

**Nature Is the Intervention: Shinrin-Yoku and Biomolecules**

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### **Abstract**

According to Salehi, et. al. (2019) alpha and beta pinene's (AP and BP) are monoterpenes found in numerous plants around the world. These two terpenes are identified as being some of the most abundant volatile organic chemicals found within global plant matter. Both AP and BP possess the potential to regulate a vast range of biological activities within the human body. Research demonstrates single and repeated exposure to AP and BP found within plant matter influences numerous physiological processes and has various pharmacological activities such as antimalarial, antioxidant, anticoagulant, antitumor, antimicrobial, anti-inflammatory, analgesic, anti-Leishmania and antibiotic resistance modulation (Salehi, et. al., 2019). AP and BP possess neuroprotective, anticonvulsant, cytoprotective, gastroprotective, and anxiolytic properties (Salehi, et. al., 2019). Repeated exposure to AP and BP through the practice of nature exposure, referred to by Japanese culture as Shinrin-yoku or "forest bathing", may improve mood, resistance to pain, body composition, and psychoneuroimmunological resilience in humans (Hansen, Jones, & Tocchini, 2017).

Shinrin-yoku, directly translated from the Japanese language as “forest bathing”, is an accepted non-medical therapy in the nation of Japan and was first researched in the early 1980’s (Hansen, Jones, & Tocchini, 2017). The practice of Shinrin-yoku was adopted within a culture known for extended workdays and a strict societal commitment to manage shared responsibilities appropriately. This high stress, high productivity society accepts this practice as a scientifically validated component of one’s self-care, and the society provides a support network for one another to encourage behavior adherence of the practice. Shinrin-yoku practice involves the act of immersing oneself in a natural or green space for relatively any amount of time however, current research demonstrates the potential for greater, longer lasting effects, after spending approximately 3 full days immersed in a natural environment (Williams, 2018). It is recognized that a collection of volatile organic chemicals produced by plants, classified as phytoncides, with some specifically referred to as terpenes, have measurable physiological effects within 15 minutes of onset of exposure (Park, et. al., 2010). Multiple systems within the human body and regions of the brain are physiologically affected by the introduction of the terpenes alpha and beta pinene (AP and BP).

Salehi et. al. (2019) discusses AP and BP properties in detail, focusing on the composition, safety, pharmacological activity, bioavailability, in-vivo biological activity, and current clinical studies. AP and BP are presented as useful in various industries beyond medicine. An example of which is AP and BP use in formation of certain polymers, adding to flexibility in synthesis (Salehi, et. al., 2019). AP and BP have a generally recognized as safe status and are often utilized in fragrances, renal and hepatic drugs, and a myriad of other chemical compounds. A powerful use scenario for AP is within anticoagulant compounds as AP

has been found to prevent thromboxane A<sub>2</sub> production as well as platelet Ca<sup>2+</sup> production (Salehi, et. al., 2019). AP and BP have gastroprotective and antiulcerogenic effects, altering gastrointestinal transit times for consumed solids and liquids.

Research related to AP and BP neuroprotective activities highlights how Alzheimer's and Parkinson's are triggered by oxidative imbalance. AP and BP are presented as reducing apoptosis and being cytoprotective, thusly, presenting an ability to defend the nervous system against neurodegenerative diseases (Salehi, et. al., 2019). AP and BP play a role in modulation of neurotransmitter activities, especially with repeated exposure (Hansen, Jones, & Tocchini, 2017). As a practical example, if exposure to AP and BP plays a role in modulation of serotonin, potential exists for reduction of impulsive aggressive behaviors, as serotonin has been found to consistently demonstrate a relationship with aggressive behaviors (Barnes, 2014).

AP and BP are two of the most widely found monoterpenoids in nature, highly bioactive, yet not often located within clinical studies (Salehi, et. al., 2019). One study which stands out within Salehi, et. al. (2019) that does contain AP and BP administration reports a statistically significant reduction in neuropsychiatric symptoms and an enhancement in attention. This warrants future research to better determine the use potential for both AP and BP as inclusion of these compounds within clinical studies may further elucidate factors of bioavailability, enhancing potential pharmacological intervention development. A lack of data related to bioavailability is singled out as essential for any advancements of future use potential.

Salehi et. al. (2019) presents a number of significant physiological effects from exposure to AP and BP. However, if AP and BP are able to regulate dysfunction of the hypothalamic-

pituitary-adrenal (HPA) axis, activating the parasympathetic nervous system, and the terpenes are readily available just outside our front doors, what needs to be done to encourage greater amounts of exposure to these natural compounds? Through the development of additional nature immersion events, free from dependence on physical activity, with a focus on time spent in natural, tree filled spaces, additional social inclusivity may be introduced into communities currently suffering from a variety of medical ailments. The development of Shinrin-yoku practice for urban dwelling humans must be encouraged, as the multitude of demonstrated physiological effects are overwhelmingly positive for most members of the human species.

Hansen, Jones & Tocchini (2017) provide an analysis of the current state of scientific evidence supporting the use of Shinrin-yoku as a preventative health intervention and form of health maintenance. A clear model of the concept for nature therapeutics and their practice within the world of evidence-based medicine is presented. Shinrin-yoku practice has a direct agonistic effect on the parasympathetic nervous system and individuals with even limited exposure to green spaces report a sense of calm during and post-green space exposure. Shinrin-yoku has been linked to a widespread reduction in pain and depression, with attribution of these physiological outcomes linked to the various groups of volatile organic chemicals released by the numerous plants found in natural environments or human designed green spaces. Shinrin-yoku is not limited by strict guidelines for practice in wilderness environments, rather, exposure to parks and tree lined streets within urban environments may serve to provide an effective dose of nature intervention (Hansen, Jones, & Tocchini, 2017).

Critical analysis of the body of research related to Shinrin-yoku is presented by Hansen, Jones & Tocchini (2017) and numerous areas of improvement are identified so as to assist future

researchers with potential study design ideas. Potential biases are identified, and multiple homogeneities within the data are disclosed, providing a framework for continual research quality improvement. Physiological markers including heart rate variability, combined with reductions in both blood pressure and salivary cortisol levels are highlighted as critical positive outcomes from continued Shinrin-yoku practice. Pathologies of chronic obstructive pulmonary disorder, hypertension, and diabetes mellitus type II are all demonstrated as mitigated by a decrease in activation of renin-angiotensin system, which reduces the workload of the heart, after continual and repeated Shinrin-yoku practice (Hansen, Jones, & Tocchini, 2017).

Psychological distress is presented as often occurring comorbidly with physiological pathologies (Hansen, Jones, & Tocchini, 2017). Robust discussion related to combining various forms of green space exposure with clinical therapeutic intervention occurs. Cognitive behavioral therapy in conjunction with Shinrin-yoku practice is reported to significantly enhance reductions in scores on the Beck Depression Inventory (BDI), Hamilton Depression Rating Scale (HAM-D17) and Spielberger State-Trait Anxiety Inventory (STAI). Specific attention is given to the recommendation of Shinrin-yoku practice as a medically viable intervention for psychological distress associated with chronic illness (Hansen, Jones, & Tocchini, 2017). The autonomic nervous system, endocrine system, and the immune system are implicated as being positively affected by Shinrin-yoku and a measurable increase in Natural Killer Cell activity is detectable in blood serum levels.

Nature exposure, nature-based therapies, time spent in green parks or various other green spaces may prove to be one of the strongest natural biological boosters readily available to humankind. The available research highlights numerous areas which are lacking in elucidation.

The current data does seem to lay the groundwork for students and professional scientists to develop treatments and practices rooted within the original idea of Shinrin-yoku, yet further exploring the biochemical reasoning behind the effectiveness of the intervention. There may be great value yet to be discovered by expanding the subject matter presented within this body of research. The practice of Shinrin-yoku may be embraced if taught to future generations of humans who are only becoming more and more reliant upon technology-based communication networks to work in global capacities. If additional, cutting edge research techniques are applied to this field, such as functional near infrared spectroscopy which measures oxyhemoglobin concentrations within tissues, additional health related recommendations may be able to be developed, promoting health equity for all humans while developing our affinity for the unencumbered embrace of green spaces.

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