REVIEW PAPER

Evaluation of the Integration Potential of Canadian Indigenous Sacred Plants into Western Health Systems

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Abstract

An increasing number of scientific studies have demonstrated the potential of traditional medicinal plants in disease treatment and drug development. However, concerns about the efficacy and safety of these remedies persist within the society and among some Western medical professionals. The current paper examines the medicinal properties of four sacred plants that have long been used by Canadian Indigenous peoples: cedar (Thuja species), sage (Salvia species), sweetgrass (Hierochloë odorata Linn), and tobacco (Nicotiana rustica Linn). While many studies have focused on individual properties of specific plants, no comprehensive review comparing the medicinal potential of all four sacred plants has been conducted. This study evaluates the efficacy and potential side effects of these Indigenous sacred plants, with the aim of integrating traditional knowledge with contemporary scientific understanding. The findings may inform further research and experimental validation, contributing to more effective applications in medical treatments.

Keywords: Indigenous healing practices, Traditional medicinal plants, Western healing methods, Canadian Indigenous people

Introduction

Indigenous communities have incorporated plants into their healing practices for centuries, creating distinct medical procedures for each species that differ from those in Western healthcare (Lewis and Elvin-Lewis, 1995). While the safety, reliability, and effectiveness of traditional plants may be viewed skeptically by Western medicine due to the lack of scientific evidence or clinical validation (Ekor M., 2014), similarities in their uses across various Indigenous populations are notable. These include the specific plant parts chosen for specific medicinal purposes, the methods of administration, and the species employed to treat specific symptoms (Borchers et al., 2000). Such similarities suggest that the selection and application of medicinal botanicals result from rigorous testing and evaluation within Indigenous communities, underscoring the potential of traditional healing practices to enhance modern disease treatment (Moerman, 1991). This potential is highlighted by several Indigenous medicinal plants that have gained United States Food and Drug Administration (FDA) approval or recognition within Western healthcare systems. For instance, Croton lechleri, a native tree of the Amazon rainforest, has been used by Indigenous peoples for centuries to treat ailments such as diarrhea and microbial infections (Alonso-Castro et al., 2012). In 2012, the FDA approved Crofelemer, a drug derived from the bark latex of Croton lechleri, for treating diarrhea in HIV/AIDS patients (Patel et al., 2013). This is one example that shows traditional Indigenous knowledge can lead to valuable contributions in modern medicine, bridging the gap between traditional healing practices and contemporary healthcare solutions.

Additionally, an increasing number of ethnobotanical studies have brought several traditional plants to the forefront of modern scientific research. For example, European Chestnut (Castanea sativa), used medicinally by Mediterranean locals for millennia, has been found to contain oleanene and ursene derivatives (pentacyclic triterpenes) that can effectively inhibit quorum sensing in Staphylococcus aureus virulence and pathogenesis across all accessory gene regulator (agr) alleles. This study showed no cytotoxic effects on human keratinocytes or murine skin, suggesting the potential for future antibiotic therapies targeting quorum sensing (Quave et al., 2016). Similarly, a 2023 study highlighted the potential of several traditional medicinal plants, including Euphorbia stricta, Euphorbia platyphylla, and Euphorbia brevicornu, in treating diseases caused by oxidative stress, such as cancer, cardiovascular diseases, and inflammatory joint diseases (Anees Ali Jafri et al., 2023). Instead of consuming entire plants as traditional remedies, the research mentioned above tends to isolate and standardize bioactive components from traditional plants. This approach shows promise in leveraging the therapeutic efficacy of the traditional plants while minimizing their side effects for drug development. To fully

harness the benefits of Indigenous botanical knowledge, further studies are essential in identifying specific bioactive compounds and develop reliable, evidence-based healthcare solutions.

Despite the growing body of research on ethnobotanicals, Western medicine has often overlooked or undervalued Indigenous medicines due to a lack of proper recognition of traditional practices (Redvers and Blondin, 2020). Insufficient plant conservation, threatened by climate change, habitat loss, and invasive species (Erland et al., 2022) along with inadequate documentation, contributes to the decline of Indigenous healing practices among younger generations (Koithan and Farrell, 2010). Furthermore, senior Indigenous healers are often hesitant to share their knowledge of herbal remedies with outsiders (Uprety et al., 2012), and the Canadian government has paid little attention to these healing practices (Li, 2017). These factors render traditional Indigenous medicines increasingly elusive to Western medical experts, fostering negative perceptions such as bias and skepticism toward traditional medicinal plants (Baines, 2012). To that end, this paper aims to bridge the gap between traditional medicines and the Western health system. By evaluating scientific reports and peer-reviewed articles on the medicinal properties of Indigenous plants, we discuss their potential in disease treatment, drug development, and integration into modern medicine. Ultimately, this exploration seeks to foster a greater appreciation for Indigenous knowledge and its role in enhancing Western healthcare practices.

This paper specifically examines the most recognized sacred plants among Canadian Indigenous peoples, namely cedar, sage, sweetgrass, and tobacco (Allen et al., 2020). These sacred plants are also found to be broadly used as traditional medicines across North and South America. Cedar (Thuja species) is a perennial conifer native to North America, historically used for construction, transportation, and medicinal purposes by Indigenous peoples on the West Coast of Canada. Sage (Salvia species), prevalent in southeastern Canada, is primarily used to enhance physical and mental well-being in a traditional ceremony known as smudging (Robinson, 2018). Sweetgrass (Hierochloë odorata Linn) is a native plant found in low-lying or rocky areas in Canada, utilized by First Nations, Métis, and Inuit peoples for various medicinal applications, including treating the common cold, creating eyewash, and serving as a hair tonic (Turner, 2018). Tobacco (Nicotiana rustica Linn) is an herbaceous plant native to South America, commonly used in cultural ceremonies to cleanse physical and mental wounds, however its addictive nature raises health concerns (Berlowitz et al., 2020). While individual studies have explored these sacred plants, a unified review of their medicinal properties remains lacking. This paper seeks to highlight their potential therapeutic applications and advocate for further experimental validation, integrating Indigenous knowledge to enrich the current Western health system.

Method

The purpose of this paper is twofold: (1) evaluating the medical applications of four sacred Indigenous plants (cedar, sage, sweetgrass, and tobacco) and (2) exploring the potential of incorporating these Indigenous medicinal plants into Western healing practices considering their side effects and efficacy. This paper only included peer-reviewed articles or credible articles published in academic journals, books, and reputable websites that were written by Indigenous people or traditional healing practitioners. Pertinent studies were searched in multiple online databases, including PubMed Central, ISI Web of Science, Science Direct, Google Scholar, and the University of Toronto Libraries. No limits were set on the publication date. The search strategy was divided into two groups: (1) the medical properties of Indigenous sacred plants and (2) the potential toxicological effect of indigenous medicines. Literature was identified if the topic includes terms such as “traditional medicines”, “Indigenous”, “aboriginal”, “Canada”, and the scientific name or common name of specific herbal medicines (i.e., cedar, sage, sweetgrass, tobacco, Thuja plicata, Thuja occidentalis, Salvia species, Hierochloë odorata Linn, and Nicotiana rustica Linn, etc.). Information about First Nations, Inuit, and Métis people in this paper was based on the annual reports published by the Government of Canada. Botanical identifications depended on The Canadian Encyclopedia, the Canadian Vascular Plants Database (VASCAN), and the Plant Database of the United States Department of Agriculture, Natural Resources Conservation Service.

Results

A total of 47 articles were reviewed on the medicinal applications of cedar (N=16), sage (N=15), sweetgrass (N=8), and tobacco (N=8), with publication dates spanning from 1991 to 2023. To explore the potential for integrating these herbal medicines into the Western healthcare system, this review considers a broad range of medicinal properties, including antibacterial, antioxidant, and anti-inflammatory effects.

(1) Cedar

Thuja plicata (Western red cedar) and Thuja occidentalis (white cedar) are two species of cedar native to North America (Misson et al., 1991). First Nations and Métis people considered them to be a sacred plant with a wide range of medical, recreational, industrial, ceremonial, and spiritual applications (Zahn et al., 2018). Thuja plicata is a dominant forest tree in British Colombia (Bennett and Prescott, 2004) where 17.2% of First Nations populations and 15.7% of Métis populations are distributed (Government of Canada, 2021). Indigenous people extract Thuja plicata leaf oil to treat wounds and upper respiratory symptoms. Thuja occidentalis, on the other hand, is prevalent across Eastern Canada, including Manitoba, Ontario, Québec, Prince Edward Island, New Brunswick, and Nova Scotia, where significant populations of First Nations (52.8%) and Métis (52.0%) reside (Government of Canada, 2021). In traditional Indigenous medicine, Thuja occidentalis is commonly used to treat wounds, fungal infections, and cancerous tumors (Caruntu et al., 2020).

Previous research has highlighted the effectiveness of Thuja plicata treatment in combating human pathogens, including bacteria, fungi, and bacterial spores, without exhibiting signs of toxicity or causing harm to human cells (Hudson et al., 2011). Thuja plicata leaf oil shows promise in promoting tissue remodeling and enhancing immune responses to inflammation, suggesting its wound-healing and anti-inflammatory properties (Han and Parker, 2017). Meanwhile, numerous studies have demonstrated the potent antimicrobial, antifungal, and sporicidal properties of Thuja occidentalis leaf oil (Naser et al., 2005; Tsiri et al., 2009; Mighri et al., 2010; Soltani et al., 2016). It has been shown to address inflammation and oxidative stress in the human body, potentially preventing neuronal damage caused by diabetes (Bhargava et al., 2022).

Its potential in treating Glioblastoma brain tumors has also been observed, as it inhibits the production of angiogenesis-promoting factors in tumor cells (Torres et al., 2016). This anti-cancer potential extends to the treatment of malignant melanomas, where Thuja occidentalis significantly reduced the production of reactive oxygen species and limited the proliferation of A375 melanoma cells (Biswas et al., 2011). If further research and clinical trials confirm these findings, Thuja occidentalis or its bioactive compounds could be developed into an adjunct therapy for melanoma patients. Furthermore, it has been reported to regulate melanoma metastasis, significantly extending the lifespan of affected animals (Sunila and Kuttan, 2006). While there are no direct studies indicating toxicity or adverse effects of cedar treatments on humans, thujone—a compound found in Thuja species—has been associated with neurotoxicity at high doses (>12.5 mg/kg body weight/day) or with prolonged exposure (Batiha et al., 2020).

(2) Sage

Sage (Salvia species) belongs to the genus of Salvia. Sage is used in treating pathogen infections, inflammations, and cancer tumors in many traditional healing practices (Hamidpour et al., 2014). It is a sacred herbal medicine for many Canadian Indigenous people to cleanse their spirits, remove negative thoughts, relieve pain, and heal wounds through a ceremony called smudging in which they burn sage (Greensky et al., 2014).

A study on the effects of Salvia species' essential oil aromas in 135 healthy adults demonstrated their potential to enhance cognitive function and improve behavioral and emotional states (Moss et al., 2010). Participants exposed to the Salvia officinalis aroma showed significantly better memory quality and secondary memory performance compared to the control group with no aroma (Moss et al., 2010). Additionally, the Bond–Lader mood scales indicated a notable increase in pleasantness and alertness in individuals exposed to Salvia officinalis (Moss et al., 2010). Furthermore, monoterpenoids—a 10-carbon compound found in Salvia species—were found to inhibit transient receptor potential (TRP) channels, which are associated with chronic pain in human skin (Vogt-Eisele et al., 2007). By blocking these channels, Salvia mellifera was reported to alleviate chronic pain without causing any toxicity or side effects during and after the therapy (Vogt-Eisele et al., 2007; Adams et al., 2019).

Various studies have supported the effectiveness of Salvia species in treating infections, inflammations, and cancers. The anti-inflammatory and antioxidant potentials of Salvia officinalis have been shown to effectively address inflammation (Edris et al., 2007, Ghorbani and Esmaeilizadeh, 2017; Walch, 2011). The crude extract of Salvia

officinalis has also been found to protect mice against diarrhea induced by castor oil and inhibit abdominal spasms in rabbits induced by potassium ions, indicating its potential antidiarrheal and antispasmodic effects in humans (Khan et al., 2011). Furthermore, researchers have discovered a combination of bioactive compounds in sage—Linalyl acetate (Ly), Terpeniol (Te), and Camphor (Ca)—that could synergistically inhibit the growth of colon cancer cell lines (HCT-116) with no adverse effects on the growth of FHs 74 Int normal human intestinal cells (Itani et al., 2008). These findings underscore sage's anticancer and anti-tumor properties, suggesting its potential as a safe and promising treatment for cancer in humans. Other Salvia species, such as Salvia ringens (Tzakou et al., 2001), Salvia multicaulis (Fahed et al., 2016), and Salvia apiana (Krol et al., 2021), have also been shown to possess remarkable antimicrobial activity.

Nevertheless, essential oils from other Salvia species, such as Salvia kronenburgii, Salvia verticillata, Salvia aurea, Salvia dolomitica, and Salvia somalensis, exert little or no antimicrobial activity against tested bacteria or fungi (Altun et al., 2007; Bisio et al., 1998; Ebani et al., 2018). These results suggest that antimicrobial activity is only effective from certain types of sage and that misusing the wrong species may lead to inefficacy or adverse effects in humans.

(3) Sweetgrass

Sweetgrass (Hierochloë odorata L.) is a sacred plant for First Nations, Inuit, and Métis populations, used in treating common colds and smudging during which people burn sage and sweetgrass to purify spaces, objects, and individuals (Turner, 2018). It also has a documented use as an insect repellent by the communities from Montana and Alberta (Cantrell et al., 2016).

Previous studies have mainly focused on the antioxidant activity of Hierochloë odorata L., demonstrating its potential to protect humans against oxidative stress in the body (Slapšytė et al., 2013; Łuczaj et al., 2014). Extracts from aerial parts of Hierochloë odorata L. are identified as 5,8-Dihydroxycoumarin (5,8-DHC) (Pukalskas et al., 2002). According to the results of ABTS (2,2′-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid)) and DPPH (2,2-diphenyl-1-picrylhydrazyl) radical scavenging activity on 5,8-DHC, researchers concluded the potential of Hierochloë odorata L. as an antioxidant for oral consumption with no acute toxicity (Pukalskas et al., 2002). Additionally, chemical compounds—phytol and coumarin—found in Hierochloë odorata L. have been identified as contributing to the mosquito-biting deterrence of sweetgrass, validating Indigenous knowledge of its practical applications in both traditional and contemporary contexts (Cantrell et al., 2016). With further clinical validations, Hierochloë odorata L. could serve as a sustainable, plant-based alternative to synthetic insect repellents, promoting a healthier, environmentally friendly approach to pest control. There is even a study pointing out a synergistic effect of combining Hierochloë odorata and Salvia officinalis that can significantly improve their stability against autoxidation (Zainuddin et al., 2002), which may explain why Indigenous people have historically used sweetgrass and sage together in various traditional practices.

Nevertheless, in a genotoxic assay conducted in 2013 on Wistar rat bone marrow cells, human lymphocytes,

and Drosophila melanogaster wing cells, 5,8-DHC was found to be potentially genotoxic according to both in vivo and in vitro results (Slapšytė et al., 2013). This suggested that 5,8-DHC isolated from sweetgrass (Hierochloë odorata L.) may possess a certain degree of cytotoxicity to human cells. Further investigation is needed to fully understand the implications of these findings, particularly regarding the safety and potential risks associated with the consumption of 5,8-DHC in sweetgrass treatment.

(4) Tobacco

Native tobacco leaves (Nicotiana rustica L.) have held a sacred role in Indigenous ceremonies and traditional practices, such as smudging, prayers, and blessings (Gendron, 2017). Indigenous healers regard Nicotiana rustica L. as a powerful medicinal plant that promotes both physical and mental health (Berlowitz et al., 2020). Traditionally, it has been administered orally in liquid form to treat conditions like epilepsy, respiratory issues, and mental health disorders (Berlowitz et al., 2020).

In this paper, we examined several clinical studies to assess the effectiveness of Nicotiana rustica L. in supporting physical and mental health. One notable case involved a 37-year-old woman with depression, anxiety, ADHD, and hypermobile Ehlers–Danlos syndrome (EDS), who experienced progressive improvements in her overall well-being after receiving a tobacco-based treatment, highlighting its therapeutic potential (Berlowitz et al., 2023). In a separate 2022 clinical trial, 80 out of 94 participants reported significant improvements in mental clarity, serenity, strength, contentment, and overall wellness after consuming liquid tobacco (Rumlerová et al., 2022). Similarly, a 2024 study on 27 female participants found a significant reduction in anxiety ($p < .0001$), depression ($p < .001$), and hostility ($p < .001$) following tobacco treatment (Berlowitz et al., 2024).

Beyond mental health benefits, Nicotiana rustica L. has demonstrated other medicinal properties, such as anti-inflammatory, anti-parasitic, and anti-nociceptive activities in studies conducted on dogs and mice (Lan et al., 2016; Bensalah et al., 2009), further suggesting its therapeutic potential. However, some clinical trials have also noted side effects, such as nausea and vomiting, following tobacco treatments on humans (Rumlerová et al., 2022).

To assess its safety, a study was conducted on female Wistar rats, which are biologically analogous to humans. The results showed no significant changes in mortality, behavior, or body weight after consuming Nicotiana rustica L., leading researchers to conclude that it is safe for humans without oral toxicity (Andjani et al., 2019).

Discussion

This paper highlights the significant medicinal potential of Indigenous healing practices, as evidenced by numerous scientific studies and clinical trials on the four sacred plants—cedar, sage, sweetgrass, and tobacco. The findings suggest that these plants offer a wide range of therapeutic benefits, and their integration into modern medicine could lead to more holistic and effective treatments. By learning from Indigenous healing methods, we can enhance modern healthcare practices, combining traditional knowledge with contemporary medical approaches to address diverse health challenges. Several studies have indicated the synergetic effects

of combining traditional plant extracts and modern medicines (Efferth et al., 2019), showing the values of incorporating traditional medicines into the Western healing practices.

Unfortunately, there is a notable lack of studies that detail the precise concentrations of medicinal compounds in these sacred plants required to achieve optimal therapeutic effects. Side effects, such as the potential addictive properties of tobacco, also necessitate long-term studies to fully understand their impact. This gap in information presents a significant challenge in translating traditional remedies into effective and standardized treatments. To address this, it is crucial to engage with practitioners who have hands-on experience with these plants, as their insights could inform more accurate application methods. Furthermore, more clinical research is needed to determine the appropriate dosages, safety profiles, and overall effectiveness of these compounds. By doing so, we can bridge the gap between traditional knowledge and modern medicine, ensuring that these natural resources are utilized in ways that are both scientifically robust and practically beneficial.

The Canadian health system currently has inequalities between traditional medicines and Western medicines in which indigenous patients are barely accessible to traditional healers (Redvers et al., 2019). Colonization has led to the dominance of Western health systems, leaving Indigenous traditional treatments in an inferior position (Akbar et al., 2020). The shortage of traditional medical knowledge in the Western world has led to prejudice, suspicions, and mistrust of indigenous healing practices among Western health professionals (Marsh et al., 2015).

This review is limited to articles published in English to avoid potential misinterpretations that may arise from non-English sources. Consequently, Indigenous languages were not included due to challenges in translation and the scarcity of credible literature available in these languages with accompanying English translations. For future studies, we aim to incorporate Indigenous voices and texts to enrich the dialogue between traditional and Western medical systems. Active collaboration between traditional and Western health systems is crucial for fostering mutual understanding, promoting respect, and improving health outcomes for both Indigenous and non-Indigenous communities (Schultz et al., 2021). More research, in cooperation with Indigenous practitioners, should be undertaken to fully explore the medical potential of Indigenous botanical resources.

Conclusion

This paper provides insight into the effectiveness of Indigenous medicinal plants by demonstrating the efficacy of cedar, sage, sweetgrass, and tobacco remedies from First Nations, Métis, and Inuit Peoples. All four sacred medicinal plants used by First Nations, Métis, and Inuit populations show the ability to improve human health with minimal side effects in clinical trials, in vitro or in-vivo models. However, more clinical research is needed to determine the appropriate dosages, safety profiles, and overall effectiveness of these compounds. Given that Western medical knowledge can

sometimes overshadow or neglect Indigenous practices (Marsh et al., 2015), it is crucial for the Canadian government to provide opportunities for physicians to learn from First Nations, Inuit, and Métis peoples about traditional healing methods (Allen et al., 2020). Collaboration between federal, provincial, and Indigenous governments is essential to co-develop a health system that integrates both traditional and Western treatments (Redvers et al., 2019). Leveraging Indigenous knowledge of medicinal plants is key to this integration, ultimately benefiting healthcare for all (Field et al., 2022).

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