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Review

Ethnomedical research and review of Q'eqchi Maya women's reproductive health in the Lake Izabal region of Guatemala: Past, present and future prospects

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ABSTRACT

Ethnopharmacological relevance: In Central America, most Maya women use ethnomedicines for all aspects of their reproductive cycle including menstruation, pregnancy and menopause. However, very few of these plants have been documented, collected and tested in appropriate pharmacological assays to determine possible safety and efficacy. The aim of this work was to provide an overview of information on the ethnomedical uses, ethnopharmacology, chemistry and pharmacological research for medicinal plants used for women's reproductive health in Guatemala, with a special emphasis on the Q'eqchi Maya of the Lake Izabal region, to demonstrate therapeutic potential and support future research in the field.
Materials and methods: Reviews of the ethnobotanical, ethnomedical and ethnopharmacological literature were performed for 30 plants collected in the Lake Izabal region of Guatemala and used by the Q'eqchi Maya for treatment of reproductive health issues were performed up to and including July 2015 using multiple databases, library searches for abstracts, books, dissertations, and websites.
Results and conclusions: Review of the published research confirms that many of the plants used by Q'eqchi Maya women for the management of reproductive health issues have pharmacological activities, including analgesic, anti-inflammatory, estrogenic, progestagenic and/or serotonergic effects, that support the use of these plants and provide plausible mechanisms of action for their traditional uses. Furthermore, a new serotonin agonist, 9, 10-methylenedioxy-5, 6-Z-fadyenolide was isolated, thereby demonstrating an untapped potential for drug discovery. However, to date much of the pharmacological assays have been in vitro only, and few in vivo studies have been performed. Considering the large percentage of the Maya population in Guatemala that use traditional medicines, there remains a significant lack of pharmacological and toxicological data for these plants. Future research should focus on the safety and efficacy of medicinal plants using in vivo preclinical studies and clinical trials, as well as chemical analysis. Since medicinal plants from the Piperaceae are most commonly used as traditional medicines by the Q'eqchi Maya women, and new bioactive compounds have been identified from Piper species, investigations of commonly used plants from this family would be an appropriate place to start. Data generated from such studies would contribute to Guatemala's national effort to promote a complementary relationship between traditional Maya medicine and public health services.

Contents

Abbreviations: COX-2, Cyclooxygenase 2; E2, Estradiol; ERα, ERβ, estrogen receptor alpha and beta; ERE, estrogen responsive element; GC, granulosa cells; 5-HT, Serotonin; 5-HT_{1-7}, Serotonin receptors 1-7; IC_{50}, median inhibitory concentration; Ki, Inhibition constant; MCF-7, human breast cancer cells; mRNA, messenger ribonucleic acid; nH, Hill coefficient; PMS, premenstrual syndrome; P4, progesterone; PR, progesterone receptor; qPCR, quantitative polymerase chain reaction; SEAP, secreted alkaline phosphatase assay; TRAMIL, Traditional Medicine for the Islands

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1. Introduction

1.1. Past research in women's reproductive health in Mexico and Central America

Although much of our understanding of attitudes, symptoms and treatments that are associated with the female reproductive cycle, including menstruation, pregnancy and menopause has been derived from studies performed primarily in the U.S. and Europe, among homogeneous groups of Caucasian, middle-class, well-educated women (Lock and Kaufert, 2001), a growing number of ethnobotanical studies have recently been published on plants used for reproductive health in the tropics (De Boer and Cotingting, 2014; De Giselle, 2014; Kamatenesi-Mugisha and Oryem-Origa, 2007; Michel et al., 2006, 2007, 2010, 2012; Ososki et al., 2002). Data from cross-cultural research studies indicates that the attitudes, symptoms and treatment choices of women vary considerably depending on their geographical location, environment, health status and specific cultural paradigms that impact women's health (Avis et al., 2001; Michel et al., 2006; Rasor and Adler, 1999). For example, research studies of menstrual health in Latin America suggest that women experience a lower incidence of menstrual symptoms as compared with their US female counterparts (Pawlowski, 2004; Severy et al., 1993). Another large cross-cultural investigation of menstruation conducted among 14 different cultural groups in 10 countries found a that 23–34% of women in developing countries, including Mexico, had reduced rates of menstrual symptoms (including dysmenorrhea, bloating, psychological changes) (Severy et al., 1993). In addition, a 2004 study among Maya women ($n=177$) in the Yucatan revealed a low (28%) prevalence of menstrual pain, and the only variable found to be significantly related to the dysmenorrhea was the age at which the women gave birth to her first child (Pawlowski, 2004). These data differ significantly from the high prevalence (up to 80%) of somatic symptoms and premenstrual mood changes among US women (Sundell et al., 1990; Smith and Schiff, 1993). Reasons for these differences are unknown but presumably diet, lifestyle and the use of ethnomedicines all appear to be involved and impact overall women's health in these countries.

In terms of menopause, the limited number of studies investigating the attitudes, symptoms and treatment choices in Latin America report more positive attitudes and less symptomology as compared to their U.S. and European counterparts (Beyene, 1986; Canto-de-Cetina et al., 1988; Leon et al., 2007; Martin et al., 1993; Malacara et al., 2002; Sievert and Espinosa-Hernandez, 2003), yet, overall, knowledge about menopause among Latin American women is lacking (Dulón-Pérez et al., 2013; Leon et al., 2007). One frequently cited study involved menopausal Maya women ($n=78$) from Chichimila, Mexico (Martin et al., 1993). The results of this study revealed that, although follicle stimulating hormone (FSH) and luteinizing hormone (LH) levels were as high in menopausal Maya women as those in U.S. postmenopausal women, none of these women reported having vasomotor symptoms that are usually associated with such hormonal changes (Martin et al., 1993). Another study among 107 Maya women in the Yucatan also found no symptomology related to menopause other than the cessation of menstruation (Beyene, 1986). Interestingly, bone mineral density, an important intermediate outcome and risk factor for fracture, was also found to be lower in women in both Mexican studies as compared with U.S. postmenopausal women, yet there was purportedly no observed osteoporosis in the Mexican women (Beyene, 1986; Martin et al., 1993). Again diet, lifestyle and the use of traditional plant based medicines have been suggested as reasons for these discrepancies.

Reviews of the Latin American literature over the past 25 years shows a rapid growth in scientific research on natural products, particularly medicinal plants (Calixto, 2005). However, very few of these ethnomedical studies have focused on women's reproductive health, while, those that have, have concentrated specifically on herbs used to enhance fertility or terminate pregnancy (abortifacients) (Arenas and Moreno Azorero, 1977; Browner, 1985, Conway and Slocumb, 1979; Southam et al., 1983). In general, the daily use of plant-based medicines (ethnomedicines) by women in Latin America continues to be based primarily on empirical knowledge and there is little or no scientific or medical information available for the safety and efficacy of these botanical medicines (Bodeker et al., 2005; Calixto, 2005; Michel et al., 2006; Van Andel et al., 2014).

1.2. Guatemala as a site for ethnomedical research in women's reproductive health

Guatemala is located at the northern end of the Central American (CA) isthmus and is inhabited by over 14 million people (Beyene and Martin, 2001). Guatemala is one of the regions with the greatest cultural and biological diversity in the world (Nations