# Insulin Resistance and Type 2 Diabetes in Nicaragua, within the Latinx Population in the United States, supportive materia medica and the Herbal Farm to Clinic Model solution: An integrative approach to herbal healing with a marginalized population

Hannah Popish, MSW
David Winston's Center for Herbal Studies, 2016-2018

**Index**

## Introduction

From January to April of 2016, the author spent three months on the island of Ometepe, Nicaragua learning from and assisting with a project in its foundational stages called "Farm to Clinic." The project originated with a naturopathic doctor, Dr. Dawson Farr, who is affiliated with a local permaculture farm and free integrative health clinic and the co-director of the permaculture farm, Project Bonafide,[1] Mitch Haddad. After seeing firsthand the challenges and costs associated with transporting medicines, herbal and otherwise, to the island from the mainland and the states, Dr. Farr wanted to partner with local farms and community members with enough space to cultivate medicinal plants to fit the needs of the community, to better offer bioregional and culturally appropriate integrated health services. In addition, though greatly appreciated, many of the herbal supports coming to the clinic were not culturally familiar to the population and were not exact fits for the ailments that needed to be healed. For example, though wild cherry bark is an effective expectorant, it is not a remedy islanders necessarily trusted or used comfortably. While on the island, the author was able to witness and better understand some of the principle ailments facing the population, one of which was insulin resistance and ultimately Type 2 diabetes (T2D). Dr. Farr further explained that many of the patients coming to the clinic were pre-diabetic or were experiencing challenges with non-communicable diseases (NCDs), all of which are excellent candidates for using natural medicine as a healing mechanism.

[1] http://www.projectbonafide.com. October, 2017.

The opportunity to see and explore the Farm to Clinic model in Nicaragua led the author to question whether this might be a model that could be replicated in and impactful for the United States (US)as well and in particular had the potential to be useful for vulnerable populations looking for alternative and affordable healthcare. More research into T2D within the Latinx population in the US suggests that this is a pressing health concern beyond Nicaragua. This marginalized population experiences the same barriers to both preventive measures and treatment post diagnosis, barriers that integrative medicine could successfully address.

In both Nicaragua and US, integrative healthcare professionals are at an advantage when treating people with insulin resistance and when embarking on conversations about how to combine lifestyle changes and herbal medicine for treatment of insulin resistance and T2D. They are able to foster relationships with clients that address the whole person as part of their protocol. There is solid evidence that with proper education and follow through, lifestyle and dietary changes can work extremely well.[2] In addition, with a focus on working with the Latinx population in the US and abroad, the use of herbal medicine may be more familiar and thus have greater compliance than mainstream medicine working in isolation.

This paper first provides a brief understanding of insulin resistance and T2D, its etiology, sequelae and treatment. Then the research moves to an examination of the Nicaraguan context of insulin resistance and T2D within the schema of the country's public health system and its newly enacted Natural Medicine Law. The causes and prevention of insulin resistance and T2D and its

[2] Winston, D. Herbal Salon: Insulin Resistance / Metabolic Syndrome. September 5, 2018.

increased incidence rate both in Latin America and the US and its disproportionate effect on the Latinx population is explored next. This paper then shares more about the Farm to Clinic model conceptually as well as its feasibility for Nicaragua and beyond with real world examples and potential pilot sites. A brief materia medica section is included for a resource list and greater understanding about plants that are especially indicated for the prevention and treatment of insulin resistance and T2D. And, to ground the research, best practices in cultivation of a selection of the aforementioned plants as well best practices in herbal medicine making and formulation is then shared. The intent behind the plant selection of this materia medica list in the body of this paper is that they are plants that can potentially be easily grown in both temperate and tropical climates and include varieties that would have some familiarity to the Latinx community, regardless of where they currently reside.

Ideally this research is applied and ethnobotanical in nature wherever possible, meaning that the research is adapted with an eye to whichever cultural context the project is part of at the time. Hopefully this paper can be of use to those in the field trying to advance the work of an integrative health herbal farm to clinic model as well as those seeking to better understand solutions for NCDs facing people in Nicaragua as well as the Latinx community stateside.

> The World Health Organization (WHO) estimates that up to 80% of the world's population rely on herbal medicinal products as a part of their primary healthcare. An increasing number of research studies have validated the safety and efficacy of certain herbal medicines in both acute and chronic conditions. In Nicaragua, the rapid rise of non-communicable diseases (NCDs), such as diabetes, has placed a heavy strain on the already overused and underfunded health system. Thus innovative solutions that involve local, sustainable, safe and efficacious herbal medicines could help bridge the gap

between the current health infrastructure capacity and current public health needs.[3] And, when some NCDs such as insulin resistance and T2D can be diagnosed early, natural medicine is an excellent treatment protocol and, in some cases, can be done outside of a hospital or a doctor's office. The goal of broadening the scope, including herbal medicine and teaching people to grow certain useful herbs in their communities and back yards ultimately translates into greater accessibility. Natural medicine, simply put, makes sense. And, it is still in use, maybe even more so, in more remote or marginalized communities that have less access to other healthcare options. Now more than ever, even as allopathic medicine continues its advancements, it is important to reach back to our roots and remember and uplift indigenous and traditional ways of healing. The two types of medicine can and should work in concert with one another, we need this confluence of ideas.

**Insulin Resistance and Diabetes:**

**A brief summary of risk factors, etiology, sequelae, prevention and allopathic treatment**

NCDs like diabetes are on the rise for low income and marginalized populations, both in Nicaragua and in the states. One of the most prevalent NCDs and one that carries highest causes of death is diabetes.[4] The disease can be understood as a progression from insulin resistance to metabolic syndrome to T2D. Type 1 Diabetes (T1D) has a strong genetic component and the prevention and treatment of it is not discussed in the body of this paper. Below is a general understanding of what constitutes the risks for insulin resistance and T2D, a summary of its

[3] Farr, D. Sustainable Medicine Project, White Paper. 2017.
[4] http://www.emro.who.int/noncommunicable-diseases/diabetes/index.html, August, 2018.

etiology and sequelae, as well as some basic prevention in the form of lifestyle changes and supports.

Risk factors for insulin resistance are numerous and increase with age as well as with lifestyle choices such as lack of adequate sleep (less than seven hours a night) and lack of exercise and certain dietary choices. In addition, being overweight (especially abdominal obesity), triglyceride levels that are over half your cholesterol levels, a diet high in refined carbohydrates and excess Omega 6 fatty acids relative to Omega 3 fatty acids, nicotine consumption, increased cortisol levels and hypertension put one at high risk. Another very important piece of prevention to address targeted risks includes having healthy gut flora and healthy digestion. Other groups at risk include women over 35 with hypothyroidism and certain ethnic groups with a genetic predisposition, including Latinxs.[5]

More specifically, T2D begins as a lack of insulin secretions from the pancreas which can the lead to hyperglycemia and many other sequelae including vasoconstriction. The body needs adequate levels, not too much and not too little, and well timed insulin in the body throughout the day and night. Insulin aids in the proper utilization of glucose, a component of numerous healthy and normal functions needed on an ongoing basis in the body such as regulating blood sugar and fueling cellular metabolism. If the body does not have sufficient insulin regulation through pancreatic secretions, it is unable to adequately dispose of sugar in the bloodstream. In addition, hyperglycemia occurs when there is a blockage of one's metabolic pathway that doesn't

[5] Winston, D. Herbal Salon: Insulin Resistance / Metabolic Syndrome. September 5, 2018.

allow proper use of insulin or what is known as insulin resistance.[6] When the levels of insulin are too high, cells, veins and arteries become constricted which can lead to a number of issues throughout the body such as obesity, loss of eyesight, strokes, a compromised cardiovascular system, and various neuropathies.[7]

> During the 1970's several researchers noted the link between obesity, diabetes, atherosclerosis, kidney stones, gout, elevated triglycerides, and hypertension. In 1988 Gerald Reaven, MD coined the term Syndrome X to describe this constellation of diseases/symptoms and he was the first researcher to propose the underlying causative factor being insulin resistance. Known sequelae of long-term insulin resistance include heart disease, atherosclerosis, stroke, elevated triglycerides, mitochondrial dysfunction, obesity, hypertension, PCOS, uric acid kidney stones, gallstones, increased risk of prostate and breast cancer as well as other cancers, uterine fibroids, type 2 diabetes, non-alcoholic fatty liver disease (NAFLD), erectile dysfunction, gout, and inflammatory diseases (due to increased cytokine adhesion factors, RAGEs, COX-2 activity and increased inflammatory prostaglandins) and possibly BPH, Alzheimer's disease, hemochromatosis and psoriasis. According to Dr. Reaven 50% of Syndrome X is genetic, 25% due to obesity and 25% due to a lack of exercise.[8]

Physicians in both Nicaragua and the US primarily use the drugs Metformin and injected Insulin in their treatment plans for T2D. Metformin's main method of action is to decrease fasting blood glucose and lipopolysaccharide levels in the body.[9] Introducing insulin stimulates the pancreas to do its job and convert the sugars to usable energy in the body.[10] Both drugs can lose their effectiveness over time and have to be constantly monitored by a health care provider to assess their levels and impact on the body and the disease. In addition, individuals using injected insulin must monitor their blood sugar levels on an ongoing basis and often constantly adjust their insulin dosage and administration accordingly.

---

[6] Winston, D. Insulin Resistance and Metabolic Syndrome: The Causes, The Risks, and Effective Treatment. 2018.
[7] http://www.townsendletter.com/May2007/oxyhomeo0507.htm. August 2017.
[8] Winston, D. Insulin Resistance and Metabolic Syndrome: The Causes, The Risks, and Effective Treatment. 2018.
[9] Marin-Peñalver, J.J., et. al. Update on the treatment of type 2 diabetes mellitus. World J Diabetes. 2016 Sep 15; 7(17): 354–395. doi: 10.4239/wjd.v7.i17.354
[10] Ibid.

While there are definitely situations in which pharmaceutical and allopathic medical care is necessary for T2D, much of the prevention, management, treatment and ultimately cure of this disease can occur through diet changes (increases in vegetables, soluble fiber, omega 3 fatty acids, whole grains and a reduction in trans fats, simple carbohydrates and alcohol), adequate sleep, stress reduction, exercise and decrease in overall Body Mass Index (BMI) and use of herbal supports, including bitters.[11]

**Diabetes in Nicaragua**

"Globally 387 million people currently have diabetes and it is projected that this condition will be the 7th leading cause of death worldwide by 2030. As of 2012, its total prevalence in Central America (8.5%) was greater than the prevalence in most Latin American countries and the population of this region widely use[d] herbal medicine."[12] In 2016 in Nicaragua, diabetes was responsible for 6% of the nation's deaths.[13]

Malignant neoplasms, ischemic heart disease, cerebrovascular diseases, diabetes mellitus, and chronic renal insufficiency are diseases with a high mortality burden that constitute the five leading causes of death. Between 2007 and 2010, these conditions were responsible for 44% of the 72,862 deaths reported (51% of which occurred among men).[14] Low to middle income

---

[11] Winston, D. Herbal Salon: Insulin Resistance / Metabolic Syndrome. September 5, 2018.
[12] Giovanni, P., Howes, M-J., Edwards, S. Medicinal plants used in the traditional management of diabetes and its sequelae in Central America: A review Journal of Ethnopharmacology 184(2016) 58-71.
[13] https://www.who.int/diabetes/country-profiles/nic_en.pdf?ua=1
[14] http://www.paho.org/salud-en-las-americas-2012/index.php?option=com_docman&task=doc_view&gid=140&Itemid. May 9, 2017.

countries are at higher risk for adult deaths caused by diabetes with estimates now at 80%.[15]"The top five countries with the highest prevalence in 2013 in the South and Central America Region include two countries in the Caribbean Islands and three countries from Central America: Nicaragua (12.45%), Guatemala (10.87%), and El Salvador (10.50%)."[16]

In Nicaragua in 2016 15.5% of the population was considered obese and 46.1% was considered overweight. 8.1% of the population was diagnosed with diabetes.[17] There is currently no policy, no strategy, no plan for prevention of diabetes that addresses overweightness and obesity, nor is there a plan to increase physical activity for those in need of support. In the Nicaraguan health sector, there are high levels of fragmentation not only in how they are organized, but also in how they operate. The network of health facilities faces major limitations related to both structure and processes; Under registration of patients seen and diseases treated is a constant problem in the health sector's information system. For the Ministry of Health, all these factors affect its overall capacity and limit its exercise of leadership.[18]

In addition, Nicaragua and other Central and South American countries have large indigenous populations who often have different needs and belief systems around health and healing and are struggling with how to address this rapid increase in NCDs.

> Governmental and nonprofit agencies now recognize that there is real cause to be concerned. In 1993 and 1997 , the Pan American Health Organization (PAHO) passed

[15] Giovanni, P., Howes, M-J., Edwards, S. Medicinal plants used in the traditional management of diabetes and its sequelae in Central America: A review. Journal of Ethnopharmacology 184(2016) 58-71.
[16] Giovanni, P., Howes, M-J., Edwards, S. Medicinal plants used in the traditional management of diabetes and its sequelae in Central America: A review. Journal of Ethnopharmacology 184(2016) 58-71.
[17] https://www.who.int/diabetes/country-profiles/nic_en.pdf?ua=1, January 2019.
[18] Ibid.

> resolutions to promote the right to health and the access to health care for indigenous peoples in the Americas. Resolutions CD37.R5 and CD40.R6: Health of Indigenous Peoples Initiative acknowledges the inequities in the status of health and lack of access to basic health services. These resolutions consist of provisions to support the right to self-determination and respect for cultural values regarding health care along with the right to alternative models of care to deal with "insufficient coverage, inadequate access, and the lack of acceptability of health services on the part of indigenous populations." It also urges member governments to establish mechanisms that allow for representation of indigenous peoples in the development of health care services for their own populations. The PAHO resolutions served to guide the health measures framework for indigenous peoples residing in the Americas.[19]

Politically, the terrain continues to become more complicated. While Nicaragua had benefited from a few decades of relative peace, 2018 saw yet another political shift. After a spontaneous popular uprising in April of 2018 due to a proposed decrease in social security benefits, Nicaragua has become an increasingly authoritarian state wherein access to resources and freedom of speech is even more limited than in recent years past. Since the protests began, people are now living under pseudonyms and in hiding, some local news stations have been shut down, and international funding has been stymied.[20]

To better understand the landscape of insulin resistance and T2D in Nicaragua, the author contacted someone intimately connected with the topic. Gareth Hickson has spent extensive time in Nicaragua studying and supporting treatments. He shares the following:

> All of my interest stemmed initially from me being a type 1 diabetic and traveling with Dr. Lane to the country as I struggled to find reasonable alternatives to the common diet items and care. **The last conversations I had on this subject indicated the number one priority from the Nicaraguan endocrinologist, medical community, and nursing perspective was education.[emphasis added].** Alternative medicines do no good if the

[19] Carrie et al. Integrating traditional indigenous medicine and western biomedicine into health systems: a review of Nicaraguan health policies and miskitu health services. International Journal for Equity in Health (2015) 14:129 DOI 10.1186/s12939-015-0260-1.

[20] https://www.nytimes.com/2018/04/20/world/americas/nicaragua-protests-ortega.html?module=inline, April 2018. https://www.nytimes.com/2018/12/24/world/americas/nicaragua-protests-daniel-ortega.html, April, 2018.

> patients have no understanding of the disease or the money to afford simple medicines. First world peoples remedies are great alternatives for care for moderate type 2 patients, but ultimately Nicaragua is a 3rd world country medically speaking. **Finding resources for medical educators and making sure those resources are used to the best advantage for the poorest of the poor is and should be the ideal goal.[emphasis added].** Regarding local remedies or problems I have seen and spoke about would be education, availability of supplies, remote rural medical care, basic nutrition and alternate choices related to diabetes.[21]

In Nicaragua, according to the Word Health Organization, only 6.3% of the population is insured.[22] Thus, even if insurance companies were willing to support treatment of diabetes in this way, access to insurance is yet another barrier and the terrain of using insurance is very undeveloped. Public health institutions do provide Metformin and Insulin for free. However, there are multiple barriers to the use of diabetic medications as well, including the fact that most public health posts do not have enough clean syringes, they do not always have the medicine in supply, not all doctors at all posts are trained in long term management of the disease, and often patients cannot travel the distance or arrive monthly as required by these medications.[23] Here again, looking to the use of herbal medicine in prevention and treatment could be of great benefit.

### *Natural Medicine Law in Nicaragua*

Law 774, otherwise known as the Natural Medicine Law was enacted in October of 2014. As part of the law, a special division was created in the national ministry of health. One of the specifications of the law is that all fifteen departments in Nicaragua must have a component of traditional medicine at their departmental clinics. Three years later, there are said to be only three

---

[21] Personal communication with Hickson, G., August 2018.
[22] https://www.fsd.org/2018/08/healthcare-in-nicaragua/. March, 2019.
[23] http://www.access2insulin.org/executive-summary-of-nicaragua-report.html. March, 2019.

or four clinics with the traditional medicine component currently in operation.[24] In addition, "this division will handle everything related to requirements for registering and labeling natural medicines. Anything packaged will need a permiso, a license, and a a lab analysis, and a specific preparation area."[25]

From June 5 - 7, 2017 PAHO and the National Autonomous University of Nicaragua (UNAM), and public health expert Dr. Daniel Gallego hosted a consortium. International medical professionals, medical students, and natural health experts gathered to discuss how to continue moving forward with the enactment of Law 774. However, in general, plans for mobilizing this law seem to have stalled due to funding and organization challenges.

**Diabetes in the United States - Disproportionate Impact on Latinxs**

In the United States in 2016, 9.1% of the population was diagnosed with diabetes.[26] Knowing how to adequately provide healthcare to the Latinx population is increasingly important. "Latinos currently comprise 15% of the U.S. population. It is estimated that by 2050, 1 out of 3 U.S. residents will be Latino."[27] In the United States 50% of Latinx men and women are likely to develop TD2 and they are 50% more likely to die from diabetes than Caucasians.[28] Some challenges of and highlights on this health disparity are "cultural sensitivity, health literacy, and a shortage of Hispanic health care providers. Acculturation barriers and underinsured or

[24] Personal communication with Farr, D., May 2017.
[25] Personal communication with Farr, D., June 2016.
[26] https://www.who.int/diabetes/country-profiles/usa_en.pdf, January 2019.
[27] Lopez, L. and Golden, S.H. A New Era in Understanding Diabetes Disparities Among U.S. Latinos—All Are Not Equal. Diabetes Care 2014 Aug; 37(8): 2081-2083. DOI 10.2337/dc14-0923.
[28] https://www.cdc.gov/features/hispanichealth/index.html, January 2019.

uninsured status remain as major obstacles to health care access."[29] Within Hispanic subgroups, Puerto Rican individuals seem to be disproportionately impacted by diabetes... In 2012, the age-adjusted rate of diagnosed diabetes was 14.8% for Puerto Ricans, 13.9% for Mexicans, 9.3% for Cubans, and 8.5% for Central and South Americans." [30] Surprisingly, rates of diabetes are positively correlated with higher rates of acculturation and increased time in the United States.[31] This may seem counterintuitive but often it is because immigrant populations are adopting a more western diet and lifestyle which their bodies were not accustomed to previously. Higher income and increased education rates are found to be protective factors.[32] In addition, higher rates of smoking nicotine and alcohol consumption in second generation Hispanic groups can be seen to lead to higher incidences of diabetes.[33] In addition, diabetes is a costly disease:

> In the USA, the total diabetes expenditure for the year 2012 was 245 billion US dollars: 176 billion expended in direct medical costs (comorbidities, medications, medical supplies, hospitalization) and 69 billion in indirect costs (loss of employment, permanent disability, low healthy life expectancy). The medical expenses of Americans with diabetes were 2.3 times higher than the medical expenses of their healthy counterparts.[34]

The cost of insulin medication in the US is increasingly expensive and prohibitory for many. Currently at as high as $1,300 per month, the price of insulin, a life-saving drug for diabetics, tripled between 2002 and 2013. Since 2008 three of the top makers raised the list price of insulin

---

[29] Velasco-Mondragon, E., et. al. Hispanic Health in the USA: A scoping review of the literature. Public Health Reviews (2016) 37:31 DOI 10.1186/s40985-016-0043-2.
[30] Velasco-Mondragon, E., et. al. Hispanic Health in the USA: A scoping review of the literature. Public Health Reviews (2016) 37:31 DOI 10.1186/s40985-016-0043-2.
[31] Lopez, L. and Golden, S.H. A New Era in Understanding Diabetes Disparities Among U.S. Latinos—All Are Not Equal. Diabetes Care 2014 Aug; 37(8): 2081-2083. DOI 10.2337/dc14-0923
[32] Ibid.
[33] Velasco-Mondragon, E., et. al. Hispanic Health in the USA: A scoping review of the literature. Public Health Reviews (2016) 37:31 DOI 10.1186/s40985-016-0043-2.
[34] Ibid.

at least 10 times."[35] Under the Affordable Care Act, Medicaid does help low income individuals cover some of the costs associated with diabetes,[36] but when the cost continues to climb, this can only be so helpful. Low rates of diabetes awareness and control, distrust of and mistreatment by health care professionals, lower incomes, and a high rate of those without health insurance all contribute to risk factors for Latinxs with diabetes.[37] Latinxs "are also more likely than other ethnic groups to discontinue diabetes medications after losing health care coverage."[38]

## Farm to Clinic Model: What is it, potential benefits, and challenges in Nicaragua and the US

### *What is it?*

Much like the popularized "Farm to Fork" model that brings produce into your home through by Community Supported Agriculture (CSA) or farm to table restaurants that buy from local farmers' markets, the opportunity to have "Farm to Clinic" medicine is very promising. The model has not yet thoroughly caught on worldwide, and thus there is not a large body of current research. In Nicaragua, there is still little familiarity with this model as it is in its nascent stages. Throughout the US, there are multiple smaller versions of this model that operate under the principles that will be outlined below as part of schools of herbal medicine or small scale herb farms run by people that have their own herbal medicine businesses and then turn the herbs into teas, tinctures, or body products. Some of these will be discussed in greater detail. This niche

---

[35] https://www.cbsnews.com/news/mother-fights-for-lower-insulin-prices-after-sons-tragic-death/?ftag=CNM-00-10aac3a. February, 2019.
[36] https://kaiserfamilyfoundation.files.wordpress.com/2013/01/8383_d.pdf. March, 2019.
[37] Lopez, L. and Golden, S.H. A New Era in Understanding Diabetes Disparities Among U.S. Latinos—All Are Not Equal. Diabetes Care 2014 Aug; 37(8): 2081-2083. DOI 10.2337/dc14-0923.
[38] Velasco-Mondragon, E., et. al. Hispanic Health in the USA: A scoping review of the literature. Public Health Reviews (2016) 37:31 DOI 10.1186/s40985-016-0043-2.

concept is currently more familiarly known as community supported herbalism (CSH), herb shares, herb exchanges, community supported medicine, and oftentimes the exchange is at the level of the community between farmers and individuals or families. Farm to Clinic expands on these current concepts to potentially include a consortium or a cooperative of herb growers that then funnel their product directly to an integrative clinic or integrative practitioners.

The idea of clinics, herbalists, and other medical professionals partnering with farmers is by no means a new one. Behind this concept is the belief that knowledge of the location of where one's herbal medicine is grown and who is growing it fosters a sense of trust and accountability, and builds important relationships and networks within the community. Ideally, the community medicine and farm to clinic model could learn from the existing CSA model to find overlaps and avoid known pitfalls. One key identifying factor with a CSA or a CSH share is that each of these operate seasonally, providing community members with food or medicine a certain number of weeks out of the year and often have a set menu such as providing seasonal remedies like teas, tinctures and / or salves. A Farm to Clinic model would be similar, but the herbs provided would ideally be available year round and tailored to the health needs of each community. Following a discussion of benefits and challenges of the Farm To Clinic model current models to learn from will be identified and a discussion of what is possible in Nicaragua and beyond will be shared.

In Nicaragua, though the Natural Medicine Law was enacted in 2014 with the mandate to integrate natural medicine at each Centro de Salud (Health Center) station in each municipality, there has been little in the way of funding or logistical support to ensure this plays out on the

ground. The long term goal is to have cross sector collaboration to make these stations a functional reality that contributes to greater health outcomes for the population, and the Farm to Clinic concept could play a huge role here. "Innovative solutions that involve local, sustainable, safe and efficacious herbal medicines could help bridge the gap between the current health infrastructure capacity and current public health needs."[39] Over the last couple of years, there have been a couple of pilot health outpost sites to push the law forward.

Additional pilot projects and documentation of their processes, especially the exchanges that occur between farms and clinics are needed. Then, all can learn from the successes and challenges of this way to get intentionally grown and harvested herbal medicines into the hands of local people in an affordable and accessible manner. Also needed is additional funding and a greater targeted body of research for pilot studies on how to make a cooperative model like farm to clinic functional and equally beneficial for each stakeholder throughout the chain. This is not currently a well-known model, and there are multiple financial and practical pieces to address with each of the players involved. Herb farmers, herb processors, people who run integrative clinics and ultimately the patients seeking this type of care all have voices we need to hear.

### *Potential Benefits in Nicaragua and US*

One unique and sustainable aspect of the farm to clinic model in Nicaragua could be the engagement of youth at various growing sites. As they learn new growing methods, begin to better understand the ecology of the earth and the body, and have the opportunity to use the herbs

[39] Farr, D. Sustainable Medicine Project, White Paper. 2017.

personally and in a clinic setting, the youth can become emissaries for this new model and carry it into future generations.[40] Overall, there is the promise for greater economic growth and stability for all stakeholders if this model is implemented effectively. In addition, there is the possibility to have a connection with new networks, both within and outside of Nicaragua. Within Nicaragua, unlikely partners are being connected such as farmers and healthcare providers.

Across the globe, this ability to connect practitioners to the herbal medicine they are utilizing, to allow a more tangible awareness of the plants, can only deepen their understanding and improve their skills as healers and thus positively impact clients. Schafer's go to book on farming herbs for larger practitioner markets states, "The relationship between herb growers and practitioners is starting to change. Our idea is to have a joining together of the grower, the practitioner, and the patient, so everybody is working together along the same lines - which is of course toward the individual's health, but also the health of the community and the health of the planet as whole."[41] If the model is able to gain ground internationally, the potential to share successes and challenges across communities is huge. Lastly, this model is timely as there is an increasing public expression of willingness on behalf of practitioners to support locally grown, high quality herbal material as well as an awareness of the need to offer integrative as well as accessible medical models.

---

[40] Farr, D. Sustainable Medicine Project, White Paper. 2017.
[41] Schafer, P. The Chinese Medicinal Herb Farm. Chelsea Green Publishing. 2011. Pg. 11.

In addition, there is a growing need for clean, quality organic herbs grown locally rather than imported. Farm to Clinic models could help secure these herbs. In particular, health practitioners working with the herbs that are traditionally used in Chinese or Ayurvedic medicine have expressed this need.[42] In recent years the herb samples that acupuncturists and Traditional Chinese Medicine (TCM) practitioners have used have been tested and found to have higher than acceptable levels of heavy metals in them, be varieties that are not as medicinally potent, or were later found to be grown and harvested in less than savory conditions.[43] Rigorous growing and testing processes that are encouraged as part of Farm to Clinic models provide this extra level of safety and ultimately trust.

Not only would stakeholders benefit economically, but the potential for patients to have lower costs in their healthcare is a reality as well. Especially if healthcare practitioners are able to use herbs to focus on prevention of insulin resistance and T2D with their clients, they could literally be saving hundreds of dollars per month. In addition, if providers begin using herbs that are both locally grown and culturally familiar to their population, the likelihood of compliance with their protocols would likely climb. In both Nicaragua and the US, the opportunity exists for communities to grow plants that are bio-regionally appropriate plant medicines that have a history of use for local populations.

Ultimately, the Farm to Clinic model has the opportunity to fill a necessary gap in healthcare access, be an economic boon for the local economy, and provide a more secure income for

---

[42] Schafer, P. The Chinese Medicinal Herb Farm. Chelsea Green Publishing. 2011.
[43] https://www.krqe.com/news/chinese-medicinal-herbs-provide-niche-market-for-us-farmers/1019825537. February, 2019. .

medicinal farmers. There are multiple players throughout the supply chain from farming to processing and packaging that could benefit. This model could be a “win/win” for all of the stakeholders involved. The Farm to Clinic model has the ability to reward farmers as well as those receiving profit for the medicinal herbs, including those on the processing side who prepare the herbs for market, the doctors and healers who have another resource at their fingertips, and ultimately the patients who receive another opportunity for healing, one that may be even more familiar to them than allopathic healing modalities.

### *Potential Challenges in Nicaragua and the US*

Both in Nicaragua and the US, combining allopathic with integrative medicine can be a challenge to practitioners and clients alike. Like many other developing countries, Nicaraguans admire and subscribe to the western medical model wherein they often visit a medical practitioner and receive a prescription for their ailments, one that potentially offers quick relief with little additional effort on the part of the patient. The same experience and attitude toward one’s healing in the in the US can also be true. An important piece of ensuring the success of the natural medicine approach to preventing and healing insulin resistance and T2D is working in concert with allopathic practitioners. Patients that choose to be treated with medicinal herbs must have a willingness to be a true partner in their healing process. An understanding and acceptance of the effort and commitment as well as a clearer roadmap for how to combine allopathic and integrative medicine in an effective collaboration is essential.

As mentioned previously, there are laws at the national level in Nicaragua and internationally through the Pan American Health Organization that recognize and grant permission for the indigenous Meskitu population in particular, as well as those in the autonomous regions of Nicaragua, to access culturally and historically appropriate forms of medicine.[44] However, the health posts in this area are few as are the roads to access them, and often they are run by international brigades that lack an understanding of indigenous healing modalities or have trouble communicating with indigenous practitioners to share traditions.[45] And, a further challenge in Nicaragua is to work alongside local government to ensure that the specifications set out by the Natural Medicine Law dovetail appropriately and work in concert with a Farm to Clinic model.

In the US, the challenges are also great. There are many small scale farmers growing herbs at the local level, however as mentioned previously, many are not currently channeling those to clinics as a sales stream. And, there is a strong likelihood that there would need to be a growers' consortium or cooperative model in order to have the surplus necessary for economic viability. In general, more research on cooperative farming models is needed to better understand how they could effectively be applied to this type of initiative. Also, while integrative clinics that often house massage therapists, acupuncturists, herbalists, Naturopaths, ODs and MDs under the same roof with interest in buying these herbs for insulin resistance and T2D and other NCDs are

---

[44] Carrie et al. Integrating traditional indigenous medicine and western biomedicine into health systems: a review of Nicaraguan health policies and miskitu health services. International Journal for Equity in Health (2015) 14:129 DOI 10.1186/s12939-015-0260-1

[45] Carrie et al. Integrating traditional indigenous medicine and western biomedicine into health systems: a review of Nicaraguan health policies and miskitu health services. International Journal for Equity in Health (2015) 14:129 DOI 10.1186/s12939-015-0260-1.

on the rise , what many of these spaces still lack is access to and use of bilingual practitioners. Another challenge to keep in mind is the strength of the pharmaceutical lobby in the US, the pressure the medical profession is under to use their drugs, and the struggles with legality that herbal medicine continues to face.

Shared challenges in Nicaragua and the US include education, capital and infrastructure. From farmland to physical space to house clinics with clinicians willing and excited to use herbal medicine, each step of the way the capacity needed and available must be examined. In Nicaragua, having land to farm upon that farmers have legal title to and want to use for an alternative crop could present a challenge. In a 2016 study in the US, it was recommended that in order to be economically viable, devoting up to one acre per farmer would be necessary for them to contribute to a project like this.[46] Other potential challenges include the effort needed to test plants for safety and quality as well as marketing and distribution of these plants.

Lastly, an overarching challenge to confront is the need for education. As farmers start this process, they will be working with plants that are potentially brand new to them. They will need to have to a strong attention to detail as they begin to identify which plants are more suited to grow in their regions than others. Farmers that have historically grown other crops, in particular annual plants for farmers markets or something that has a set growing season and sales channel like coffee will require more extensive education. Some plants will not thrive, and the initial time and effort needed to discover which varieties are best suited will be another potential loss and up

[46] https://www.krqe.com/news/chinese-medicinal-herbs-provide-niche-market-for-us-farmers/1019825537. February 2019.

front investment of time and money that must be considered. Education for farmers about how best to prepare their soils and grow new plants from seed could help address this challenge. In addition, some medicinal plants take anywhere from one to ten years to reach maturity, so planning for this delayed time frame and subsequent need to potentially plan for multiple income streams is necessary. Education will also be needed to ensure that each step of medicinal plant cultivation from growing to processing to making medicine reaches necessary sanitation and quality levels. Lastly, as mentioned previously, in addition to having the herbs and practitioners willing and able to offer them as healing options, there is also the need to educate populations so that they better understand insulin resistance and T2D and its effects on the body and are comfortable with integrative medicine.

## International examples of Farm to Clinic and similar approaches

### *Blue Ridge Chinese Medicine Consortium*

One model that has been in existence since 2014 is the Appalachian Herb Growers Consortium (AHGC), a project of the Blue Ridge School of Chinese Medicine in Floyd County, Virginia. Their intent is "to foster regional economic empowerment and job creation through ecological cultivation of traditional Asian herbal agricultural products."[47] Their niche is growing traditional Chinese medicinal herbs and they currently work with fifty growers within a two hour radius of their center. For full results of the survey from Program Director Adam Fisher please see Appendix A. Since 2014, the AHGC has moved from selling to simply local providers to

[47] Appalachian Herb Growers and Consortium, Program Guidelines & Agreement, January 2017.

extending the reach to other neighboring states and sharing their model with other interested parties through education.

Fisher shared that what is absolutely necessary for this model to work is consistent and long term funding. In addition, separating the growing from the processing components of the endeavor seems like an important component and one that both streamlines production as well as reduces the need for varied training. For example, the Appalachian Grower's Consortium offers farming training to participants, but they then centrally manage the cleaning, drying, and processing of all herbal materials in addition to the marketing and selling of the farmers' goods.

> Perhaps an advisory committee is necessary to ensure that the steps forward are mindful to the participating farmers' values, as well as the role of your clinic. I also recommend starting relatively small, by growing the herbs for in-house use. Our original medicinal herb gardens at the Blue Ridge Center for Chinese Medicine are 10 years old for that very reason. We were able to trial various species that we had no cultivation information in this region. It allowed us to not only see what did well and what didn't, but also what did *too* well! In tropical regions, the risk of invasive tendencies in otherwise 'well-behaved' plants is much higher. All the successfully grown and harvested herbs were used at the clinic, bringing down our bottom line.
>
> … the processing of the herbs is going to be a limiting factor, especially in the wet season. This is something to mostly worry about much later, but worth noting now. Post-harvest handling in a warm climate means getting the herbs to a processing site asap before degradation or contamination may occur.[48]

***Appalachian Herb Harvest Hub - www.asdevelop.org***

Founded in 1996 and located in Virginia, this Herb Hub model is another one to pay close attention to for inspiration and real world examples. "Collectively as a group, we're trying to create a niche market where large herbal buyers are willing to pay a premium price point for

[48] Personal communication between Dr. Dawson Farr and David Grimsley, former Executive Director of Blue Ridge Center for Chinese Medicine, April 25, 2016.

certified forest grown material in a process that is transparent, traceable and sustainably managed."[49] They herbs they are focus on, ones like goldenseal, ginseng, and black cohosh, are in high demand.[50] Much like the cooperative model they also provide education for farmers on education and marketing as well as use of centrally located infrastructure such as herb dryers and herb packaging facilities.

### ***Herbalista Free Clinic - www.herbbus.com***

While not technically a "farm to clinic" model, Herbalista encourages the simple and accessible model of "grow a row." Farmers who are geographically close to Herbalista's herbal bus, a herbal health clinic on wheels, are encouraged to designate a part of their land to grow something in high demand in their area for medicine makers, herbalists, or others in need, such as calendula. This model could easily be translated to other sites and even work for farmers who are predominately growing other crops such as coffee but have decent arable land that they could intercrop with some herbal offerings.

### ***Sonoma County Herb Exchange - www.sonomaherbs.org***

Founded in 1996 and based in California, this herb exchange is an arm of the 501c(3) Sonoma County Herb Association. Their goal is to connect herb growers with herb buyers. They provide a physical space for the exchange, require a minimum weight of two pounds per order, and offer bulk herbs as well as fresh and dried options. An added benefit of their model is that they provide educational opportunities for the herb growers and they focus on small-scale non

---

[49] https://www.heraldcourier.com/news/local/appalachian-sustainable-development-received-donated-herb-dryer/article_d9ce29c8-400d-11e9-a6af-335218ec6ac0.html, March, 2019.
[50] https://www.asdevelop.org. February, 2019.

mechanized farmers. They also consider themselves frontrunners in beginning to grow chinese medicinal herbs.

### *Growing groups*

"Several states have set up 'growing groups' to help farmers establish trial stands of the most popular plants."[51] They are including farmers that have traditionally grown other crops and want to expand their farms and economic range. There is a consortium of growers in New York that was established in 2016, with some inspiration and guidance from the AHGC that had upwards of fifty farmers trialing a variety of medicinal herbs to sell to acupuncture and alternative health clinics. They estimate that in New York there is a thirty million dollar market for medicinal herbs grown in this way.[52]

### *Colombia - inroads to Complementary and Alternative Medicine (CAM)*

"In December 2012, the Bogota Health Department funded a pilot initiative to train public health teams (physicians, nurses, nurse-aids and environmental professionals) on the cultivation, preparation and use of local medicinal plants. The project aimed at bridging a disconnect that exists between common community use of medicinal plants and classic public health

---

[51] https://www.krqe.com/news/chinese-medicinal-herbs-provide-niche-market-for-us-farmers/1019825537. February, 2019.
[52] https://www.farmprogress.com/crops/medicinal-plants-growing-30-million-new-york-market. February, 2019.

interventions."[53]This project was the first of its kind to include medicinal plants in trainings and included an educational illustrated book as well to aid in communities' understanding of the program's goals.

The foundation was set and this project greatly aided due to national political support for its goals. "In 2009 the Health Department of Bogota, Colombia, sought to bridge the gap between its dominantly allopathic healthcare system and other Complementary and Alternative Medicine (CAM) systems. It launched a pilot project entitled '*Promotion of Complementary and Alternative Medicine in the Primary Healthcare Framework in Bogota*.' The overall goal of the pilot project was to integrate CAM practices into the service portfolio of public hospitals in the city, as well as to generate experience, evidence and a knowledge base that could support the construction of public policies on CAM, within the national healthcare system."[54]

The educational booklet they authored is entitled "The cultivation, use and preparation of medicinal plants for health maintenance"[55] and could be a great resource for others attempting pilot projects. This booklet is fifty-two pages in Spanish and includes illustrations and a table of contents with garden and farm planning details, soil preparation, notes on seeding and propagation of herbs such as ginger, rosemary, and eucalyptus, organic fertilizer options and recipes, how to address what challenges a plant may be facing in its growth process, which basic

---

[53] Gallego Perez, D. et. al. Cultivation, preparation and use of local medicinal plants in primary healthcare, the experience of Bogota, Colombia. November, 2014.
[54] Gallego-Perez, D. et. al. Integration of Complementary and Alternative Medicine in the Colombian Healthcare System; a pilot project in Bogota D.C.
[55] Aldana Martinez, N.S., Gallego Pérez, D., Moya Muñoz, A. Cartillo sobre cultivo, uso, y preparación de plantas medicinales para el cuidado de la salud. December 2012.

plants to include, examples of herbal household remedies, and dosing and usage of teas and tinctures.

### *BioNica* - **www.bionica.org**

BioNica has multiple sites where they have had success training farmers how to farm in the biointensive method and grow herbal medicine crops alongside fruits and vegetables. "Biointensive" in its simplest form means cultivating a large number of species on a small amount of land with a very specific way to take care of the soil and feed the plants for optimal growing success.

Educators from BioNica have already helped numerous non-profit organizations, clinics, and universities start herbal medicine gardens and they are primed and ready to continue on this path as needed. As of Summer 2017, one of the BioNica leaders began to identify community members close to Managua that would be interested in learning about cultivating, processing and using medicinal plants and teaching members of their community. They are already beginning their involvement with PhotoNica which is discussed in further detail as a potential pilot project below.

### *Clinica Verde* - **www.clinicaverde.org**

Clinica Verde, founded in 2012 with a mission of creating a new model of care for families in need, is a located in Boaco, Nicaragua. As their website states, Clinica Verde has a "preventive approach to the wellbeing of our cherished patients, providing not just clinical care, but nutrition and health education in an environment designed to support and improve health outcomes."[56] They are a privately run outpatient clinic. The design of the clinic is intentional, with client and staff needs and social sustainability as well as environmental sustainability in mind. Clinica Verde has partnered with BioNica for their community garden initiative to help spark conversations and learning around healthy eating habits. Though privately funded, they could be a model to use as community health centers continue to take off in Nicaragua, and provide a concrete example of a combination of an herbal garden right outside of a health clinic.

**Potential Pilot sites for Nicaragua's Farm to Clinic**

***Project Bonafide and NDI - www.projectbonafide.com***

Project Bonafide (PB) is situated on the island of Ometepe. Originally, from 2014 through early 2017 the idea was to develop a partnership between the then existing naturopathic clinic on the island hosted by Natural Doctors International (NDI) and the permaculture farm, PB. The hope was that PB would be a growing and processing site for a large amount of the herbal medicines that were needed at NDI. Due to complications surrounding staffing and geographic placement of the medicinal herb garden, the project never fully took off at PB. However, PB was able to share a large number of plant starts, including Turmeric (*Curcuma longa*) with Dr. Farr who subsequently shared the plants with BioNica which then placed them at other sites such as

[56] www.clinicaverde.org, July, 2018.

NicaPhoto, which is discussed below.

Unfortunately, in early 2017 NDI closed its doors and no longer operates on the island. The hope is that the Centro de Salud outposts in each municipality can serve a similar purpose and use herbal products grown and created throughout Nicaragua.

### *NicaPhoto Project - www.nicaphoto.org*

NicaPhoto is located in an economically depressed area of Nicaragua called Nagarote in the state of Leon. They are dedicated to youth education, community health, and ending food insecurity. One of the main tenets of their project is to provide holistic health care support and education for at-risk members of the community.

The Executive Director of NicaPhoto is interested in providing classroom and herb processing space for the initial stages of a Farm to Clinic project and as of Summer 2017 had support from their Board to do so. They also have an on site coordinator for their community garden. Much of what is being grown is cultivated in the biointensive style. In addition, they already have bountiful gardens for their after school lunch program and have started multiple medicinal plants received from the initial Project Bonafide pilot.

### *Managua Oriental Medical School*

The Managua Oriental Medical School school was founded by Dr. Toshiharu Yamaki and includes acupuncture alongside its other complementary and alternative medicine training

modalities. The school has an agreement with the Pan American Health Organization (PAHO) and hosts brigades from the medical field internationally. The son of the school's founder worked on the island with Dr. Farr for ten days and expressed interest in the farm to clinic model at this time.[57] Local people are growing herbs for them but at this point there is no testing for them to insure their quality and efficacy. They are currently using herbs common to western medicine and would like to be using chinese herbs. Applying the AHGC principles here in particular could prove to be fruitful, and the school has the resources necessary to fuel such a project.

**Materia Medica for insulin resistance and diabetes**

Throughout this section, the following will be addressed: the historical use of the plants for treating diabetes and its sequelae, whether the plant is already in use in Nicaragua and its ethnobotanical roots if it is not currently in use, and the research that supports this specific materia medica. Among the plants already in use in Nicaragua, the "families with the largest number of medicinal species are Fabaceae (18 species), Rubiaceae (15 species), Solanaceae (9 species), Euphorbiaceae (8 species), Piperaceae(8 species), and Asteraceae (7 species). The majority (76%) of medicinals are native herbs (59 species) and trees (53 species) to eastern Nicaragua."[58] Much of the existing knowledge and use of medicinal plants in Nicaragua originates from the two primary indigenous groups the Rama and Miskitu and has been mixed with input from outsiders and travelers.

---

[57] Personal communication with Farr, D., June 2017.
[58] Coe, F. Ethnobotany of the Rama of Southeastern Nicaragua and Comparisons with Miskitu Plant Lore. *Economic Botany* , 62(1), pp. 40-59. 2008.

In addition to prevention through herbal medicine the sequelae would be treated as well and thus the plants include ones that treat nerve damage, visual loss, urinary issues, kidney disease, skin diseases and infections, and cardiovascular disease.[59] For each plant, the actions, the part of plant used, notable constituents, and recommended dosage are shared. Dose is, of course, something to be addressed on a person-to-person basis. These are loose recommendations that require fine-tuning between practitioner and client.

One cross-cutting similarity in many of the plants mentioned across the literature for prevention and treatment of diabetes is their high alkaloid and polyphenol content and the correlation between these constituents and support for diabetes.[60] In particular, these constituents seem to carry with them hyperglycaemic effects. In particular, the plants containing berberine have been "found to significantly lower blood sugar levels, enhance insulin sensitivity and reduce triglycerides, insulin secretion, and leptin" because of their ability to stimulate the pancreas.[61] Another class of herbs to consider using for insulin resistance and T2D are bitters. Some of the plants below fall in that category, but many do not and greater emphasis could be put there in the future. Bitters are most helpful in the prevention stage because they inhibit insulin secretion, can moderately reduce blood sugar levels, and work in concert with the digestive system for ideal gut health.[62]

---

[59] Giovanni, P., Howes, M-J., Edwards, S. Medicinal plants used in the traditional management of diabetes and its sequelae in Central America: A review. Journal of Ethnopharmacology 184(2016) 58-71. 2016.
[60] Giovanni, P., Howes, M-J., Edwards, S. Medicinal plants used in the traditional management of diabetes and its sequelae in Central America: A review. Journal of Ethnopharmacology 184(2016) 58-71. 2016.
[61] Winston, D. Insulin Resistance and Metabolic Syndrome: The Causes, The Risks, and Effective Treatment. 2007, revised 2018.
[62] Winston, D. Herbal Salon: Insulin Resistance / Metabolic Syndrome. September 5, 2018.

Also of note is that there is a great deal of crossover from plants used and studied in the Ayurvedic tradition for insulin resistance and T2D that are grown in tropical zones in India that could also grow well in Nicaragua and temperate parts of the US. Finally, one major benefit of many of the plants covered is that they fall into the category of "food medicine" - meaning that they are often safer to use and have very few herb drug interactions and may even enhance the efficacy of certain pharmaceuticals used for insulin resistance and T2D.

For the purposes of organization, the plants are placed in order with the most researched and potentially most accessible and/or easy to grow featured first. While some plants have far less research to date, they are included due to their promising nature, their potential for successful treatment, and their ability to be grown relatively easily.

**Turmeric - *Curcuma longa***

"Turmeric used with Bitter Melon and Amla lowered blood sugar levels and protected diabetics from peripheral oxidative damage (diabetic neuropathy and diabetic retinopathy). The combination helped reduce HbA1c and C-reactive protein levels. In a human trial, people with prediabetes (fasting plasma glucose between 100 mg/dL and 124 mg/dL, HbA1c from 5.7-6.4% or a 12 hour glucose tolerance test with a range of 140 mg/dL to 199 mg/dL) found that those given Turmeric had improved ß cell function and none progressed to full blown diabetes, while 16.4% of the controls did (Chuengsamarn, et al, 2012). In a RCT, people with metabolic syndrome (MeTS) were given Turmeric, Black Seed, a combination of the herbs or a placebo. Those getting Turmeric (2.4 g/day) had reduced LDL-C and CRP. People given Black Seed (1.5

g/day) had reduced lipids and fasting blood glucose. The group that received the combination (1.5 g Turmeric, 900 mg Black Seed) had the most significant results with greater reductions in body fat %, fasting blood glucose, LDL cholesterol, triglycerides and CRP (Amin, et al, 2015)." [63] In addition Turmeric has been shown to prevent diabetic associated eye damage.[64]

Herb Drug Interaction

A recent study was conducted examining the differences between Type 2 diabetes patients on metformin and those on metformin taking 6 g of turmeric supplementation daily as adjunctive therapy. The study found that those taking turmeric showed decreased fasting glucose and HbA1c levels, reduction in lipid peroxidation, and enhanced total antioxidant status in addition to exhibiting beneficial effects on dyslipidemia LDL cholesterol, non HDL cholesterol, and LDL/HDL ratio, and reduced inflammatory marker.[65]

Actions**:**Antioxidant, Anti Inflammatory, Cholagogue, Hypocholesterolemic, Immunoregulator

Part used: Rhizome

Notable constituents: Carotenoids, Sesquiterpenes, Curcumin

Dose:

Tea (Infusion): 1/2 tsp. dried, freshly powdered rhizome, 8 oz. hot water, steep covered for 45 minutes, take 4 oz. 4x/day

Tincture (1:2 or 1:4), 60% ETOH Dose: 2-4 mL (40-80 gtt.) TID/QID

---

[63] Winston, D. Ayurvedic Materia Medica - Turmeric. 5/15/2017.
[64] Pescosolido, N., Giannotti, R., et al, Curcumin: Therapeutic Potential in Ophthalmology, Planta Med, 2014;80:249-54.
[65] N. Maithili Karpaga Selvi et al. May 2014.

Capsules - Standardized 80-90% Curcumin: 250 mg - 500 mg TID (Curcumin products should contain whole Turmeric, Piperine or PC to enhance absorption).[66]

Turmeric in Nicaragua / ethnobotany:

Ethnobotanical use of Turmeric originates in Southeast Asia. "Apart from its religious, cultural, and magical uses, it has been an inseparable part of the Ayurvedic system of medicine in India and Chinese systems.[67] It is currently being grown and gaining popularity in Nicaragua.

**Ginger - *Zingiber officinale***

"In a second human study of dialysis patients, [ginger] lowered triglyceride levels, but not cholesterol (Tabibi, et al, 2016). It also reduced blood sugar levels, HbA1c, ApoB and MDA as well as protecting against diabetes-induced oxidative damage (Shidfar, et al, 2015; Khandouzi, et al, 2015; Li, et al, 2012)."[68] Ginger has also been shown to modestly reduce blood pressure.[69]

Actions**:** Anti Inflammatory, antioxidant

Part used: Rhizome

Notable constituents: Monoterpenes, phenolics

Dose:

---

[66] Winston, D. Ayurvedic Materia Medica - Turmeric. 5/15/2017.
[67] Velayahuden, K.C., et. al. Ethnobotany of Turmeric (*Curcuma Longa* L.). Indian Journal of Traditional Knowledge. Volume 11(4), October 2012, pp. 607-614.
[68] Winston, D. Chinese Materia Medica - Gan Jiang. 3/8/2017.
[69] L. Galvez Renella, et. al. Phenolic compounds, antioxidant activity and *in vitro* inhibitory potential against key enzymes relevant for hyperglycemia and hypertension of commonly used medicinal plants, herbs and spices in Latin America.Volume 101, Issue 12, June 2010, Pages 4676-4689. https://doi.org/10.1016/j.biortech.2010.01.093.

Tea (infusion): 1/4-1/2 tsp. dried, powdered root, 8 oz. water, steep covered 10 minutes to 1/2 hour, take 4 oz. 3x/day

Tincture - if made with dried ginger - (10-30 gtt) TID/QID. If made with fresh ginger - 1.5-2 mL (30-40 gtt) TID/QID

Capsules: 1-2 capsules BID/TID[70]

Also wonderful to simply add as seasoning in cooking every day.

Ginger in Nicaragua / ethnobotany:

Ginger is used by the Miskitu indigenous group of Nicaragua, primarily in cooking.[71]

**Holy Basil - *Ocimum tenuiflorum or Ocimum sanctum***

"For those experiencing metabolic syndrome or diabetes, insulin resistance, obesity, or with poor glycemic control in need of re regulation of blood sugar levels, Holy Basil has been shown to be effective (Rai, et al, 1997; Agrawal, et al, 1996). In addition those with elevated LDL/VLDL cholesterol levels, triglycerides, BMI and liver enzymes have lowered those with regular consumption of Holy Basil (Satapathy, et al, 2016; Rai, et al, 1997)."[72]

Actions: Antioxidant, hypoglycemic, hypocholesterolemic, immune amphoteric

Part used: Aerial parts

Notable constituents: Flavonoids, Sesquiterpene, Ocimumosides

Dose:

---

[70] Winston, D. Chinese Materia Medica, Gan Jiang. 3/8/2017.
[71] Coe. F. Ethnobotany of the Miskitu of Eastern Nicaragua. Journal of Ethnobiology 17(2):171-214. Winter 1997.
[72] Winston, D. Ayurvedic Materia Medica - Holy Basil. 5/15/2017.

Tea (Infusion): 1 tsp. dried leaf, 8 oz. hot water, steep, covered, 15-20 minutes, take 4 oz. 3x/day

Tincture: 2-3 mL (40-60 gtt.) TID/QID[73]

Holy Basil in Nicaragua / ethnobotany:

Holy Basil is native to South Asia and is currently grown in Nicaragua.

> Holy basil is considered by Hindus to be the earthly incarnation of the goddess Tulsi who is a companion of the god Vishnu. Thus, tulsi is a common name for this plant in Asia. Tulsi is the most sacred of all plants in Hinduism, which is why it is commonly seen growing in special pots in the courtyards of Hindu homes. During ritualistic worship, tulsi leaves are offered to Vishnu and his avatars. Vaishnavas (followers of Vaishnavism, a major branch of Hinduism) make prayer beads from the stems and roots of tulsi plants. Wearing these prayer beads (called *Tulsi malas*) is said to connect one with the gods and bring their protection. Because tulsi is considered to be a manifestation of deity on earth, it is seen as a connection point to heaven, and so tulsi leaves are placed in the mouths of people who are dying in order to ensure a safe journey into celestial realms.[74]

**Ashwagandha - *Withania somnifera***

In animal studies, Ashwagandha has been shown to reduce blood sugar levels. In general, it is an excellent choice to support depleted, fatigued individuals,[75] a profile which many struggling with diabetes fit. In addition it is used to treat hypertension and reduce cortisol levels.[76] One study on diabetic animals found that ten daily doses positively effected blood glucose, insulin and cortisol levels.[77]

Actions**:** Anti Inflammatory, adaptogen, immune amphoteric

---

[73] Ibid.
[74] https://awkwardbotany.com/2014/04/06/ethnobotany-holy-basil/, February 2019.
[75] Winston, D. Ayurvedic Materia Medica - Ashwagandha. 6/9/2017.
[76] Ibid.
[77] Ajit, K. Thakur, et. al. Reverse Ayurvedic Pharmacology of Ashwagandha as an Adaptogenic Anti-Diabetic Plant: A Pilot Study. Current Traditional Medicine. Volume 1, Number 1, April 2015, pp. 51-61(11).

Part used: Root

Notable constituents: Alkaloids

Dose: Tea (Decoction): 1/2 tsp. dried, powdered root, 8 oz. water, decoct 10 minutes, steep 30 minutes, take 4 oz. 3x/day

Tincture (1:5), 45% ETOH Dose: 2-3 mL (40-60 gtt.) TID

Capsules: 2 capsules (00) BID[78]

Ashwagandha in Nicaragua / ethnobotany:

Ashwagandha is indigenous to India and has been a highly respected plant in Ayurveda for thousands of years and is included in their *rasayana* group of herbs - a daily nutritive that is interwoven in Indian culture. Traditionally it has been used as a sleep tonic and to enhance male libido.[79]

**Hibiscus - *Hibiscus sabdariffa***

**"**Hibiscus reduces blood sugar levels, LDL/VLDL cholesterol levels and inhibits inflammation in adults and overweight children (Joven, et al, 2014; Sabzghabaee, et al, 2013; Gurrola-Diaz, et al, 2010; Ali, et al, 2005). An extract of the flower also reduced waist circumference-body fat ratio and waist-to-hip ratio in obese people (Chang, et al, 2014). In a human trial (Mozaffari-Khosravi, et al, 2009) type 2 diabetics had significant increases in HDL cholesterol when taking Hibiscus.."[80]Hibiscus is considered a cardiotonic herb and thus can help protect the vascular system as it manages the sequelae associated with diabetes. "Different studies, both in animal,

[78] Winston, D. Ayurvedic Materia Medica - Ashwagandha. 6/9/2017.
[79] http://ayurveda.alandiashram.org/ayurvedic-herbs/ashwagandha. January, 2019.
[80] Winston, D. Materia Medica - Hibiscus. May 2017.

and human models, have shown that an extract or infusion of [hibiscus tea] influences the atherosclerosis process, blood sugar and lipids, and blood pressure…[studies] reported that [hibiscus tea] infusion reduces cholesterol by 8.3–14.4% after 4 weeks... and showed that [hibiscus tea] infusion reduce[d] blood pressure in patients with hypertension," [81]leading to its supportive nature all around.

Actions**:** Hypoglycemic, Anti Inflammatory, Antioxidant, Hypocholesterolemic, Hypotensive

Part used: Flower (Calyx)

Notable constituents: Flavonoids, phenolics, mucilage

Dose:

Tea (Infusion): 1-2 tsp. dried flowers, 8 oz. hot water, steep for 10-15 minutes, take 2-3 cups per day Tincture (1: 2 or 1:5), 30% ETOH, 10% vegetable glycerin 2-4 mL (40-80 gtt.) TID, tea is more ideal than tincture however as a way to ingest hibiscus[82]

Hibiscus in Nicaragua / ethnobotany:

Hibiscus originated in West Africa and was introduced to Mexico during the colonial period and it has a long history of use across the world for a variety of ailments.[83] *Te de Jamaica* made from the *flor de jamaica* or Hibiscus flower is a common beverage in Nicaragua and across Central America that is drunk with meals.

[81] Mozaffari-Khosravi, H., et. al. The effects of sour tea (*Hibiscus sabdariffa*) on hypertension in patients with type II diabetes. *Journal of Human Hypertension* volume 23, pages 48–54 (2009).
[82] Winston, D. Materia Medica - Hibiscus. May 2017.
[83] http://vinculando.org/mercado/flor_jamaica.html, February 2019.

**Moringa - *Moringa oleifera***

Moringa has undergone extensive study as an effective supplement to use alongside Metformin to improve rates of lower blood glucose levels and decrease the incidences of TD2.[84] Moringa powder also has been shown to reduce lipid peroxide in a study done on diabetic positive rats.[85] In another study, rats showed a significant reduction in serum glucose and nitric oxide, with concomitant increases in serum insulin and protein levels after a dose of an extract of Moringa pods.[86]

Actions**:** Hypoglycemic

Part used: Pods and leaves

Notable constituents: Phenolics, alkaloids, flavonoids

Dose: 1-2 tbsp dried leaf in 8 oz in hot water infusion, 2-3 times per day or eaten daily as food (leaves and pods) in salad

Moringa in Nicaragua / ethnobotany:

[84] Fakeye, T.O. Effect of Moringa oleifera in metformin plasma level in type 2 diabetes mellitus. https://clinicaltrials.gov/ct2/show/NCT03189407. 2017.
[85] Al-Malki, A.D., and El Rabey, H.A. The Antidiabetic Effect of Low Doses of Moringa oleifera Lam. Seeds on Streptozotocin Induced Diabetes and Diabetic Nephropathy in Male Rats. BioMed Research International. Volume 2015. http://dx.doi.org/10.1155/2015/381040.
[86] Gupta, R. et. al. Evaluation of antidiabetic and antioxidant activity of *Moringa oleifera* in experimental diabetes. Journal of Diabetes 4 (2012) 164–171. doi: 10.1111/j.1753-0407.2011.00173.x.

Moringa has been used traditionally throughout the tropics and is currently grown in Nicaragua. It is also really high in minerals and an excellent dietary supplement for those in developing countries.[87]

**Bitter Melon - *Momordica charantia***

Bitter Melon is mostly used to aid with skin diseases and infections, cardiovascular health, and to improve kidney function and blood pressure, all comorbidities associated with diabetes. The specific indications for Bitter Melon include insulin-dependent diabetes and non-insulin dependent diabetes mellitus.[88] There seems to be a distinction between the wild bitter melon versus the cultivated plant. For people with metabolic syndrome, the wild bitter melon was found in a human trial to reduce waist circumference and decrease insulin resistance.[89] Bitter melon, while successful on multiple levels such as lowering blood sugar and stimulating the insulin resistance signaling pathway (Lo, et al, 2013), still may not be as effective as drugs like Metformin (Fuangchan, et al, 2011) but does show promise as potentially being more effective than rosiglitazone (Inayut-ur-Rahman, et al, 2009). It is really important if patients are on insulin while including bitter melon in their treatment protocol to constantly measure their blood sugar levels.[90]

<u>Actions</u>: Antimicrobial, anti-ulcerogenic, anti-nociceptive

---

[87] Amabye, T.G. Chemical Compositions and Nutritional Value of Moringa Oleifera Available in the Market of Mekelle. Journal of Food and Nutrition Sciences. Volume 3, Issue 5, September 2015, Pages: 187-190.
[88] Winston, D. Ayurvedic Materia Medica - Bitter Melon. June 9, 2017.
[89] Tsai, C-T., Chen, E. et al, Wild Bitter Gourd Improves Metabolic Syndrome: A Preliminary Dietary Supplementation Trial, Nutr J, 2012; 11:4.
[90] Winston, D. Ayurvedic Materia Medica - Bitter Melon. June 9, 2017.

Notable constituents: Alkaloids (tecomine, tecostanine), triterpenoids

Part of plant used: The leaf is most commonly used. However, many of the studies have focused on the fruits and there are few RCTs on the leaf. "Leaf extracts inhibit intestinal α-glucosidase, modulate postprandial hyperglycemia and reduce triglycerides and cholesterol in vivo."[91] And in one study, a water extraction of the seeds is the part shown to have a hypoglycemic effect.[92]

Dosage:

Tincture (1:2): 1-1.5 mL TID/QID

Tea: 1 tsp. dried fruit, 10 oz. water, decoct 15 minutes, steep 15 minutes, take 2 oz. TID Capsule: 100 mg QID[93]

Bitter Melon in Nicaragua / ethnobotany:

Bitter melon has a wide reach in its history of and current use in treatment of diabetes as it has been documented and tested from the indigenous and local communities in the tropics of the Caribbean, South America, Central America, Mexico, India, Africa, and areas of Asia.[94]

### Chanca Piedra / Gale of the Wind - *Phyllanthus niruri*

"Chanca piedra has been evaluated for antioxidant activity and its response to high blood pressure and high blood sugar. The high phenolic content of chanca piedra has shown antioxidant activity, which has been found to support balanced blood sugar and normal blood

---

[91] Giovanni, P., Howes, M-J., Edwards, S. Medicinal plants used in the traditional management of diabetes and its sequelae in Central America: A review. Journal of Ethnopharmacology 184(2016) 58-71.
[92] Lo, H.Y., Ho, T.Y., et al, Momordica charantia and its Novel Polypeptide Regulate Glucose Homeostasis in Mice via Binding to Insulin Receptor, J Agric Food Chem, 2013 Mar 13;61 (10):2461-8.
[93] Winston, D. "Insulin Resistance and Metabolic Syndrome: The Causes, The Risks, and Effective Treatment." April 25, 2018.
[94]Winston, D. Ayurvedic Materia Medica - Bitter Melon. June 9, 2017.

pressure."[95],[96] This plant is primarily well known for its support of the liver and kidneys and research is growing regarding its use in the treatment of diabetes.

Actions**:** Antioxidant, Hypoglycemic, Hypocholesterolemic,

Part used: Root or whole plant

Notable constituents: Phenolics, flavonoids, alkaloids

Dose:

This plant can be used as tea, tincture, or in capsule form. 15-20g in tea is recommended.[97]

Chanca Piedra in Nicaragua / ethnobotany:

Chanca Piedra is indigenous to the rainforests of Latin America and India and is currently grown in Nicaragua and has peaked the interest of naturopathic physicians in the area.

### Juanislama - *Lippia alba*

There is little current research on the uses of Juanislama for diabetes. However, it is already in wide use for treatment of diabetes in Nicaragua.[98] Greater study is needed and as this plant readily grows in Nicaragua, pilot studies on its usage and efficacy are recommended. Duke notes

---

[95] https://www.globalhealingcenter.com/natural-health/benefits-of-chanca-piedra/, September 2018.
[96] L. Galvez Renella, et. al. Phenolic compounds, antioxidant activity and *in vitro* inhibitory potential against key enzymes relevant for hyperglycemia and hypertension of commonly used medicinal plants, herbs and spices in Latin America.Volume 101, Issue 12, June 2010, Pages 4676-4689. https://doi.org/10.1016/j.biortech.2010.01.093
[97] http://hierbasmalas.blogspot.com/2009/10/phyllanthus-urinaria-niruri.html, August 2018.
[98] Personal Communication, Farr, D. Spring 2016.

treatment of diabetes in his explanation of Juanislama as well.[99] There are also examples of this plant being used in Colombia for treatment of diabetes.[100]

Actions**:** Analgesic, antispasmodic, antidepressant, digestive, anti inflammatory

Part used: Leaves and flowers

Notable constituents: Essential oils, alkaloids, tannins, iridoids, phenylethanoic, flavone glycosides and bioflavonoids

Dose:

Tea (Infusion): 1-2 tsp. dried flowers and leaves, 8 oz. hot water, steep for 10-15 minutes, take 2-3 cups per day

Juanislama in Nicaragua / ethnobotany:

Juanislama is native to southern Texas, across Latin America, and has been highly researched and used especially in Brazil, especially in its essential oil form.[101] Juanislama grows well and is already cultivated in multiple places in Nicaragua.

### **Mexican Poppy - *Argemone mexicana***

[99] Duke, J. Duke's Handbook of Medicinal Plants of Latin America. CRC Press Taylor & Francis group. 2009. pg 145.
[100] Ocampo, R. and Balick, M. Plants of Semillas Sagradas: An Ethnomedicinal Garden in Costa Rica. Finca Luna Nueva Extractos de Costa Rica, S.A. 2009. Pg. 67.
[101] http://www.biotrade.org/ResourcesPublications/biotradebrief-lippiaalba.pdf, January 2019.

Mexican poppy is currently being researched for its ability to have antidiabetic activity. Currently more animal than human studies exist and more research is needed.[102] This is another promising botanical that readily grows in the tropics.

Actions**:** Antioxidant

Part used: Leaves, latex

Notable constituents: Isoquinoline alkaloids, flavonoids

Dose: More research is needed

Mexican Poppy in Nicaragua / ethnobotany:

The Mexican Poppy has a long history of use among the Aztecs for use in ritual, sacred and magical purposes. In addition its been used across Latin America as a teacher plant. The plant is also found and used in India.[103] It currently grows well in Nicaragua.

**Boldo - *Peumus boldus***

There are preliminary studies being done on extracts of Boldo for its efficacy in treatment of diabetes and sequelae of diabetes. In one study, as a component of a greater formula including extracts of Milk Thistle, Globe Artichoke, Dandelion Root, it was shown to inhibit

[102] http://entheology.com/plants/argemone-mexicana-prickly-poppy/, January 2019.
[103] Nayak, P.S. Antidiabetic activity and modulation of antioxidant status by fractions of Argemone mexicana in Alloxan induced diabetic rats. International Journal of Green Pharmacy. Vol 6, No 4. 2012.

α-glucosidase and help prevent metabolic disorders.[104] In other research it has been shown to increase blood sugar levels and support healthy blood pressure levels.[105]

Actions**:** Hypotensive, hypoglycemic

Part used: Leaf

Notable constituents: Antioxidants, phenolics

Dose: More study is needed, however the leaf is very safe to drink in tea

Boldo in Nicaragua / ethnobotany:

Boldo is currently grown and utilized in Nicaragua.

### Jackass Bitters - *Neurolaena lobata*

Dr. Andrew Weil, Dr. James Duke and others in the field point to traditional uses of Jackass Bitters for the treatment of diabetes and supporting healthy blood sugar levels. However, greater study is needed and the few studies that exist are on animals at this point in time.[106] Duke, in concert with Dr. Rosita Arvigo, notes that studies have shown it to reduce blood sugar and that it has extensive use across Latin America in the treatment of diabetes.[107]

---

[104] Villiger, A. et al. *In vitro* inhibitory potential of *Cynara scolymus, Silybum marianum, Taraxacum officinale*, and *Peumus boldus* on key enzymes relevant to metabolic syndrome. Journal of Phytomedicine. Volume 22, Issue 1, 15 January 2015, Pages 138-144. https://doi.org/10.1016/j.phymed.2014.11.015.
[105] L. Galvez Renella, et. al. Phenolic compounds, antioxidant activity and *in vitro* inhibitory potential against key enzymes relevant for hyperglycemia and hypertension of commonly used medicinal plants, herbs and spices in Latin America.Volume 101, Issue 12, June 2010, Pages 4676-4689. https://doi.org/10.1016/j.biortech.2010.01.093.
[106] https://www.drweil.com/health-wellness/body-mind-spirit/diabetes/jackass-bitters-for-diabetes/. January, 2017.
[107] Duke, J. Duke's Handbook of Medicinal Plants of Latin America. CRC Press Taylor & Francis group. 2009. pps. 479 - 481.

Actions**:** Hypotensive, hypoglycemic

Part used: Leaf

Notable constituents: Sesquiterpenes

Dose: More research is needed

Jackass Bitters in Nicaragua / ethnobotany:

Jackass Bitters grow well in rainforest regions of the world and have had a very wide area of use from wound healing to parasite treatment to diabetes.

**Gum Guggul - *Commiphora mukul***

"It is useful for metabolic syndrome, obesity (utilized alongside Triphala) and type II diabetes. In animal studies Guggul lowered plasma glucose, LDL/VLDL cholesterol levels and triglycerides, while improving endogenous antioxidants such as SOD, catalase and glutathione (Bellamkonda, et al, 2011)."[108] It is highly anti-inflammatory and thus able to aid with many of the inflammatory markers associated with diabetes.

Actions**:** Anti Inflammatory, hypocholesterolemic

Part used: Gum Resin

Notable constituents: Triterpenes, sterols

Dose:

[108] Winston, D. Ayurvedic Materia Medica - Gum Guggul. 6/9/2017.

Tea (Decoction): 1 tsp. powdered dried resin, 10 oz. water, decoct 15 minutes, steep covered 1 hour, take 4 oz. 3x/day

Tincture: 1-2 mL (20-40 gtt) TID

Capsules (standardized to Guggulsterones): 100-500 mg TID[109]

Gum Guggul in Nicaragua / ethnobotany:

Gum Guggul originates in India and East Asia and is not currently in use in Nicaragua. It is considered endangered due to its slow growing nature and the difficulty of germinating it from seed. However, if this plant were able to be grown and harvested consciously, it would be a wonderful one to keep in the medicine cabinet for insulin resistance and T2D.

**Fenugreek - *Trigonella foenum-graecum***

"In a 3-year long human clinical trial, the use of Fenugreek (10 g per day) helped to prevent people with metabolic syndrome from becoming diabetic (Gaddam, et al, 2015)."[110] A study in India with participants diagnosed with T2D showed significant impact of decreased blood sugar levels by including fenugreek as part of their protocol. A simple complementary addition of fenugreek seeds 10 g/day can have a synergistic effect along with diet control and exercise on fasting blood glucose and HbA1C within 6 months of treatment. Of added benefit is that this is an affordable and accessible supplementation.[111]

---

[109] Ibid.
[110] Winston, D. Ayurvedic Materia Medica - Fenugreek. 6/9/2017.
[111] Ranade, M. and Mudgalkar, N. A simple dietary addition of fenugreek seed leads to the reduction in blood glucose levels: A parallel group, randomized single-blind trial. Ayu. 2017 Jan-Jun; 38(1-2): 24–27. doi: 10.4103/ayu.AYU_209_15.

Actions**:** Anti Inflammatory, hypoglycemic, hypocholesterolemic

Part used: Seed

Notable constituents: Steroidal saponins, fiber, flavonoids

Dose:

Tea (Decoction): 1-2 tsp. fresh ground seed, 8 oz. water, decoct 10-15 minutes, steep covered 1 hour, take 2-3 cups/day

Tincture: 2-4 mL (40-80 gtt.) TID/QID

Powder: 10-30g TID

Capsules: 300-600 mg BID (standardized to 50% saponins)[112]

Fenugreek in Nicaragua / ethnobotany:

Fenugreek is widely used in Ayurveda and Indian cooking and has no current history of use or growth in Nicaragua.

### American Ginseng - *Panax quinquefolius*

"It can be useful as part of a protocol for blood sugar dysregulation such as T2D (Vuksan, et al, 2000), insulin resistance (Vuksan, et al, 2001) or metabolic syndrome (Wu, et al, 2007), as it enhances insulin sensitivity (De Souza, et al, 2015). In a RCT, Panax quinquefolius reduced arterial stiffness and systolic blood pressure in diabetic men (Mucalo, et al, 2013)."[113]

Actions**:** Antioxidant, Hypoglycemic, adaptogen, immune Amphoteric

[112] Winston, D. Ayurvedic Materia Medica - Fenugreek. 6/9/2017.
[113] Winston, D. Native American Materia Medica - American Ginseng. 6/22/2017.

Part used: Root, leaf, berries

Notable constituents: Panaxosides

Dose:

Tea (Decoction): 1-2 tsp. dried root, 12 oz. water, decoct 20 minutes, steep 45 minutes, take 2-3 cups per day Tincture (1:5 or 1:2), 35% ETOH Dose: 2-4 mL (40-80 gtt.) TID[114]

American Ginseng in Nicaragua / ethnobotany:

American Ginseng has a long history of use in the Eastern US by the Native Americans for medicine. It is currently under threat as an overharvested medicinal. No growth in Nicaragua is known at this time and it may be difficult to cultivate there due to its need for temperate forest and shade.

**Gymnema - *Gymnema sylvestre***

"Gymnema regulates blood sugar levels and can be used for type I and type II diabetes (Li, et al, 2015; Kumar, et al, 2010; Baskaran, et al, 1990; Shanmugasundaram, et al, 1990). It reduces insulin requirements, fasting blood glucose, glycosylated hemoglobin and glycosylated plasma protein levels. It can be used with Fenugreek, Chinese Yam/Shan Yao, Jiaogulan, Bitter Melon or Kudzu/Ge Gen. Animal studies suggest this herb increases endogenous insulin production and availability by enhancing membrane permeability in the Islets of Langerhans and helping to regenerate damaged β-cells (Ahmed, et al, 2010).

[114] Ibid.

It reduces LDL / VLDL cholesterol levels, triglycerides, cravings for sweets, appetite (for about 90 minutes) and inhibits absorption of glucose in the small intestine (Kanetkar, et al, 2007). It can be used as part of a protocol for obesity along with Triphala and Gum Guggul. In an animal study it reduced weight, blood pressure, triglycerides, inflammatory markers and unhealthy blood lipids in obese mice (Kumar, et al, 2012). This suggests it would be useful for metabolic syndrome, but there is controversy about this. Increasing insulin production in people with hyperinsulinemia would be counter-productive, so until this is better understood it is probably best to avoid using it in people with metabolic syndrome."[115] Studies have shown it to help prevent obesity and support overall metabolic function.[116]

Actions: Hypoglycemic, appetite suppressant, hypocholesterolemic

Notable constituents: Gurmarin, triterpene saponins, gymnemic acid

Part of plant used: Leaves

Dose:

Tea (Infusion): 1/2 tsp. dried, powdered herb, 8 oz. hot water, steep 1 hour, take 2-4 oz. 3x/day

Tincture (1:4 or 1:5), 35% ETOH Dose: 1-2 ml (20-40 gtt.) QID*

Triune: 1/9 - 1/18 part

Standardized extracts: 400-500 mg - one or two capsules per day (standardized to 25% gymnemic acid)[117]

---

[115] Winston, D. Ayurvedic Materia Medica - Gymnema. 5/15/2017.
[116] Kanetkar, P. et al. *Gymnema sylvestre*: A Memoir. Journal of Clinical Biochemical Nutrition. 2007 Sep; 41(2): 77–81. doi: 10.3164/jcbn.2007010.
[117] Winston, D. Ayurvedic Materia Medica - Gymnema. 5/15/207.

Gymnema in Nicaragua / ethnobotany:

Gymnema is native to India and Africa and grows well in tropical zones. The plant has a long history of use in Ayurvedic medicine and is known in Hindi as "the sugar destroyer."[118]

**True Cinnamon - *C. verum***

"The bark of Ceylon Cinnamon also increases the beta cells' ability to utilize endogenous insulin (it reduces insulin resistance) and is useful for insulin-resistant diabetes, hyperinsulinemia and metabolic syndrome (Anderson, et al, 2015; Lu, et al, 2012; Mang, et al, 2006; Khan, et al, 2003). Cinnamon bark also reduced hemoglobin A1C levels in patients with T2D (Lu, et al, 2012; Crawford, 2009), it mildly lowered blood pressure (Akilen, et al, 2010) and reduced blood sugar levels as well as VLDL-C and triglycerides (Anderson, et al, 2015; Allen, et al, 2013). I frequently use Cinnamon with Bitter Melon and Fenugreek for treating metabolic syndrome and with Gymnema, Bitter Melon and Hibiscus for people with T2D. It has also been shown to help improve symptoms of several conditions associated with insulin resistance and metabolic syndrome, such as nonalcoholic fatty liver disease (NAFLD) and polycystic ovarian syndrome (PCOS). In a RCT, Cinnamon (750 mg BID) decreased fasting blood glucose, triglycerides, LDL-cholesterol, ALT, AST, GGT and C-reactive protein levels in people with NAFLD (Askari, et al, 2014). "[119]

Actions**:** Anti Inflammatory, Antioxidant, Hypoglycemic, Immunoregulator

Part used: Bark

---

[118] Tiwari, P. Phytochemical and Pharmacological Properties. of *Gymnema sylvestre*: An Important Medicinal Plant. Biomed Research International. 2014; 2014: 830285. Published online 2014 Jan 6. doi: 10.1155/2014/830285.
[119] Winston, D. Chinese Materia Medica, Gui Zhi - Cinnamon. 3/8/2017.

Notable constituents: Volatile oils, Phenolics

Dose:

Tea (Infusion): 1/4-1/2 tsp. dried powdered bark, 8 oz. water, steep covered 15-20 minutes, take 4 oz. 3-4x/day Tincture (1:4 or 1:5), 70% ETOH Dose: 1-1.5 mL (20-30 gtt.) TID

Triune: 1/18 part

Capsules: 1-2 00 capsules BID[120]

True Cinnamon in Nicaragua / ethnobotany:

Cinnamon is indigenous to South East Asia but rapidly spread throughout tropical regions worldwide. The tree is currently grown in Nicaragua and used as a spice as well as for multiple medicinal uses.[121]

**Quassia - *Quassia spp.***

In animal research, various species of Picrasma and Quassia have exhibited hypotensive, anti inflammatory, hypoglycemic and antiulcerogenic activity. In these studies it has been found to relieve experimentally-induced colitis (Zhao, et al, 2013), allergic asthma (Shin, et al, 2014), hypertension (Zhao, et al, 2013) and diabetes (Husain et al, 2015).[122]

---

[120] Ibid.
[121] https://www.cabi.org/isc/datasheet/13573, February 2019.
[122] Winston, D. Native American Materia Medica - Quassia. July 2017.

Actions**:** Antibacterial, hypotensive

Part used: Bark, wood

Notable constituents: Quassinoids

Dose:

Tea (Cold Infusion): 1/4-1/2 tsp. dried cut/sifted wood, 12 oz. water, steep for 6-12 hours, take 2 oz. 3x/day Tincture (1:5), 30% ETOH Dose: .5-1 mL (10-20 gtt.) TID

Triune: 1/36 part

Capsules: 1 (10 grain capsule) BID[123]

Quassia in Nicaragua / ethnobotany:

Quassia spp has been grown in Nicaragua and the Quassia amara specifically has been used by the Rama, Garifuna, Miskitu, and Sumu tribes for multiple ailments including malaria.[124]

**Best practices in cultivation of medicinal plants for Diabetes in Nicaragua and Temperate regions of the United States**

Of note is that Nicaragua has both a rainy season (approximately September to November) or what is known as summer/*verano* and a dry season (approximately May to October) or what is known as winter/*invierno* so planting and harvesting periods should take this weather into consideration. The recommended growing region in the US for the plants discussed below is mostly temperate and zones 6b, 7a, and 7b which will help frame planting and harvesting

[123] Ibid.

[124] Coe. F. Ethnobotany of the Miskitu of Eastern Nicaragua. Journal of Ethnobiology 17(2):171-214. Winter 1997.

guidelines as well. This means that first frost dates hover around mid-late October depending on one's location. and last frost dates hover around mid-late April. Knowing more exact dates based on location will also aid in planting and harvesting decisions. Some of the plants chosen below grow better in tropical regions but with effort and inputs can be grown in temperate regions as well. These plants were also selected because they tend to have low pest pressure, making them easier for new growers. Appendix B includes some more in depth resources about general seed starting and cultivation guidelines.

### *Turmeric*

Nicaragua - Cultivation: On the island of Ometepe ,Turmeric is currently grown in large quantities at an ecolodge called Totoco.[125] The first step is soil preparation. Depending on where the turmeric is planted, rock removal may need to occur first. At Totoco, they dug about 16 inches deep, sifted out all rocks, returned the good soil, and added a small amount of sand for drainage during the rainy season. Tubers were planted about one foot apart so they had sufficient space to grow and put in the ground in April so there was little need to water in and maintain young plants. Their plants did better in more full sun with less shade but here experimentation depending on your site and what else is present will be necessary.

[125] https://www.totoco.com.ni/ecolodge-2/. February, 2019.

Nicaragua - Harvest/Drying/Storage: The turmeric at Totoco is harvested after about 10 months in the ground. It can be left longer and it will continue to root down, stacking the tubers on top of itself and some pieces getting larger. About half is left in the ground to regenerate for the next year. When harvesting take care to harvest from above and use the proper hoe so as not to damage the tubers while harvesting. Rinse to clean the pieces and then cut them into smaller pieces (¼ inch or less) for quicker and more uniform drying that preserves essential qualities without incurring risk of mold. At Totoco the turmeric is dried by placing it on a fine screen in direct sun. They let it sit for two to three days, moving pieces around a few times a day for even drying and even color. They have also experimented with bringing it to a drying facility that also dries coffee but a grower would need large quantities of turmeric to make this financially feasible. A household level food dehydrator can also be used to dry rootlets, see below. Turmeric can then be powdered or stored in its smaller pieces in a sealed glass jar or frozen for up to one year. If needed, a dessicant can be placed in the jars.

Temperate United States - Cultivation: Ideally turmeric is pre-sprouted in February or March in crates with not much more than peat moss in a warm (over 70 degrees) environment so that it can be planted by April or May. Maple Springs Farm in North Carolina recommends starting with larger seed pieces will produce a larger final crop. When they plant they line the trench with 2-3" of compost, plus a 10.2.8 fertilizer which is the equivalent of 50 pounds of nitrogen per acre. A large initial feeding of nitrogen is important for the turmeric to form decent sized tubers as well as a nitrogen feeding monthly after the shoots of the plant emerge from June to September. Maple Springs Farm has found that turmeric also likes foliar compost and fish or seaweed

sprays. Turmeric can be grown in a hoop house if one wanted to try to overwinter the tubers or it can be grown outside in sun to part shade.[126] Depending on its location, Turmeric can be between four and eight feet tall.

Temperate United States - Harvest/Drying/Storage: Turmeric is harvested just before the first frost and as some of the top leaves start to turn yellow or brown. If it is left in the ground (not inside the hoop house) too long after the leaves brown, it will quickly begin to rot. A similar drying process to what is used in Nicaragua is recommended. The author has also tried slicing the turmeric into very small pieces and using a dehydrator for 48 - 72 hours to speed up the drying process and avoid the potential for mold. If needed, a dessicant can be placed in the jars.

### *Ginger*

Almost exactly the same processes for cultivation and harvesting of ginger can be followed as is outlined above for turmeric. In the states, ginger cannot survive the winter in the ground even in a hoophouse because it does not have time to develop a thicker outer skin to protect it from the elements. It also needs a little less fertilizer overall to get established as it is slightly more hardy than the turmeric.

### *Hibiscus*

Hibiscus grows well in tropical or semi-tropical regions as a self-seeding annual or perennial depending on the environment and in more temperate climates as a cultivated annual each year.

[126] Personal Communication with Dawson, S. of Maple Springs Farm, LLC. October 2018.

Cultivation:

Hibiscus seeds (which are also easy to save once the plant has matured) do best when they are lightly scarified (rubbed on medium to rough grit sandpaper or knicked lightly with a knife) before trying to germinate them. Once this is complete, seeds in a regular potting soil medium that is kept moist will germinate easily. Small plants will then grow best in full sun, in fertile, fast drying soils spaced one foot apart and planted in temperate areas after first frost. Plants grow to four to six feet tall depending on location.[127]

Harvest/Drying/Storage:

The part of the plant that is used medicinally is the calyx, the leathery external casing of the seed pod once the flower has finished and is about to go to seed. The calyxes can be removed with a small paring knife for greater ease and expediency or by hand. Drying can be done on a screen in the shade (recommended for retaining medicinal qualities) for approximately 5 days depending on the humidity of the location or in a dehydrator for 24-72 hours. The hibiscus calyces can be stored in an airtight glass container for upwards of one year.

### *Holy Basil*

Cultivation:

[127] https://strictlymedicinalseeds.com/product/hibiscus-hibiscus-sabdariffa-seeds-organic/. February 2019.

Holy Basil needs light to germinate. In both tropical and temperate climates it will self seed readily as an annual, often quite far away from where the initial plants were on your site. If the seeds are being started indoors or in a greenhouse, tamp seeds gently into the surface of the soil, keep moist, and germination will generally happen within a couple of days. Holy Basil grows best when plants are two to three feet apart but will grow closer together just with foliage that grows more straight up instead of bushing out with more pieces to harvest easily.[128] Holy Basil grows to be about one foot tall.

Harvest/Drying/Storage:

Cut the aerial parts of Holy Basil, right before they go to flower or while in early flower just above a node. One should be able to get multiple harvests per growing season of this plant, allowing the about two weeks in-between harvests depending on the growing climate and weather of the season. Effective drying strategies for Holy Basil include hanging it upside down in a dark well ventilated area for four to seven days, setting it on a screen in the shade for the same amount of time, or using a type of food dehydrator. Once the plant is dry, the final step before storage is to garble the herb material. Garbling is the process of separating the leaf from the stem as the most medicinal part of the plant is the leaf. This process can be done manually in a large bowl or by rubbing the stalks over a frame with screen with the correct dimensions to let the herb material through to save. Dried holy basil can be stored in an airtight glass jar for a year or more. A good test to see if the material is still viable is to smell it as the volatile essential oils should be readily apparent when the herb is still alright to use medicinally.

[128] https://strictlymedicinalseeds.com/product/tulsi-vana-ocimum-gratissimum-seeds-organic/. February 2019.

### *Ashwagandha*

Cultivation:

Ashwagandha seeds require light to germinate, germinate within two to four weeks and take two hundred days to reach maturity. If attempting germination in a temperate area, they are easier to get to sprout if in a heated greenhouse.[129] Ashwagandha can be grown year round in tropical regions or grown as an annual in temperate climates. Ashwagandha likes to be spaced one foot apart and grows to be two to three feet tall.[130] This plant would grow easily in tropical climates as it is indigenous to India. It is considered a low maintenance crop and actually produces higher quality medicine when it is not over-composted, over-fertilized or over-watered.[131]

Some experiments are currently being done to grow Ashwagandha in temperate climates either in greenhouses or with row cover. So far, it seems it may not be the best suited as it is considered a tender perennial. Dawson of Maple Springs Farm overwintered one in a hoop house as a trial and it came back three times larger the next year. However, for their particular operation the cost benefit ratio of using hoop house space for that particular plant did not make sense long term.[132]

Harvest/Drying/Storage:

The root is the part of the plant that is harvested to be used medicinally. Ideally, for highest potency the roots are harvested after at least two years. However if one is an a temperate area

---

[129] Schafer, P. The Chinese Medicinal Herb Farm. Chelsea Green Publishing. 2011. Pg. 273.
[130] https://strictlymedicinalseeds.com/product/ashwagandha-vedic-withania-somnifera-seeds-organic/. February 2019.
[131] Schafer, P. The Chinese Medicinal Herb Farm. Chelsea Green Publishing. 2011. Pg. 274.
[132] Dawson, S. of Maple Springs Farm, LLC. Personal Communication, October 2018.

and putting in new plants outside each year, they can be harvest at year one. Roots in temperate areas are harvested in the fall when the tops die back so as to avoid rot or damage to the root that happens more easily after the fall.[133] Post-harvest the root can be treated similarly to turmeric and ginger. Cut the root into small pieces, ¼ inch or less and dry it on screens or in a dehydrator. Then store the Ashwagandha root in airtight glass jars for up to a year. If needed, a dessicant can be placed in the jars.

### *Chanca Piedra*

Cultivation:

Chanca Piedra is an annual that germinates easily and is aided by soaking the seeds in water for 20-30 minutes before planting. Germination takes about a week and if sowing inside in trays the plantlets are ready to transplant outside in about three to four weeks and will reach maturity in eighty to one hundred days. This plant grows well in loamy well drained soil and thrives in tropical regions.[134] Chanca Piedra grows to be between thirty and sixty centimeters tall.[135]

Harvest/Drying/Storage:

The whole plant is used medicinally. Harvest Chanca Piedra at its maturity, after about two to three months, to ensure that the plant is used at its height of medicinal potency.[136] The plant material is then dried either in a dehydrator or on screens in a shaded, well ventilated area.

---

[133] Dawson, S. of Maple Springs Farm, LLC. Personal Communication, February 2019.
[134] http://agritech.tnau.ac.in/horticulture/horti_medicinal%20crops_phyllanthus.html. February 2019.
[135] https://hort.purdue.edu/newcrop/CropFactSheets/phyllanthus.html. February 2019.
[136] http://agritech.tnau.ac.in/horticulture/horti_medicinal%20crops_phyllanthus.html. February 2019.

**Best practices in medicine making and formulation**

As one begins to make medicine with these useful plants for insulin resistance and diabetes, establishing a vocabulary becomes important to assist the process. Below are some key words used in herbal medicine making that will help practitioners decipher any directions and make their own medicine with ease. Many reading this are already familiar with these principles. However as this is meant to be a guide for all levels and especially to be used at the community level, a bit of greater detail is included. Appendix B includes more in depth resources for how to process herbs for medicine as well as further guidance in formulation. Rosemary Gladstar's beginner's guide to medicinal herbs helped form the outline below.[137]

*Root medicine, aerial parts or whole plant*- When making medicine with plants, practitioners want to use the most medicinal component(s). You will see recipes indicating whichever part that may be as this varies from plant to plant. In the body of this paper within the materia medica section, the "part used" segment would be the guide for the plants for insulin resistance and T2D. The root is the part of the plant that grows beneath the earth's surface. Take care when harvesting if you are the one doing this part of the labor, so as not to nick the surface. Aerial parts refer to any part of the plant grown above the ground and could refer to stalk, leaf, and / or flower. Whole plant is exactly as it sounds, a combination of its above and below ground parts.

*Dried versus fresh plant material* - This element is of course mostly self explanatory, this is just to note that medicine will be made differently and have different potencies depending on whether or not it is dried or fresh and this can vary plant to plant as well. The added value of dried plant

[137] Gladstar, R. Medicinal Herbs: A Beginner's Guide. Storey Publishing. 2012.

material is that it can be transported easily and it can be stored for longer. Often when making tinctures, much less plant material is needed when using dried plants as they are already more potent.

*Infusion versus decoction* - These terms refer to how to use plant material in a water extraction, i.e. how to have the highest medicinal potency as a tea. The key distinction is that an infusion is not simmered, whereas a decoction must be simmered. An infusion is usually done with the aerial parts of the plant and is done by simply pouring water that is just off-boil on top of your plant material and letting it steep anywhere from five minutes to overnight. If the plant is high in essential oils, it can be nice to cover the mug or jar so they do not escape. A decoction is usually done with roots as the medicinal properties take more heat and more time to extract. To decoct one brings the roots to a simmer for about twenty minutes before turning off the heat and straining the herbs out of the mixture. Regarding plant to water ratio, opinions vary. One tablespoon of plant material to eight ounces of water is sufficient and for a higher dose one could try one ounce of plant material to thirty two ounces of water.

*Tincture* - A tincture is a liquid extraction of medicinal plants. To extract the plant material, use a combination of a ratio of alcohol (the higher the alcohol percentage the better, i.e. a vodka or brandy is the medium often used) and water to plant material, sometimes glycerine. Different plants (and fresh plant versus dried plant material, as well as roots versus aerial parts, all require different ratios. The plants and liquid mixture then sit together for 1 - 4 months in a glass jar in a

cool dark place and the liquid is then strained from the plants. The strained liquid is your tincture.

*Best practices in formula making*

Most of the time clients do not come to a provider with a singular health complaint. Those with insulin resistance and T2D are no different. Perhaps they are also experiencing some fatigue, hypertension, joint and muscle soreness, or have difficulty focusing. Any of the herbs discussed above can be included or even work synergistically with other plants in a more complete formula for a client. If their primary concern is insulin resistance or T2D, then proportionately the plants targeting wellness in this area will make up the bulk of your formula with other plants coming in at smaller percentages in a supporting role.

**Conclusion, recommendations, and future goals**

As this paper has shown, insulin resistance and T2D are serious NCDs with diabetes being the leading cause of death among NCDs[138] and one that disproportionately negatively impacts marginalized populations, both in Nicaragua and in the US. Insulin resistance and T2D, while serious diseases, can be successfully and cost effectively addressed by using herbal medicine, lifestyle and diet changes as preventative measures. Herbal medicine, as the materia medicine section of this paper has demonstrated, is proven successful. As an added benefit, herbal medicine has the potential to be even more accessible to populations in need, as it is more

[138] http://www.emro.who.int/noncommunicable-diseases/diabetes/index.html, August, 2018.

familiar and can be cost effective. The Farm to Clinic model is the necessary bridge to successfully bring appropriate, useful plants to integrative health models and to create opportunities for all stakeholders as the demand for solutions to NCDs like diabetes increases.

This model has the potential to have a positive impact for farmers, health clinicians, those looking for affordable options to work with insulin resistance and T2D as well as to create economic opportunities within local economies. While there are similar challenges and next steps in Nicaragua and the US, the needs vary a bit by site and recommendations are included below. However, a common thread needed to ensure that Farm to Clinic gains traction is increased education. This education will need to include access to information about how herbal medicine can successfully prevent and treat insulin resistance and T2D, farming techniques for growing this herbal medicine, and resources for how to market the herbal medicine and work collectively to build successful integrative health clinics. Overall, the importance of building connections among farmers, networks for market availability, and trust between herbal practitioners and allopathic practitioners cannot be underestimated. In addition, the ability to tap into existing partnerships and to use larger companies with similar missions for support are key for the future success of this model. For example, recently the herbal medicine company in the US Gaia donated a four hundred square food herb dryer to the Appalachian Sustainable Development's Herb Hub. "Having commercial equipment available helps to increase profits for farmers. A farmer in 2018 was able to save $36 per pound of dried herb by using equipment

available at the Herb Hub compared to small home-scale equipment."[139] Groups must seek out these resources to build collective momentum so that all may benefit.

In Nicaragua, the next best step could be to pick one main pilot site and create the necessary infrastructure around that site. A point person within an organization and potential pilot site like PhotoNica needs to be identified to pull all of the components together. A focus on infrastructure includes increasing physical capital such as the actual space necessary to successfully process the herbs as well a space to house the integrative clinic where the herbs will be used. In addition, human capital is needed across the board from education for farmers to training modules for medicine makers and clinicians wanting to work with herbal medicine and potentially work with populations they have not worked with in the past. This pilot site could then provide a draft business model as well as the hard data and numbers to make the case for why the Farm to Clinic model can be beneficial for multiple stakeholders. Conversations at the national level about how best to identify sites for health outposts and enacting the Natural Medicine Law need to continue. And, ideally, the models in Nicaragua and the states could continue to co-evolve, to share information on their challenges and successes to better learn and grow the model together.

In the US, planning a forum where similar models are able to gather could be rewarding and useful. Groups like the AHGC and the Appalachian Herb Hub on the East coast and the Sonoma County Herb Exchange on the West coast could share experiences about farming techniques, what it is like to work together with multiple farmers, and market access in regard to their ability

[139] https://www.heraldcourier.com/news/local/appalachian-sustainable-development-received-donated-herb-dryer/article_d9ce29c8-400d-11e9-a6af-335218ec6ac0.html, March, 2019.

to partner with clinicians. The connection of herb growers to larger buyers is already happening with regularity in the US. However, continuing to widen the scope of education around what a difference local, quality herbs can make for practitioners and clients and specifically widening the market to include sales directly to integrative clinics are important next steps. There are integrative clinics in the US that could also serve as pilot sites. In NC, Armonía Health[140] is an acupuncture clinic that sees a large Latinx population as part of its mission. The author is in conversations with the owner about the provision of locally grown herbs to be used in that clinic. Here again, to have enough volume and access for the clinics, multiple farmers that join forces in a consortium format could be ideal.

May the plants included in this paper and the recommendations for how to cultivate and work with them be a jumping off point to begin using herbal medicine in the treatment of insulin resistance and T2D to begin the work of collaboration in earnest. Accessible, affordable medical models, especially for marginalized populations are increasingly important. For the health of our bodies and for the health of the planet, the Farm to Clinic model holds great promise.

[140] https://armoniahealth.com/. March, 2019.

**Bibliography**

Agrawal, P., Rai, V., et al, Randomized Placebo-Controlled, Single-Blind Trial of Holy Basil Leaves in Patients With Noninsulin-Dependent Diabetes Mellitus, Int. Jrl. Clin. Pharm. Tox, 1996:34(9):406-9

http://agritech.tnau.ac.in/horticulture/horti_medicinal%20crops_phyllanthus.html. February 2019.

Ahmed, A.B., Rao, A.S., et al, In Vitro Callus and In Vivo Leaf Extract of Gymnema sylvestre Stimulate β-Cells Regeneration and Anti-Diabetic Activity in Wistar Rats, Phytomedicine, 2010;17(13):1033-9

Ajit, K. Thakur, et. al. Reverse Ayurvedic Pharmacology of Ashwagandha as an Adaptogenic Anti-Diabetic Plant: A Pilot Study. Current Traditional Medicine. Volume 1, Number 1, April 2015, pp. 51-61(11).

Al-Malki, A.D., and El Rabey, H.A. The Antidiabetic Effect of Low Doses of Moringa oleifera Lam. Seeds on Streptozotocin Induced Diabetes and Diabetic Nephropathy in Male Rats. BioMed Research International. Volume 2015. http://dx.doi.org/10.1155/2015/381040.

Aldana Martinez, N.S., Gallego Pérez, D., Moya Muñoz, A. Cartillo sobre cultivo, uso, y preparación de plantas medicinales para el cuidado de la salud. December 2012.

Amabye, T.G. Chemical Compositions and Nutritional Value of Moringa Oleifera Available in the Market of Mekelle. Journal of Food and Nutrition Sciences. Volume 3, Issue 5, September 2015, Pages: 187-190.

Appalachian Herb Growers and Consortium, Program Guidelines & Agreement, January 2017.

https://awkwardbotany.com/2014/04/06/ethnobotany-holy-basil/, February, 2019.

https://armoniahealth.com/. March, 2019.

https://www.asddev.org, February, 2019.

http://ayurveda.alandiashram.org/ayurvedic-herbs/ashwagandha. January, 2019.

Baskaran, K., Kizar Ahamath, B., et al, Antidiabetic Effect of a Leaf Extract From Gymnema sylvestre in Non-Insulin Dependent Diabetes Mellitus Patients, J Ethnopharmacol, 1990 Oct;30(3):295-300.

http://www.biotrade.org/ResourcesPublications/biotradebrief-lippiaalba.pdf, January 2019.

Bone, K., Gymnema: A Key Herb in the Management of Diabetes, Townsend Letter For Doctors and Patients, Dec, 2002, 28-30

https://www.cabi.org/isc/datasheet/13573, February 2019.

Carrie et al. Integrating traditional indigenous medicine and western biomedicine into health systems: a review of Nicaraguan health policies and miskitu health services. International Journal for Equity in Health (2015) 14:129 DOI 10.1186/s12939-015-0260-1.

Coe. F. Ethnobotany of the Miskitu of Eastern Nicaragua. Journal of Ethnobiology 17(2):171-214. Winter 1997.

https://www.cbsnews.com/news/mother-fights-for-lower-insulin-prices-after-sons-tragic-death/?ftag=CNM-00-10aac3a. February, 2019.

https://www.cdc.gov/features/hispanichealth/index.html, January 2019.

www.clinicaverde.org, July, 2018.

Duke, J. Duke's Handbook of Medicinal Plants of Latin America. CRC Press Taylor & Francis group. 2009.

https://www.drweil.com/health-wellness/body-mind-spirit/diabetes/jackass-bitters-for-diabetes/. January, 2017.

http://entheology.com/plants/argemone-mexicana-prickly-poppy/, January 2019.

http://www.emro.who.int/noncommunicable-diseases/diabetes/index.html, August, 2018.

https://www.farmprogress.com/crops/medicinal-plants-growing-30-million-new-york-market. February, 2019.

Fakeye, T.O. Effect of Moringa oleifera in metformin plasma level in type 2 diabetes mellitus. https://clinicaltrials.gov/ct2/show/NCT03189407. 2017.

Farr, D. Sustainable Medicine Project, White Paper. 2017.

https://www.fsd.org/2018/08/healthcare-in-nicaragua/. March, 2019.

Fuangchan, A., Sonthisombat, P., et al, Hypoglycemic Effect of Bitter Melon Compared with Metformin in Newly Diagnosed Type 2 Diabetes Patients, J Ethnopharmacol, 2011; Mar 24;134(2):422-8.

Gallego Perez, D. et. al. Cultivation, preparation and use of local medicinal plants in primary healthcare, the experience of Bogota, Colombia. November, 2014.

Gallego-Perez, D. et. al. Integration of Complementary and Alternative Medicine in the Colombian Healthcare System; a pilot project in Bogota D.C.

Giovanni, P., Howes, M-J., Edwards, S. Medicinal plants used in the traditional management of diabetes and its sequelae in Central America: A review Journal of Ethnopharmacology 184(2016) 58-71. 2016.

Gladstar, R. Medicinal Herbs: A Beginner's Guide. Storey Publishing. 2012.
https://www.globalhealingcenter.com/natural-health/benefits-of-chanca-piedra/, September 2018.

Gupta, R. et. al. Evaluation of antidiabetic and antioxidant activity of *Moringa oleifera* in experimental diabetes. Journal of Diabetes 4 (2012) 164–171. doi: 10.1111/j.1753-0407.2011.00173.x.

https://www.heraldcourier.com/news/local/appalachian-sustainable-development-received-donated-herb-dryer/article_d9ce29c8-400d-11e9-a6af-335218ec6ac0.html, March, 2019.

http://hierbasmalas.blogspot.com/2009/10/phyllanthus-urinaria-niruri.html, August 2018.

https://hort.purdue.edu/newcrop/CropFactSheets/phyllanthus.html. February 2019.

Inayat-ur-Rahman, M., Bashir, M., et al, Serum Sialic Acid Changes in Non-Insulin-Dependent Diabetes Mellitus (NIDDM) Patients Following Bitter Melon (Momordica charantia) and Rosiglitazone (Avandia) Treatment, Phytomedicine, 2009;16(5):410-5.

https://kaiserfamilyfoundation.files.wordpress.com/2013/01/8383_d.pdf. March, 2019.

Kanetkar, P. et al. *Gymnema sylvestre*: A Memoir. Journal of Clinical Biochemical Nutrition. 2007 Sep; 41(2): 77–81. doi: 10.3164/jcbn.2007010.

https://www.krqe.com/news/chinese-medicinal-herbs-provide-niche-market-for-us-farmers/1019825537. February, 2019.

Kumar, S.N., Mani, U.V., et al, An Open Label Study on the Supplementation of Gymnema sylvestre in Type 2 Diabetics, J Diet Suppl, 2010 Sep;7(3):273-82

L. Galvez Renella, et. al. Phenolic compounds, antioxidant activity and *in vitro* inhibitory potential against key enzymes relevant for hyperglycemia and hypertension of commonly used medicinal plants, herbs and spices in Latin America.Volume 101, Issue 12, June 2010, Pages 4676-4689. https://doi.org/10.1016/j.biortech.2010.01.093.

Li, Y., Zheng, M., et al, Effect of Gymnema sylvestre, Citrullus colocynthis and Artemisia absinthium on Blood Glucose and lIpid Profile in Diabetic Human, Acta Pol Pharm 2015 Sep-Oct;72(5):981-5

Lo, H.Y., Ho, T.Y., et al, Momordica charantia and its Novel Polypeptide Regulate Glucose Homeostasis in Mice via Binding to Insulin Receptor, J Agric Food Chem, 2013 Mar 13;61 (10):2461-8.

Lopez, L. and Golden, S.H. A New Era in Understanding Diabetes Disparities Among U.S. Latinos—All Are Not Equal. Diabetes Care 2014 Aug; 37(8): 2081-2083. DOI 10.2337/dc14-0923.

Marin-Peñalver, J.J., et. al. Update on the treatment of type 2 diabetes mellitus. World J Diabetes. 2016 Sep 15; 7(17): 354–395. doi: 10.4239/wjd.v7.i17.354

Mozaffari-Khosravi, H., et. al. The effects of sour tea (*Hibiscus sabdariffa*) on hypertension in patients with type II diabetes. *Journal of Human Hypertension* volume 23, pages 48–54 (2009).

Nayak, P.S. Antidiabetic activity and modulation of antioxidant status by fractions of Argemone mexicana in Alloxan induced diabetic rats. International Journal of Green Pharmacy. Vol 6, No 4. 2012.

https://www.nytimes.com/2018/04/20/world/americas/nicaragua-protests-ortega.html?module=inline, April 2018.

https://www.nytimes.com/2018/12/24/world/americas/nicaragua-protests-daniel-ortega.html, April, 2018.

Ocampo, R. and Balick, M. Plants of Semillas Sagradas: An Ethnomedicinal Garden in Costa Rica. Finca Luna Nueva Extractos de Costa Rica, S.A. 2009.

http://www.paho.org/salud-en-las-americas-2012/index.php?option=com_docman&task=doc_view&gid=140&Itemid. May 9, 2017.

Personal Communication with Dawson, S. of Maple Springs Farm, LLC. October 2018. February 2019.

Personal communication with Farr, D., June 2016, May 2017.

Personal communication between Dr. Dawson Farr and David Grimsley, former Executive Director of Blue Ridge Center for Chinese Medicine, April 25, 2016.

Personal communication with Hickson, G., August 2018.

Pescosolido, N., Giannotti, R., et al, Curcumin: Therapeutic Potential in Ophthalmology, Planta Med, 2014;80:249-54

http://www.projectbonafide.com. October, 2017.

Rai, V., Mani, U.V., et al, Effect of Ocimum sanctum Leaf Power on Blood Lipoproteins, Glycated Proteins and Total Amino Acids in Patients With Non-Insulin-Dependent Diabetes Mellitus, J Nur and Environ Med, 1997;7(2):113-8 -14

Ranade, M. and Mudgalkar, N. A simple dietary addition of fenugreek seed leads to the reduction in blood glucose levels: A parallel group, randomized single-blind trial. Ayu. 2017 Jan-Jun; 38(1-2): 24–27.
doi: 10.4103/ayu.AYU_209_15

Satapathy, S., Das, N., et al, Effect of Tulsi (Ocimum sanctum Linn.) Supplementation on Metabolic Parameters and Liver Enzymes in Young Overweight and Obese Subjects, Ind J Clin Biochem, 2016 Sept;10.1007/s12291-016-0615 -4:7 pp

Indian J Clin Biochem. 2015 Apr; 30(2): 180–186.

N. Maithili Karpaga Selvi, M. G. Sridhar, R. P. Swaminathan, and R. Sripradha. Efficacy of Turmeric as Adjuvant Therapy in Type 2 Diabetic Patients. Published online 2014 May 8. doi: 10.1007/s12291-014-0436-2

Shanmugasundaram, E.R., Rajeswari, G., et al, Use of Gymnema sylvestre Leaf Extract in the Control of Blood Glucose in Insulin-Dependent Diabetes Mellitus, J Ethnopharmacol, 1990, Oct;30(3):281-94

https://strictlymedicinalseeds.com/product/ashwagandha-vedic-withania-somnifera-seeds-organic/. February 2019.

https://strictlymedicinalseeds.com/product/hibiscus-hibiscus-sabdariffa-seeds-organic/. February 2019.

https://strictlymedicinalseeds.com/product/tulsi-vana-ocimum-gratissimum-seeds-organic/. February 2019.

http://www.townsendletter.com/May2007/oxyhomeo0507.htm. August 2017.

Tiwari, P. Phytochemical and Pharmacological Properties. of *Gymnema sylvestre*: An Important Medicinal Plant. Biomed Research International. 2014; 2014: 830285. Published online 2014 Jan 6. doi: 10.1155/2014/830285.

https://www.totoco.com.ni/ecolodge-2/. February, 2019.

Tsai, C-T., Chen, E. et al, Wild Bitter Gourd Improves Metabolic Syndrome: A Preliminary Dietary Supplementation Trial, Nutr J, 2012; 11:4.

Velasco-Mondragon, E., et. al. Hispanic Health in the USA: A scoping review of the literature. Public Health Reviews (2016) 37:31 DOI 10.1186/s40985-016-0043-2.

Velayahuden, K.C., et. al. Ethnobotany of Turmeric (*Curcuma Longa* L.). Indian Journal of Traditional Knowledge. Volume 11(4), October 2012, pp. 607-614.

Villiger, A. et al. *In vitro* inhibitory potential of *Cynara scolymus, Silybum marianum, Taraxacum officinale*, and *Peumus boldus* on key enzymes relevant to metabolic syndrome. Journal of Phytomedicine. Volume 22, Issue 1, 15 January 2015, Pages 138-144. https://doi.org/10.1016/j.phymed.2014.11.015.

https://www.who.int/diabetes/country-profiles/nic_en.pdf?ua=1, January 2019.

Winston, D. "Insulin Resistance and Metabolic Syndrome: The Causes, The Risks, and Effective Treatment." April 25, 2018.

Winston, D. Ayurvedic Materia Medica - Ashwagandha. 6/9/2017.

Winston, D. Ayurvedic Materia Medica - Bitter Melon. June 9, 2017.

Winston, D. Ayurvedic Materia Medica - Fenugreek. 6/9/2017.

Winston, D. Ayurvedic Materia Medica - Gum Guggul. 6/9/2017.

Winston, D. Ayurvedic Materia Medica - Gymnema. 5/15/2017.

Winston, D. Ayurvedic Materia Medica - Holy Basil. 5/15/2017.

Winston, D. Ayurvedic Materia Medica - Turmeric. 5/15/2017.

Winston, D. Chinese Materia Medica - Gan Jiang. 3/8/2017.

Winston, D. Chinese Materia Medica, Gui Zhi - Cinnamon. 3/8/2017.

Winston, D. Materia Medica - Hibiscus. May 2017.

Winston, D. Native American Materia Medica - American Ginseng. 6/22/2017.

Winston, D. Native American Materia Medica - Quassia. July 2017.

Winston, D. Herbal Salon: Insulin Resistance / Metabolic Syndrome. September 5, 2018.

**APPENDIX A**
**Survey response from Appalachian Grower's Consortium,**
**Blue Ridge School of Chinese Medicine**
**Direct communication with Program Director Adam Fisher**
**May 2017**

1. *What do you DEFINITELY encourage growers to do? (i.e. farming practices, varieties to plant, packaging/preparing for market, saving / sharing seed)*

We encourage growers to follow ecologically sound growing practices. At a minimum, we ask growers to follow organic standards (no synthetic fertilizers, herbicides, pesticides) and to cultivate a minimum of three herbal species, representing three different plant families, to avoid monoculture planting. In addition, we work very diligently to help the growers choose plants appropriate to the microclimates present on their farms, to cultivate the herbs in a habitat similar to its native preferences. In general, we allow for some pest pressure. Supplemental nutrition and irrigation of established plantings are only implemented on an as needed basis, and many of the herbs are grown without any amendments or irrigation. We encourage growers to consider pollinator health, and the health of the overall ecosystem in their farm planning.

2. *What do you do suggest growers NOT DO?*

Use synthetic chemicals. Attempt to modify the environment to suit the herbs, rather than selecting the herbs to fit the environment. Develop a monoculture. Neglect or ignore their plantings.

3. *What are some of the key risks? (i.e. climate, FDA type of controls, packaging/freshness issues)?*

Climate, potential future pests, diseases
Educating our market base on the true cost of domestic herb production
Program organization, funding for staff time and labor

4. *How do you help growers mitigating risks?*

We provide complete program tracking for all stages of herb production, from providing the seeds from verified sources and the resulting transplants, through final sale. We are able to offer seeds at very reduced rates, and herbal transplants at no upfront cost to growers. Additionally, if growers demonstrate good stewardship, we are able to forgive the financial assessment for plants lost through unforeseen climatic, pest, and disease situations, allowing our growers to learn how to grow these crops, without having to outlay a large amount of money up front. These policies are more detailed in our attached Grower Agreement.
In addition, our AHGC staff provides all the post harvest handling (washing, chopping, drying, packaging, marketing, selling) so that the farmers do not have to become experts at all stages of herb production in order to have a product that can deliver them a return.

5. *How do you identify / help growers identify potential markets?*

Our markets are Herbal Practitioners and Product Makers with an emphasis on Practitioners of Acupuncture and East Asian Medicine. Our AHGC staff team does the marketing for the farmers.

6. *Similarly, how have you identified the medicinal crops that are ideal for local growers?*

Much time and effort have been spent within our organization over the past several years to begin answering this question. We consider: Will the crop grow in our climate? Is it a potential fit in this landscape? Is it in demand by practitioners? Will it yield a crop that deliver a return to the farmer?

7. *What type of support do growers ask you for the most?*

Farm planning, education for all stages of cultivation and harvest

8. *What have been some of the biggest challenges in the medicinal herb growing community that you've seen?*

The need for organization, collective programs. Without paid staff at the organizational level, we would not be able to get our program off the ground. In general, it seems that herbal products are greatly devalued on the producer end, and that current sale prices of the raw dried herbs do not even come close to covering the cost of production. Many of our herbs are root crops that take multiple years of cultivation before harvest. Waiting for a return is a challenge for growers who need income in the present. Additionally, the cost of processing the herbs in a clean, inspected processing/drying facility, can easily be overlooked, when producing clean consistent products is very important to access the market.

9. *What do you propose as some of the ways to overcome these challenges?*

Our program sought and received grant funding, so at the present time is able to offer organization, and takes care of all stages of processing, marketing and selling.

10. *Do you see this as a replicable model? If so, what advice would you have in doing so and especially any thoughts you could share about doing so in a developing country?*

This program is very replicable, as long as it is funded. This sort of a program could not be implemented in the same way without financial support in the first 5-10 years.

**APPENDIX B**
**Farm to Clinic Resources**

***Growing herbs***

Cech, R. The Medicinal Herb Grower: A Guide for Cultivating Plants that Heal. Horizon Herbs, LLC. 2009.

Carpenter, J. and M. The Organic Medicinal Herb Farmer: The Ultimate Guide to Producing High-Quality Herbs on a Market Scale. Chelsea Green Publishing. 2015

Ocampo, R. and Balick, M. Plants of Semillas Sagradas: An Ethnomedicinal Garden in Costa Rica. Finca Luna Nueva Extractos de Costa Rica, S.A. 2009.

Schafer, P. The Chinese Medicinal Herb Farm. Chelsea Green Publishing. 2011.

Starting medicinal plants from seed:
https://chestnutherbs.com/guideline-to-growing-medicinal-herbs-from-seeds/

***Processing herbs***

Herb dehydrator possibilities -
Solar one you can build (graphic in Spanish):
https://www.pinterest.com/pin/502925483357290600/

Made from an old refrigerator:
https://www.pinterest.com/pin/309974386823318656/

Food dehydrator that can hold herb material- reputable, functional brand:
https://excaliburdehydrator.com/pages/dehydrators

Screen mesh for garbling herb material (the screen is easy enough to build one's self, here is a visual for reference):
https://strictlymedicinalseeds.com/product-category/other-products/screens/

Tincture press (a visual of a hydraulic press, can make one's own):
https://www.pinterest.com/pin/400679698079388738/

***Medicine making***

Cech, R. Making Plant Medicine. Herbal Reads, LLC. 4th Edition 2016.

Gallego Perez, D. et. al. Cultivation, preparation and use of local medicinal plants in primary healthcare, the experience of Bogota, Colombia. November, 2014. (in Spanish).

Gladstar, R. Medicinal Herbs: A Beginner's Guide. Storey Publishing. 2012.