



How Indigenous Traditional Medicine and modern science are working together to combat diabetes

With global diabetes rates on the rise, particularly in Indigenous communities, **Professor Pierre S Haddad** from the Université de Montréal has been working with Canadian Indigenous populations to investigate how medicinal plants can be used for diabetes treatment. Their work aims to translate Indigenous Traditional Knowledge into scientific language and provides an exemplary template of how to conduct research on Traditional Medicine.

American Larch, *Larix laricina*

Global cases of diabetes mellitus (DM) have increased dramatically over the last few decades and are predicted to continue, with the International Diabetes Federation (IDF) predicting one person in ten to be diabetic by 2035. Type 2 DM (T2DM) is characterised by the body's deregulation of blood glucose, resulting in blood glucose levels remaining chronically elevated. Levels of T2DM are disproportionately high in Indigenous communities. This trend is evident in Canadian Indigenous communities, who suffer significantly higher rates of T2DM (17.2%) than the rest of the country (5%).

CULTURALLY RELEVANT HEALTHCARE

The discrepancy between diabetes in Indigenous and non-Indigenous communities has been linked to rapid changes in lifestyle and genetic predisposition. In addition, the issue is confounded by the fact that a conventional drug-based approach to diabetes treatment often has limited success within Indigenous communities as it fails to address the holistic approach of Traditional Medicine (TM). Many Indigenous healers take a holistic approach to medicine, addressing the patient's physical, mental, emotional, and spiritual wellbeing, with medicinal plants often playing a key part. Therefore, there exists a need for a more culturally relevant approach to diabetes medicine. To this effect, the World Health Organization (WHO) published a resolution in 2009 promoting preservation, research and inclusion of TM in healthcare.

To address specifically the dramatic rise of diabetes in Canadian Indigenous communities, the Canadian Institutes of Health Research established the Team in Aboriginal Antidiabetic Medicines (CIHR-TAAM) in 2003. As lead of the CIHR-TAAM, Professor Haddad works together with academic colleagues and Indigenous communities to translate Cree Traditional Knowledge (TK) of medicinal plants into the scientific language that is better understood

within the diabetes research community. This research requires a careful approach in many areas, notably protection of Indigenous intellectual property rights and protection from over-exploitation of plant resources.

A NOVEL APPROACH: MODERN SCIENCE ALONGSIDE TRADITIONAL KNOWLEDGE

The initial aim of Professor Haddad and his team was to provide a proof of concept that medicinal plants used in Cree TM hold antidiabetic properties. To achieve this, medicinal plants were firstly identified using a novel ethnobotanical approach based on a set of diabetes-related symptoms. Ethnobotany is the scientific study of how plants are used by humans, including their application to health and wellbeing. Plants which were found to have the highest antidiabetic potential were then screened for primary (glucose-lowering) and secondary (toxicity, drug interactions, complications) activity. This screening process used a comprehensive platform of *in vitro* cell-based and cell-free bioassays to better understand the target tissues and mechanisms of action (Table 1) of the plants. Bioassay-guided fractionation (repeated separation of components in an extract to isolate pure, biologically active compounds) was then used to identify the active principles of the most active species, with *in vivo* animal models of diabetes used to confirm the biological activity of key plant species. In parallel to this scientific approach, Cree Elders and healers prioritised medicinal plants for treating diabetes symptoms, according to their Traditional Knowledge.

THE POWER OF PLANTS

A striking finding from this research is that the majority, four out of six, of the plants found to have the highest antidiabetic potential by the scientific study are the same as those prioritised by the Cree Elders and healers. This result confirms not only the great wisdom and knowledge of Indigenous healers but also the value of cross-cultural collaboration in health research. In addition, many plants were found to have multiple biological activities ▶

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that are complementary to those of other species, raising an interesting possibility that plant combinations could be customised to treat different diabetic profiles.

FACTORS OF SUCCESS

Stemming from collaboration and co-operation (so-called participatory community-based research), the success of this research depended heavily on the relationships between researchers and participating Indigenous communities. In order to acquire successful results, it was vital to gain the trust of communities involved. Anxieties from the Cree communities typically concerned ownership and misuse of TK alongside fears that the publication of results would lead to the over-exploitation of plant resources. To address these concerns, Haddad and TAAM firstly endeavoured to build trusting relationships by ensuring a strong personal presence, for example at regular meetings, and personal accountability, by giving their 'word of honour'. Indeed, the culturally sensitive approach of TAAM to this project can be summarised by their declaration that 'we have underlined respect, patience, humility, and interconnectedness as fundamental guiding principles'. Another key element of this collaboration was a legally binding research agreement that ensured the protection of collected TK and the consent of Elders at all stages of the project. It also included a protocol for the pre-publication review of documents by Cree Elders. The hope is that these documents can serve as an adaptable template for future research. In addition, cultural brokers, with understanding of both community values and the academic world, were used to bridge the gap between science and TK.

LOOKING TO THE FUTURE

Whilst TAAM's work has provided interesting results, Professor Haddad stresses the importance of further research. In particular, the period of use of medicinal plants needs to be increased in future studies and the impact of long-term use of medicinal plants needs to be investigated. In addition, future studies would benefit from the use of modern methods such as genechip technology to better understand the activity of medicinal plants used in TM. Professor Haddad's work has illustrated the value of collaborating with Indigenous communities to fully understand their wealth of Traditional Knowledge. Professor Haddad and his team's approach provides an inspiring example of collaborative research that could be applied to many other projects in the scientific community.



Labrador Tea, *Rhododendron groenlandicum*

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Common Name	Principle mechanisms behind antidiabetic activity
Balsam Fir	Reduces hepatic glucose production Uses both insulin-dependent and insulin-independent mechanisms
Speckled Alder	Limits the expansion of adipose tissue in anti-obesity activities
American Larch	Enhances insulin sensitivity
White Spruce	Inhibits intestinal glucose transport and activity of liver glucose-6-phosphatase Protects preneuronal cells from high glucose toxicity
Balsam Poplar	Antiobesity effects: • Suppression of adipogenesis • Improved insulin resistance • Favoured "energy wastage" mechanisms such as fat oxidation
Labrador Tea	Acts on muscle, liver, adipose tissue and intestine <i>in vitro</i> through insulin-dependent and insulin-independent activities Improves insulin sensitivity and reduces fatty liver <i>in vivo</i>
Northern Labrador Tea	Improves <i>in vitro</i> glucose transport and adipogenesis Protects preneuronal cells from glucose toxicity Prevents AGE (Advanced Glycation Endproduct) formation
Purple Pitcher Plant	Stimulates glucose transport in muscle cells Protects against diabetic neuropathy
Showy Mountain Ash	Increases glucose uptake by skeletal muscle cells Protects preneuronal cells against glucotoxicity Inhibits intestinal glucose transport
Lingonberry	Lowers blood sugar levels May enhance insulin sensitivity, reduce hepatic glucose production, and increase muscle glucose disposition

Q&A

What are the challenges of using lifestyle changes to prevent and treat Type 2 diabetes within Indigenous communities?

As with any community, lifestyle changes are hard to implement and interventions proposed need to be culturally relevant. In addition, the focus should shift away from stigmatisation, from managing perceived 'weaknesses' toward encouraging and celebrating resilience. Interventions should also be more holistic (physical, mental, emotional and spiritual) and rooted in community-based approaches rather than individual-based ones.

What are the barriers to Indigenous communities accessing conventional drug-based diabetes medicines?

One could cite the typical factors such as remoteness and low income that significantly limit access to conventional health professionals and their drug-based therapies. However, there are also questions of mistrust toward modern drugs, notably because of their non-negligible side effects. Finally, drug-based therapies are not holistic nor culturally well-adapted.

To what other branches of research could a legally binding research agreement between Indigenous communities and research scientists be applied?

The answer is quite simple... All!!!! There is no reason why any research with Indigenous communities should not be framed by high ethical standards.

What is the most important next step to address the dramatic rise in Type 2 diabetes in Indigenous communities?

Although culturally adapted treatment options are crucial to develop, prevention strategies that are holistic, culturally relevant, community-based and engage multiple stakeholders should be a high priority.

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How could Traditional Medicine be commercially exploited whilst protecting Indigenous Traditional Knowledge?

This is a loaded question... Elders, notably Traditional Medicine knowledge holders say that Traditional Medicine knowledge is gifted and learned/experienced from the land and from mentors. They also see themselves more as custodians rather than owners of this knowledge and associated intellectual property.

We heard two important issues raised by Elders and knowledge holders. Firstly, Traditional Medicine should be easily accessible; yet, commercialisation did not raise enthusiasm among Elders and knowledge holders. Secondly, Traditional Medicine knowledge should be protected and passed on. We had numerous discussions on how best to protect Indigenous Traditional Knowledge. The current legal framework in Canada, and often elsewhere, does not provide ideal protection, be it through intellectual property, patent or copyright laws as well as other tools. This being said, using the legal tools of the predominant culture (e.g. patents) is a lesser evil than not protecting at all.

One potential avenue could be for Indigenous communities to develop 'ethical' traditional remedies that respect cultural and quality standards. As raised by our Cree partners, income generated by any potential commercialisation of Traditional Medicine should be controlled by the community and serve to 1) ensure the transmission and safeguard of Traditional Knowledge, 2) facilitate access to traditional medicines for community members and 3) encourage further ethical, community-based, participatory research with trustworthy academic scientists.

Detail

RESEARCH OBJECTIVES

Professor Haddad's research focuses on how the Traditional Knowledge of Indigenous peoples can be translated and included in healthcare.

FUNDING

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COLLABORATORS

- Minnie Awashish, Kathleen Wooton and Jane Blacksmith, Cree Nation of Mistissini
- Jill Torrie, Cree Board of Health and Social Services of James Bay
- John Thor Arnason, PhD, Steffany Bennett, PhD, Brian Foster, PhD and Cory Harris, PhD, University of Ottawa
- Alain Cuerrier, PhD, Montreal Botanical Garden

BIO

Dr Haddad is a tenured professor in the Department of Pharmacology and Physiology at the Université de Montréal. He has authored over 130 peer-reviewed publications and is recognised internationally for his work on medicinal plants and functional foods in metabolic diseases such as obesity and diabetes, notably relating to Aboriginal health. His fields of expertise include natural health products, Traditional Medicine, metabolic diseases, diabetes and obesity.



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