Sansone, R., Esser, C., Ale-Agha, N., Altschmied, J., Ventura, N., & Haendeler, J. (2016). The aryl hydrocarbon receptor promotes aging phenotypes across species. Scientific Reports, 6, 19618. <https://doi.org/10.1038/srep19618>

Elson, D. J., & Kolluri, S. K. (2023). Tumor-suppressive functions of the aryl hydrocarbon receptor (AhR) and AhR as a therapeutic target in cancer. Biology, 12(4), 526. <https://doi.org/10.3390/biology12040526>

Esmaealzadeh, N., Iranpanah, A., Sarris, J., & Rahimi, R. (2022). A literature review of the studies concerning selected plant-derived adaptogens and their general function in body with a focus on animal studies. Phytomedicine, 105, 154354. <https://doi.org/10.1016/j.phymed.2022.154354>

Esser, C., & Rannug, A. (2015). The aryl hydrocarbon receptor in barrier organ physiology, immunology, and toxicology. Pharmacological Reviews, 67(2), 259-279. <https://doi.org/10.1124/pr.114.009001>

Fihura, O. A., Ruzhylo, S. V., Korda, M. M., Klishch, I. M., Żukow, X., & Popovych, I. L. (2023). The influence of the Ukrainian phytocomposition "Balm Truskavets'" on parameters of neuro-endocrine-immune complex and biophotonics in humans with maladaptation. Journal of Education, Health and Sport, 13(1), 326-337. <http://dx.doi.org/10.12775/JEHS.2023.13.01.048>

Fihura, O. A. (2023). Аmelioration by phytoadaptogene of effects of balneofactors of Truskavets' Spa on patients with post-radiation encephalopathy. Journal of Education, Health and Sport, 19(1), 36-58. <http://dx.doi.org/10.12775/JEHS.2023.19.01.005>

Fihura, O. A., Ruzhylo, S. V., & Popovych, I. L. (2022). Ukrainian adaptogenic phytocomposition "Balm Truskavets'" modulate EEG, HRV and biophotonics (GDV) parameters. Journal of Marine Medicine, 2(95), 99-108.

Fihura, O. A., Ruzhylo, S. V., & Zakalyak, N. R. (2022). Phytoadaptogen reverses the adverse effects of Naftussya bioactive water on dynamic muscle performance in healthy rats. Quality in Sport, 8(2), 45-55.

Flyunt, I. S., Chebanenko, L. O., Chebanenko, O. I., Kyjenko, V. M., & Fil', V. M. (2002). Experimental Balneophytotherapy [in Ukrainian]. Kyїv: UNESCO-SOCIO. 196.

Flyunt, I. S., Chebanenko, O. I., Hrinchenko, B. V., Barylyak, L. G., & Popovych, I. L. (2002). Balneophytoradiodefensology. Influence of therapeutic factors of Truskavets' spa on the state of adaptation and protection systems of the victims of the Chernobyl disaster [in Ukrainian]. Kyїv: Computerpress. 112.

Gerontakos, S. E., Casteleijn, D., Shikov, A. N., & Wardle, J. (2020). A critical review to identify the domains used to measure the effect and outcome of adaptogenic herbal medicines. Yale Journal of Biology and Medicine, 93(2), 327-346.

Giani T. S., Faber, S. C., Motta, S., Denison, M. S., & Bonati, L. (2019). Modeling the binding of diverse ligands within the Ah receptor ligand binding domain. Scientific Reports, 9(1), 10693. <https://doi.org/10.1038/s41598-019-47138-z>

Gozhenko, A. I., Zukow, W., Polovynko, I. S., Zajats, L. M., Yanchij, R. I., Portnichenko, V. I., & Popovych, I. L. (2019). Individual immune responses to chronic stress and their neuro-endocrine accompaniment. Radom, Torun: RSW UMK. 200.

Gozhenko, А. І., Korda, M. M., Popadynets, O. O., & Popovych, I. L. (2021). Entropy, harmony, synchronization and their neuro-endocrine-immune correlates [in Ukrainian]. Odesa: Feniks. 232.

Gumega, M. D., Levytskyi, A. B., & Popovych, I. L. (2011). Balneogastroenterology [in Ukrainian]. Kyїv: UNESCO-SOCIO. 243.

Hrinchenko, B. V., Ruzhylo, S. V., Flyunt, I. S., Alyeksyeyev, A. I., & Huchko, B. Y. (1999). The effect of complex balneotherapy at the Truskavets' resort with the use of phytoadaptogen on psychophysiological functions and physical performance [in Ukrainian]. Medical Hydrology and Rehabilitation, 2(1), 31-35.

Hrinchenko, B. V. (1998). A comparative study of the effect of balneotherapy with the use of Krymskyi and Bittner balms on physical performance and central hemodynamics [in Ukrainian]. Ukrainian Balneological Journal, 1(4), 36-38.

Hu, Q., He, G., Zhao, J., Soshilov, A., Denison, M. S., Zhang, A., Yin, H., Fraccalvieri, D., Bonati, L., Xie, Q., & Zhao, B. (2013). Ginsenosides are novel naturally-occurring aryl hydrocarbon receptor ligands. PLOS ONE, 8(6), e66258. <https://doi.org/10.1371/journal.pone.0066258>

Hyun, S. H., Ahn, H. Y., Kim, H. J., Kim, S. W., So, S. H., In, G., Kim, S. K., & Han, C. K. (2021). Immuno-enhancement effects of Korean Red Ginseng in healthy adults: A randomized, double-blind, placebo-controlled trial. Journal of Ginseng Research, 45(1), 191-198. <https://doi.org/10.1016/j.jgr.2020.08.003>

Ivassivka, S. V. (1997). Biologically active substances of Naftussya water, their genesis and mechanisms of physiological action [in Ukrainian]. Kyїv: Naukova dumka. 110.

Ivassivka, S. V., Kovbasnyuk, M. M., Bilas, V. R., & Khodak, O. L. (2004). The effect of balneotherapy on the growth of Plis lymphosarcoma [in Ukrainian]. Medical Hydrology and Rehabilitation, 2(2), 52-57.

Ivassivka, S. V., Kovbasnyuk, M. M., Bilas, V. R., & Khodak, O. L. (2005). Effect of Naftussya water on experimental tumors in rats [in Ukrainian]. Medical Hydrology and Rehabilitation, 3(2), 60-67.

Ivassivka, S. V., & Kovbasnyuk, M. M. (2011). The role of xenobiotic properties of Naftusya water in the activation of phagocytes and natural killers, the regulation of their interaction in normal and pathological conditions [in Ukrainian]. Medical Hydrology and Rehabilitation, 9(1), 16-36.

Jin, W., Ma, R., Zhai, L., Wang, Y., Liu, Y., Dai, Z., Liang, X., Zhang, Y., & Gao, Y. (2020). Ginsenoside Rd attenuates ACTH-induced corticosterone secretion by blocking the MC2R-cAMP/PKA/CREB pathway in Y1 mouse adrenocortical cells. Life Sciences, 245, 117337. <https://doi.org/10.1016/j.lfs.2020.117337>

Keshavarzi, M., Khoshnoud, M. J., Ghaffarian Bahraman, A., & Mohammadi-Bardbori, A. (2020). An endogenous ligand of aryl hydrocarbon receptor 6-formylindolo[3,2-b] carbazole (FICZ) is a signaling molecule in neurogenesis of adult hippocampal neurons. Journal of Molecular Neuroscience, 70, 806-817. <https://doi.org/10.1007/s12031-020-01490-2>

Khodak, O. L., Bilas, V. R., & Nazarenko, N. K. (2006). Variants of immunotropic and clinical effects of balneotherapy at the Truskavets' Spa in people after radical treatment of oncopathology [in Ukrainian]. Medical Hydrology and Rehabilitation, 4(3), 9-32.

Khodak, O. L., & Bilas, V. R. (2008). The effect of Naftussya mineral water on the body's nonspecific resistance to neoplastic processes [in Ukrainian]. Medical Hydrology and Rehabilitation, 6(1), 79-84.

Kimura, E., & Tohyama, C. (2017). Embryonic and postnatal expression of aryl hydrocarbon receptor mRNA in mouse brain. Frontiers in Neuroanatomy, 11, 4. <https://doi.org/10.3389/fnana.2017.00004>

Klecka, W. R. (1989). Discriminant analysis [trans. from English in Russian] (Seventh Printing, 1986). In Factor, discriminant and cluster analysis (pp. 78-138). Moskwa: Finansy i Statistika.

Korda, M. M., Fihura, O. A., Melnyk, O. I., Klishch, I. M., Yanchij, R. I., Zukow, W., Ruzhylo, S. V., Popovych, D. V., & Popovych, I. L. (2024). Ukrainian phytocomposition "Balm Truskavets'", metabolism, physical working capacity and neuro-endocrine-immune complex. Lviv: Svit. <http://dx.doi.org/10.5281/zenodo.14640273>

Kostyuk, P. G., Popovych, I. L., & Іvassivka, S. V. (Eds.). (2006). Chornobyl', adaptive and defensive systems, rehabilitation [in Ukrainian]. Kyїv: Computerpress. 348.

Kou, Z., & Dai, W. (2021). Aryl hydrocarbon receptor: Its roles in physiology. Biochemical Pharmacology, 185, 114428. <https://doi.org/10.1016/j.bcp.2021.114428>

Kozyavkina, O. V., Kozyavkina, N. V., Gozhenko, O. A., Gozhenko, A. I., Barylyak, L. G., & Popovych, I. L. (2015). Bioactive water Naftussya and neuroendocrine-immune complex [in Ukrainian]. Kyїv: UNESCO-SOCIO. 349.

Kumar, P., Banik, S. P., Goel, A., Chakraborty, S., Bagchi, M., & Bagchi, D. (2023). Chemical, microbial and safety profiling of a standardized Withania somnifera (Ashwagandha) extract and Withaferin A, a potent novel phytotherapeutic of the millennium. Functional Foods in Health and Disease, 13(2), 36-51. <https://doi.org/10.31989/ffhd.v13i2.1020>

Lapovets, L., & Lutsyk, B. (2004). Handbook of laboratory immunology [in Ukrainian]. Lviv. 173.

Li, L. A., & Wang, P. W. (2005). PCB126 induces differential changes in androgen, cortisol, and aldosterone biosynthesis in human adrenocortical H295R cells. Toxicological Sciences, 85(1), 530-540. <https://doi.org/10.1093/toxsci/kfi130>

Lu, S., Wu, D., Sun, G., Geng, F., Shen, Y., Tan, J., Sun, X., & Ding, S. (2019). Gastroprotective effects of Kangfuxin against water-immersion and restraint stress-induced gastric ulcer in rats: Roles of antioxidation, anti-inflammation, and pro-survival. Pharmaceutical Biology, 57(1), 770-777. <https://doi.org/10.1080/13880209.2019.1679814>

Lupandin, A. V. (1989). On the role of catecholaminergic synapses in the mechanism of adaptation formation with the participation of polyphenolic adaptogens [in Russian]. Fiziologicheskii Zhurnal SSSR, 75(8), 1082-1088.

Lyubitelev, A., & Studitsky, V. (2023). Inhibition of cancer development by natural plant polyphenols: Molecular mechanisms. International Journal of Molecular Sciences, 24(13), 10663. <https://doi.org/10.3390/ijms241310663>

Meerson, F. Z. (1991). Protective effects of adaptation and some prospects for the development of adaptive medicine [in Russian]. Uspekhi Fiziologicheskikh Nauk, 22(2), 52-89.

Moreno-Nieves, U. Y., Mundy, D. C., Shin, J. H., Tam, K., & Sunwoo, J. B. (2018). The aryl hydrocarbon receptor modulates the function of human CD56bright NK cells. European Journal of Immunology, 48, 771-776. <https://doi.org/10.1002/eji.201747289>

Murray, I. A., & Perdew, G. H. (2020). How Ah receptor ligand specificity became important in understanding its physiological function. International Journal of Molecular Sciences, 21(24), 9614. <https://doi.org/10.3390/ijms21249614>

Nebert, D. W., & Bausserman, L. L. (1970). Genetic differences in the extent of aryl hydrocarbon hydroxylase induction in mouse fetal cell cultures. Journal of Biological Chemistry, 245(23), 6373-6382.

Oh, C. S., Kim, H. J., Jeong, H. W., Park, J. H., & Park, W. (2023). Immunomodulatory effects of Korean Red Ginseng (Panax ginseng) and its active ingredients. Hantopic, 5(2), 1. <https://doi.org/10.23146/HAN.2023.4.01>

Ojo, E. S., & Tischkau, S. A. (2021). The role of AhR in the hallmarks of brain aging: Friend and foe. Cells, 10(10), 2729. <https://doi.org/10.3390/cells10102729>

Panasyuk, Y. M., Levkut, L. H., Popovych, I. L., Alekseyev, O. I., Kovbasnyuk, M. M., & Balanovskyi, V. P. (1994). Experimental study of adaptogenic properties of "Crimean" balm [in Ukrainian]. Fiziologichnyi Zhurnal, 40(3-4), 25-30.

Panasyuk, Y. M., Levkut, L. G., Popovych, I. L., Shumakov, M. F., Sychova, A. O., Alekseyev, O. I., & Bakova, M. M. (1996). Adaptogenic agent [in Ukrainian]. Ukraine Patent No. 10271. Bull № 4.

Panossian, A. (2023). Challenges in phytotherapy research. Frontiers in Pharmacology, 14, 1199516. <https://doi.org/10.3389/fphar.2023.1199516>

Panossian, A., & Efferth, T. (2022). Network pharmacology of adaptogens in the assessment of their pleiotropic therapeutic activity. Pharmaceuticals, 15(9), 1051. <https://doi.org/10.3390/ph15091051>

Panossian, A., Seo, E. J., & Efferth, T. (2018). Novel molecular mechanisms for the adaptogenic effects of herbal extracts on isolated brain cells using systems biology. Phytomedicine, 50, 257-284. <https://doi.org/10.1016/j.phymed.2018.09.204>

Panossian, A., Seo, E. J., & Efferth, T. (2019). Effects of anti-inflammatory and adaptogenic herbal extracts on gene expression of eicosanoids signaling pathways in isolated brain cells. Phytomedicine, 60, 152881. <https://doi.org/10.1016/j.phymed.2019.152881>

Panossian, A., & Wikman, G. (2010). Effects of adaptogens on the central nervous system and the molecular mechanisms associated with their stress-protective activity. Pharmaceuticals, 3(1), 188-224. <https://doi.org/10.3390/ph3010188>

Panossian, A. G., Efferth, T., Shikov, A. N., Pozharitskaya, O. N., Kuchta, K., Mukherjee, P. K., Banerjee, S., Heinrich, M., Wu, W., Guo, D. A., & Wagner, H. (2021). Evolution of the adaptogenic concept from traditional use to medical systems: Pharmacology of stress- and aging-related diseases. Medicinal Research Reviews, 41(1), 630-703. <https://doi.org/10.1002/med.21743>

Phelan, D., Winter, G. M., Rogers, W. J., Lam, J. C., & Denison, M. S. (1988). Activation of the Ah receptor signal transduction pathway by bilirubin and biliverdin. Archives of Biochemistry and Biophysics, 357(1), 155-163. <https://doi.org/10.1006/abbi.1998.0814>

Poland, A., Glover, E., & Kende, A. S. (1976). Stereospecific, high affinity binding of 2,3,7,8-tetrachlorodibenzo-p-dioxin by hepatic cytosol. Evidence that the binding species is receptor for induction of aryl hydrocarbon hydroxylase. Journal of Biological Chemistry, 251(16), 4936-4946.

Popadynets, O., Gozhenko, A., Badyuk, N., Popovych, I., Skaliy, A., Hagner-Derengowska, M., Napierata, M., Muszkieta, R., Sokołowski, D., Zukow, W., & Rybałko, L. (2020). Interpersonal differences caused by adaptogen changes in entropies of EEG, HRV, immunocytogram, and leukocytogram. Journal of Physical Education and Sport, 20(Suppl. 2), 982-999. <https://doi.org/10.7752/jpes.2020.s2139>

Popovych, A. I. (2018). Features of the immunotropic effects of partial components of the balneotherapeutic complex of spa Truskavets'. Journal of Education, Health and Sport, 8(12), 919-935. <http://dx.doi.org/10.5281/zenodo.2546368>

Popovych, A. I. (2019). Features of the neurotropic effects of partial components of the balneotherapeutic complex of spa Truskavets'. Journal of Education, Health and Sport, 9(1), 396-409. <http://dx.doi.org/10.5281/zenodo.2596710>

Popovych, I. L. (2011). Stresslimiting adaptogene mechanism of biological and curative activity of water Naftussya [in Ukrainian]. Kyїv: Computerpress. 300.

Popovych, I. L., Flyunt, I. S., Alyeksyeyev, O. I., Barylyak, L. G., & Bilas, V. R. (2003). Sanogenetic bases of rehabilitation on spa Truskavets' urological patients from Chornobylian contingent [in Ukrainian]. Kyїv: Computerpress. 192.

Popovych, I. L., Gozhenko, A. I., Korda, M. M., Klishch, I. M., Popovych, D. V., & Zukow, W. (Eds.). (2022). Mineral waters, metabolism, neuro-endocrine-immune complex. Odesa: Feniks. 252.

Popovych, I. L., Ivassivka, S. V., & Flyunt, I. S. (2000). Bioactive water Naftussya and the stomach [in Ukrainian]. Kyїv: Computerpress. 234.

Popovych, I. L., Kozyavkina, O. V., Kozyavkina, N. V., Korolyshyn, T. A., Lukovych, Y. S., & Barylyak, L. G. (2014). Correlation between indices of the heart rate variability and parameters of ongoing EEG in patients suffering from chronic renal pathology. Neurophysiology, 46(2), 139-148. <https://doi.org/10.1007/s11062-014-9420-y>

Popovych, I. L., Kulchynskyi, A. B., Gozhenko, A. I., Zukow, W., Kovbasnyuk, M. M., & Korolyshyn, T. A. (2018). Interrelations between changes in parameters of HRV, EEG and phagocytosis at patients with chronic pyelonephritis and cholecystitis. Journal of Education, Health and Sport, 8(2), 135-156. <http://dx.doi.org/10.5281/zenodo.1179635>

Popovych, I., Ruzhylo, S., Ivassivka, S., & Aksentiychuk, B. (Eds.). (2005). Balneocardioangiology. The impact of balneotherapy in the spa Truskavets' on the cardiovascular system and physical performance [in Ukrainian]. Kyїv: Computerpress. 239.

Potapovich, A. I., Lulli, D., Fidanza, P., Kostyuk, V. A., De Luca, C., Pastore, S., & Korkina, L. G. (2011). Plant polyphenols differentially modulate inflammatory responses of human keratinocytes by interfering with activation of transcription factors NFκB and AhR and EGFR–ERK pathway. Toxicology and Applied Pharmacology, 255(2), 138-149. <https://doi.org/10.1016/j.taap.2011.06.007>

Quintana, F. J., & Sherr, D. H. (2013). Aryl hydrocarbon receptor control of adaptive immunity. Pharmacological Reviews, 65(4), 1148-1161. <https://doi.org/10.1124/pr.113.007823>

Rejano-Gordillo, C., Marín-Díaz, B., Ordiales-Talavero, A., Merino, J., González-Rico, F., & Fernandez-Salguero, P. (2022). From nucleus to organs: Insights of aryl hydrocarbon receptor molecular mechanisms. International Journal of Molecular Sciences, 23(23), 14919. <https://doi.org/10.3390/ijms232314919>

Ruzhylo, S. V., Popovych, A. I., Zakalyak, N. R., Chopyk, R. V., Fihura, O. A., Bilas, V. R., Badiuk, N. S., Gozhenko, A. I., Popovych, I. L., & Zukow, W. (2021). Bioactive water Naftussya and ozokerite have the same neuro-endocrine-immune effects in male rats caused by aryl hydrocarbons. PharmacologyOnLine, 3, 213-226.

Saha, N., & Samuel, M. (2024). Dietary xenobiotics and their role in immunomodulation. Food Science and Biotechnology, 1-13. <https://doi.org/10.1007/s10068-024-01454-x>

Sergeeva, I., Kiseleva, T., Pomozova, V., Shkrabtak, N., Frolova, N., & Vereshchagin, A. (2021). Experimental studies of the effect of schisandra chinensis extract on the state of adaptive capabilities of rats under chronic and general exposure to cold. International Journal of Environmental Research and Public Health, 18(22), 11780. <https://doi.org/10.3390/ijerph182211780>

Shin, J. H., Moreno-Nieves, U. Y., Zhang, L. H., Chen, C., Dixon, A. L., Linde, M. H., Mace, E. M., & Sunwoo, J. B. (2021). AHR regulates NK cell migration via ASB2-mediated ubiquitination of Filamin A. Frontiers in Immunology, 12, 624284. <https://doi.org/10.3389/fimmu.2021.624284>

Struk, Z. D., Melnyk, O. I., Zukow, W., & Popovych, I. L. (2019). The diversity of immune reactions to balneotherapy and their accompaniments. Journal of Education, Health and Sport, 9(11), 349-373. <http://dx.doi.org/10.5281/zenodo.3533871>

Sun, X. B., Matsumoto, T., & Yamada, H. (1992). Anti-ulcer activity and mode of action of the polysaccharide fraction from the leaves of Panax ginseng. Planta Medica, 58(5), 432-435. <https://doi.org/10.1055/s-2006-961504>

Szaefer, H., Licznerska, B., & Baer-Dubowska, W. (2024). The aryl hydrocarbon receptor and its crosstalk: A chemopreventive target of naturally occurring and modified phytochemicals. Molecules, 29(18), 4283. <https://doi.org/10.3390/molecules29184283>

Tang, J. S., Cait, A., Li, Y., Abolins-Thompson, H., Gell, K., Herst, P. M., Vissers, M., & Gasser, O. (2021). Practical approach to explore the effects of polyphenols on aryl hydrocarbon receptor regulated immune function. Journal of Agricultural and Food Chemistry, 69(31), 8625-8633. <https://doi.org/10.1021/acs.jafc.1c01845>

Tekin, İ. Ö., & Marotta, F. (2018). Polyphenols and immune system. In R. R. Watson, V. R. Preedy, & S. Zibadi (Eds.), Polyphenols: Prevention and treatment of human disease (pp. 263-276). Academic Press. <https://doi.org/10.1016/B978-0-12-813008-7.00021-X>

Todorova, V., Ivanov, K., & Ivanova, S. (2021). Comparison between the biological active compounds in plants with adaptogenic properties (Rhaponticum carthamoides, Lepidium meyenii, Eleutherococcus senticosus and Panax ginseng). Plants, 11(1), 64. <https://doi.org/10.3390/plants11010064>

Trego, M. L., Hoh, E., Kellar, N. M., Meszaros, S., Robbins, M. N., Dodder, N. G., Whitehead, A., & Lewison, R. L. (2018). Comprehensive screening links halogenated organic compounds with testosterone levels in male Delphinus delphis from the Southern California Bight. Environmental Science & Technology, 52(5), 3101-3109. <https://doi.org/10.1021/acs.est.7b04652>

Tserkovnyuk, A. V., & Ruzhylo, S. V. (2001a). Aerobic training optimization of the effect of balneotherapy at the Truskavets' resort on physical performance and its support systems [in Ukrainian]. Ukrainian Balneological Journal, 2, 39-45.

Tserkovnyuk, A. V., & Ruzhylo, S. V. (2001b). The influence of aerobic training against the background of balneotherapy at the Truskavets' resort on physical performance and its hemodynamic and metabolic support [in Ukrainian]. Ukrainian Balneological Journal, 1, 55-64.

Wang, X., Hawkins, B. T., & Miller, D. S. (2011). Aryl hydrocarbon receptor-mediated up-regulation of ATP-driven xenobiotic efflux transporters at the blood-brain barrier. FASEB Journal, 25, 644-652. <https://doi.org/10.1096/fj.10-169227>

Wang, Y., Ye, X., Ma, Z., Liang, Q., Lu, B., Tan, H., Xiao, C., Zhang, B., & Gao, Y. (2008). Induction of cytochrome P450 1A1 expression by ginsenoside Rg1 and Rb1 in HepG2 cells. European Journal of Pharmacology, 601(1-3), 73-78. <https://doi.org/10.1016/j.ejphar.2008.10.057>

Winkelmann, T., Thayer, J. F., Pohlak, S. T., Nees, F., Grimm, O., & Flor, H. (2017). Structural brain correlates of heart rate variability in healthy young adult population. Brain Structure and Function, 222(2), 1061-1068. <https://doi.org/10.1007/s00429-016-1185-1>

Xue, Z., Li, D., Yu, W., Zhang, Q., Hou, X., He, Y., & Kou, X. (2017). Mechanisms and therapeutic prospects of polyphenols as modulators of the aryl hydrocarbon receptor. Food & Function, 8(4), 1414-1437. <https://doi.org/10.1039/c6fo01810f>

Yang, X., Liu, H., Ye, T., Lei, X., Jiang, K., Zhou, Y., Xiao, X., Xie, K., Wang, G., & Duan, C. (2020). AhR activation attenuates calcium oxalate nephrocalcinosis by diminishing M1 macrophage polarization and promoting M2 macrophage polarization. Theranostics, 10(26), 12011-12025. <https://doi.org/10.7150/thno.51144>

Ye, L., Zhao, B., Hu, G., Chu, Y., & Ge, R. S. (2011). Inhibition of human and rat testicular steroidogenic enzyme activities by bisphenol A. Toxicology Letters, 207(2), 137-142. <https://doi.org/10.1016/j.toxlet.2011.09.001>

Zhang, M., Ma, L., Luo, J., Ren, T., Liu, S., Pan, L., Liang, J., Wang, Z., Jiang, K., Xiao, X., & Zheng, F. (2024). Low-medium polarity ginsenosides from wild ginseng improves immunity by activating the AhR/MAPK pathway through tryptophan metabolism driven by gut microbiota. Journal of Agricultural and Food Chemistry, 72(47), 26142-26154. <https://doi.org/10.1021/acs.jafc.4c04830>

Zhou, L. (2016). AHR function in lymphocytes: Emerging concepts. Trends in Immunology, 37(1), 17-31. <https://doi.org/10.1016/j.it.2015.11.007>

Zukow, W., Fihura, O. A., Żukow, X., Muszkieta, R., Hagner-Derengowska, M., Smoleńska, O., Michalska, A., Melnyk, O. I., Ruzhylo, S. V., Zakalyak, N. R., Kondratska, H. D., Voloshyn, O. R., & Popovych, I. L. (2024). Prevention of adverse effects of balneofactors at Truskavets' Spa on gastroenterologic patients through phytoadaptogens and therapeutic physical education: Mechanisms of rehabilitation. Journal of Physical Education and Sport, 24(4), 791-810. <https://doi.org/10.7752/jpes.2024.04093>

Zukow, W., Fihura, O. A., Korda, M. M., Klishch, I. M., Ruzhylo, S. V., Melnyk, O. I., Yanchij, R. I., & Popovych, I. L. (2024). Modulating effects of Ukrainian phytocomposition "Balm Truskavets'" on post stress changes in neuroendocrine-immune complex, metabolome, electrocardiogram, and gastric mucosa at rats. Journal of Education, Health and Sport, 64, 55171. <https://dx.doi.org/10.12775/JEHS.2024.64.55171>

Zukow, W., Fil, V. M., Kovalchuk, H. Y., Voloshyn, O. R., Kopko, I. Y., Lupak, O. M., Ivasivka, A. S., Musiyenko, O. V., Bilas, V. R., & Popovych, I. L. (2022). The role of innate muscular endurance and resistance to hypoxia in reactions to acute stress of immunity in rats. Journal of Physical Education and Sport, 22(7), 1608-1617. <https://doi.org/10.7752/jpes.2022.07202>

Zukow, W., Flyunt, I-S. S., Ponomarenko, R. B., Rybak, N. Y., Fil', V. M., Kovalchuk, H. Y., Sarancha, S. M., & Nahurna, Y. V. (2020). Polyvariant change of step-test under the influence of natural adaptogens and their accompaniments. Pedagogy and Psychology of Sport, 6(2), 74-84. <https://doi.org/10.12775/PPS.2020.06.02.008>

Zukow, W., Flyunt, I-S. S., Ruzhylo, S. V., Kovalchuk, H. Y., Nahurna, Y. V., Popovych, D. V., & Sarancha, S. M. (2021). Forecasting of multivariant changes in step test under the influence of natural adaptogens. Pedagogy and Psychology of Sport, 7(1), 85-93. <https://doi.org/10.12775/PPS.2021.07.01.007>

Zukow, W., Gozhenko, O. A., Zavidnyuk, Y. V., Korda, M. M., Mysula, I. R., Klishch, I. M., Zhulkevych, I. V., Popovych, I. L., Muszkieta, R., Napierata, M., Hagner-Derengowska, M., & Skaliy, A. (2020). Role of organic carbon and nitrogen of mineral waters in their neuro-endocrine effects at female rats. International Journal of Applied Exercise Physiology, 9(4), 20-25.

Zukow, W., Muszkieta, R., Hagner-Derengowska, M., Smoleńska, O., Żukow, X., Fil, V. M., Kovalchuk, H. Y., Voloshyn, O. R., Kopko, I. Y., Lupak, O. M., Ivasivka, A. S., Musiyenko, O. V., Ruzhylo, S. V., Kindrat, V., & Popovych, I. L. (2022a). Role of organic substances of Naftussya bioactive water in its effects on dynamic and static fitness in rats. Journal of Physical Education and Sport, 22(11), 2733-2742. <https://doi.org/10.7752/jpes.2022.11347>

Zukow, W., Muszkieta, R., Hagner-Derengowska, M., Smoleńska, O., Żukow, X., Melnyk, O. I., Popovych, D. V., Tserkoniuk, R. G., Hryhorenko, A. M., Yanchij, R. I., Kindrat, V., & Popovych, I. L. (2022b). Effects of rehabilitation at the Truskavets' spa on physical working capacity and its neural, metabolic, and hemato-immune accompaniments. Journal of Physical Education and Sport, 22(11), 2708-2722. <https://doi.org/10.7752/jpes.2022.11344>