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Plants used by the Cree Nation of Eeyou Istchee (Quebec, Canada) for the treatment of diabetes: A novel approach in quantitative ethnobotany

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Abstract

In the last decade, the Cree Nation of Eeyou Istchee has witnessed a 150% increase in the prevalence of Type II Diabetes (T2D) for people aged over 20 years. Clinical intervention using conventional therapeutic methods has yielded only a limited success within this population. An ethnobotanical survey was carried out to identify potentially antidiabetic plant species used within the traditional pharmacopoeia of the Cree. Interviews were held with 34 Cree Elders using a list of 15 symptoms ranked according to their association to T2D. A total of 18 species were cited during the survey, spanning 9 plant families. Species were prioritized for pharmacological analysis according to a Syndromic Importance Value, based on their frequency of citation by informants and the number and specificity of symptoms for which they were used. Correspondence and clustering analyses were also performed to determine the specificity of association between species and symptoms and the symptom-based correlation between species. A data matrix and species ranking order generated from Cree-specific literature demonstrates significant similarity and correlation to our original matrix and ranking, respectively. This article demonstrates the applicability of various underutilized quantitative tools in ethnobotany, while taking a convincing preliminary step towards a therapy more in harmony with Cree culture and lifestyle.

Keywords: Diabetes; Antidiabetic; Cree; Ethnobotany; Quantitative analysis; Medicinal plants

1. Introduction

There are currently over 171 million people worldwide who have diabetes, and this figure is expected to more than double in the next 30 years (WHO, in press). In Canada, it is a significant health problem with a prevalence of 4.8% among people aged over 20 years, representing an annual economic burden of approximately US$9 billion (Health Canada, 2003). The significance of this disease is most pronounced in Canada's aboriginal population, wherein the age-standardized prevalence is three to five times that of the general population (Health Canada, 2003). Moreover, aboriginal patients with diabetes have a greater chance of mortality due to overloaded medical facilities and a lack of compliance with modern medical treatment (Young et al., 2000). The adoption of a sedentary lifestyle, the consumption of non-traditional foods, and a genetic predisposition to the disease are thought to be the major underlying causes of the epidemic (Boston et al., 1997; Young et al., 2000; Hegele, 2001).

The Cree are a member of the Algonkian language family and represent the largest aboriginal group in Canada, numbering over 72,000 individuals across the country (Statistics Canada, 2002). The Cree of Eeyou Istchee (CEI) represent a subpopulation of the greater Cree Nation having a total population of approximately 13,500 people. They are present in nine communities spread out between the 49th and 55th parallels in the province of Quebec, Canada (Secrétariat aux affaires autochtones, 2004). Over the past decade, the age-adjusted prevalence of diabetes among the CEI has risen from 6.6% to 17.7% for people aged over 20 years (Brassard et al., 1993; Kuzmina and Dannenbaum, 2004; Légaré, 2004). This dramatic rise in diabetes, coupled with the second highest prevalence of gestational diabetes reported in an aboriginal group worldwide, highlights the urgent need for effective prevention and treatment strategies (Rodrigues et al., 1999). It should be noted that diabetes among the CEI is almost

Abbreviations: CEI, Cree of Eeyou Istchee; SIV, Syndromic Importance Value; T2D, Type II Diabetes

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exclusively of Type II (Kuzmina and Dannenbaum, 2004; Légaré, 2004).

Despite the implementation of dietary intervention strategies and the presence of numerous educational programs, the prevalence of T2D continues to increase among the CEI (Boston et al., 1997; Gray-Donald et al., 2000; Young et al., 2000; Légaré, 2004). This is largely due to the fact that most management strategies are designed by non-aboriginal professionals and there is an overall lack of cultural appropriateness and awareness (Boston et al., 1997). Consequently, there is a growing need to develop novel approaches towards the management and prevention of diabetes, particularly those in harmony with aboriginal people's culture and lifestyle. In this context, it has been shown that despite access to conventional medical facilities, the use of and dependence upon complementary and alternative medicine by many minority populations continues to thrive (Johns et al., 1990; Berman et al., 1999). Thus, it is not surprising that numerous publications over the last 2 decades have underlined the importance of exploring traditional medicine as a potential source of effective diabetic remedies (WHO, 1980; Bailey and Day, 1989; Marles and Farnsworth, 1995; Oubré et al., 1997; Ryan et al., 2000; Young et al., 2000).

Worldwide, over 1200 species of plants have been recorded as traditional medicine for diabetes (Marles and Farnsworth, 1995). Although most of these species have not undergone rigorous scientific evaluation, over 80% of those which have been tested show antidiabetic activity (Marles and Farnsworth, 1995). It is also worth noting that a number of drugs currently used to treat diabetes are historically derived from plant or fungal material. These include metformin (derived from *Galega officinalis*) (Oubré et al., 1997), acarbose (derived from *Actinoplances* spp.) (Marles and Farnsworth, 1995), and 4-hydroxyisoleucine (currently undergoing clinical trials, derived from *Trigonella feonum-feacum*) (Broca et al., 2004). Despite this convincing evidence, and the presence of several documents which confirm the wealth of ethnomedicinal knowledge held by the Cree Nation (Holmes, 1884; Strath, 1903; Black, 1980; Blacksmith, 1981; Leighton, 1985; Marshall et al., 1989; Zieba, 1992; Siegfried, 1994; Clavelle, 1997; Moerman, 1998; Marles et al., 2000), no work has been done to examine the antidiabetic potential of Cree medicinal plants.

The objective of this study was to identify medicinal plants that have potential antidiabetic properties within the Cree pharmacopoeia. This study represents the first stage of a collaborative project aiming to identify and pharmacologically validate Cree medicinal plants that demonstrate an antidiabetic potential so that they may be integrated into dietary intervention strategies in collaboration with the Cree Board of Health and Social Services of James Bay. Rather than performing an exhaustive survey of the plants used by the Cree of Eeyou Istchee, the authors focused on one community to develop an experimental method suitable to the greater objective of this project. In so doing, this study will provide general ethnobotanical data on a historically understudied population (Holmes, 1884; Strath, 1903), while illustrating the ethnobotanical applicability of several quantitative tools.

2. Methodology

2.1. Study site

Interviews were conducted with Cree Elders in the community of Mistissini, located along the southern border of the CEI territory (48°51′N and 72°12′W; elevation of 121.90 m). This community was chosen due to a limited ethnobotanical coverage and a high plant diversity relative to the other CEI communities. It is located within the eastern boreal forest, a region characterized by an open lichen woodland, which progresses to denser spruce forest as the crown closure becomes greater (Scott, 1995). This is a relatively harsh climate with an average precipitation of 900 mm, an average daily temperature of 1.4 °C, and only 3 months of the year where the average temperature is above 15 °C. Dominant tree species include *Picea glauca* (Moench) Voss, *Abies balsamea* (L.) Mill. in the dense upland forest, stands of *Pinus banksiana* Lamb. on drier sites, *Populus tremuloides* Michx., *Betula papyrifera* Marsh., with *Alnus incana* subsp. *rugosa* (Du Roi) R.T. Clausen in fire cleared patches, and *Picea mariana* BSP. and *Larix laricina* K. Koch in lowland bogs (Scott, 1995).

2.2. Interviews

Since diabetes is a complex multifactorial disease and a relatively new phenomenon among the Cree population, the ethnobotanical approach used was based on the numerous symptoms and complications of the disease. Hence, a questionnaire was developed that addressed 15 symptoms of T2D, rather than diabetes per se. The choice of these symptoms was validated from previous ethnobotanical literature and a team of endocrinologists and diabetes scientists (Oubré et al., 1997; McCune and Johns, 2002, 2003). This approach has the dual advantage of obtaining a large amount of pertinent ethnomedicinal knowledge, while being suitable to the Cree herbalist's role of treating ailments with easily discernable symptoms (Zieba, 1992).

A total of 34 Elders from 23 households participated in the study. Our objective was to interview a large number of Elders to maximize the number of species cited while providing a sufficient sample size to determine the degree of consensus among informants. Allowing couples to be interviewed together reduced the interview sample size, yet it allowed for a more comfortable environment for the informants during the interview session. The Elders who participated were identified by community members as those who were most knowledgeable in Cree traditional medicine. The age of the informants ranged from 60 to 97 years, with an average of 75.5 years. Of the 34 Elders interviewed, 12 had T2D. Interviews took place in the Cree language in the informant's home with the help of an interpreter. Informants were aware of their right to refuse to answer specific questions, to stop the interview at any time, or to simply decline the interview altogether. Interview length ranged from 30 to 120 min.

Interviews began by asking informants about their understanding of the nature of diabetes and its causes. Informants were then asked if they knew of any traditional remedies that