International Journal of Phytocosmetics and Natural Ingredients 2015;2:2

doi 10.15171/ijpni.2015.02

Minireview

Contributions of Natural Ingredients From the Mesoamerican Biodiversity for the Phytocosmetic Industry

Armando Cáceres[1,2*], Sully M. Cruz[1]

[1]Facultad de Ciencias Químicas y Farmacia, Universidad de San Carlos, Guatemala
[2]Laboratorios de Productos Naturales Farmaya, Guatemala

Correspondence to
Armando Cáceres
Email:
acaceres@farmaya.net

Received 13 April 2015
Accepted 25 May 2015
ePublished 26 May 2015

Abstract

Mesoamerica is a region of high diversity, which complement the biological richness with a profound value for this local biodiversity by its inhabitants, including diverse applications such as flavors, aromas, spices and condiments, dyes and colorants; food (grains, oilseeds, fruits, herbs), and medicinal plants, herbals and cosmetics. This minireview paper deals with the historical usage of plants for hair and skin care, and the recent investigations conducted in Guatemala on antioxidant activity, colorant evaluation, solar protection and tyrosinase inhibition potential for skin clearing of native species from the Mesoamerican biodiversity. Several native species from the Mesoamerican biodiversity are potentially useful for application in the phytocosmetic industry. Based on recent studies in Guatemala the following species are suggest for further assessment. For antioxidant activity and colorant properties, *Litsea guatemalensis, Piper jacquemontianum, Rhizophora mangle, Smilax domingensis* and *Tagetes lucida,* for solar protection activity *Phlebodium pseudoaureum*, and, for antityrosinase activity *Piper variabile*. It is suggested a joint effort from the academic and industrial sectors for a multinational cooperation in order to develop new phytocosmetic materials and products within an innovative and sustainable approach.

Keywords: *Smilax domingensis*, Tyrosinase inhibition, Solar protection, Antioxidants

Introduction

Mesoamerica is a cultural and historical region were several important civilizations developed, such as Toltec, Zapotec, Maya and Aztec. Guatemala is a diverse country, pluricultural and multilingual, with a profoundly syncretic culture as a heritage of Maya and Spanish cultures.
It is a region of high diversity, which complement the biological richness with a profound value for this local biodiversity by its inhabitants with an integral vision, including diverse applications such as flavors, aromas, spices and condiments, dyes and colorants; food (grains, oilseeds, fruits, herbs), and medicinal plants, herbals and cosmetics. This minireview paper deals with the historical usage of plants for hair and skin care, and the recent investigations on antioxidant, solar protection and tyrosinase inhibition potential for skin clearing of native species from the Mesoamerican biodiversity.

Biodiversity and Tradition as a Source of Natural Resources

The several indigenous groups established in Mesoamerica over time, demonstrated a good knowledge of its surrounding and a profound respect for its uses within an integral vision. Ethnobotanical surveys demonstrated abundant information on the use of flavors, aromas, species and condiments; dyes and colorants; food (grains, oilseeds, fruits, herbs); medicine and cosmetics, as well as other vegetal an animal resources for everyday life.
Based on the review by Batres and Batres from 2011 about the plants used by the Mayas for hair and skin care, at least dozen of species were detected (Table 1).[1] Some of them are still in use by the local populations, but others are less used or find seldom in the wild.

Plants With Antioxidant Activity

Oxidation occurs in all biological processes, characterized by electron loose, oxygen utilization and hydrogen cession. All oxidations are accompanied by a reduction (redox) process. A free radical is an unstable chemical specie with one or more unpaired electron in its external orbit. As oxidants, free radicals react rapidly with any biologic molecule free or coupled to cellular structures, such as glycosides, phospholipids, amino acids, nucleotides and lipoproteins. Free radicals might interact with membrane functions, enzyme production, cellular respiration and genic induction, providing stress and ageing. Vast preclinical studies as well as several clinical approaches has been conducted for the safe utilization of vegetal antioxidants.[2,3]

Please cite this paper as: Cáceres A, Cruz SM. Contributions of natural ingredients from the Mesoamerican biodiversity for the phytocosmetic industry. *International Journal of Phytocosmetics and Natural Ingredients.* 2015;2:2. doi:10.15171/ijpni.2015.02

The literature review about national or regional surveys for the screening of natural resources for antioxidant activity, demonstrate that several plants used as food, medicine and cosmetic have interesting antioxidant activity. Antioxidant activity has been demonstrated in several vegetal materials, using diverse models for activity evaluation. From Europe, well known and widely distributed plants have shown important activity, manly berries from Rosaceae family as well as other seeds and nuts,[4-8] while for Asia, Africa and Latin America several native species have demonstrated important antioxidant activity (Table 2).[9-13]

In Guatemala, four studies have demonstrated antioxidant activity in selected medicinal and food plants, particularly *Tagetes lucida,*[14] *Acalypha guatemalensis, Ocimum micranthum, Smilax spinosa,*[15] *Valeriana prionophylla,*[16] *Crotalaria longirostrata, Lycianthes synanthera, Solanum americanum* and *S. wendlandii.*[17]

In 24 species used as food or medicine in Guatemala, ethanol extracts were prepared with dried plants and evaluated by 1,1-diphenyl-2-picrylhidrazyl (DPPH) reduction, total phenolic compounds by Folin-Ciocalteu method, 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulphonic acid (ABTS) reduction, and ferric reduction power quantitated by colorimetric methods. Results demonstrated that 6 species have important antioxidant activity, particularly *Smilax domingensis, T. lucida, Litsea guatemalensis, Pimenta dioica, Phlebodium pseudoaureum* and *Piper auritum.*[18]

In a group of 44 extracts from 11 species of *Piper* genus, 4 (*P. jacquemontianum, P. psilorachis, P. schippianum* and *P. variabile*) demonstrated antioxidant activity higher than vitamin E and rutin, and similar to vitamin C, quercetina, Trolox, and TBHQ.[19]

A study in 3 species with colorant properties, demonstrated that *Rhizophora mangle, S. domingensis* and *Hibiscus sabdariffa* demonstrated good activity by the DPPH or TEAC methods, better than vitamin E, but less than quercetin and rutin.[20] *Litsea guatemalensis* extracts, particularly ethyl acetate extract, demonstrated higher activity than vitamin C and E, quercetin, rutin, TBHQ and Trolox.[21]

Other Cosmetic Activities Investigated

Natural colorants with potential for the phytocosmetic industry have been confirmed in *Boconia arborea, Byrsonioma crassifolia, Erythrina berteroana, H. sabdariffa, P. pseudoaureum, R. mangle, S. domingensis* and *T. lucida*., showing good stability and equivalent values to chemical colorants, such as Yellow #5 and #6 an Red #3.[20]

The solar protection factor of *P. pseudoaureum* extract was demonstrated by using the extract alone and improved protection by octyl methoxycinnamate (parasol) as recommended by the European Cosmetic Association (COLIPA). Synergistic effect of fronds and rhizomes extracts associated by antisolar agent demonstrated that both show an absorption spectrum close to the UV wavelength with maximum erythematous effects (308 nm), and absorb more energy in association than separated.[22] Beside the antisolar activity, in the cosmetic industry, the application of plant materials with antioxidant activity is important for photometric protection.[23]

Tyrosinase is an enzyme of the melanogenic cycle, which provides color to skin, hair and eyes; when present in high concentrations it produces hyperpigmentation, such as senile lentigo, melasma, and pigmented freckles. Hyperpigmentation is relatively common in Latin America and available therapeutics are diverse, some acting by tyrosinase inhibition, and other by increase keratinocyte turnover or melanocyte proliferation inhibition. Main drugs used for these purposes include hydroquinone, mequinol, kojic acid, corticosteroids, azelaic acid, arbutin and rucinol.[24,25] Antityrosinase activity has been demonstrated in native plants from several Asian countries, particularly Bangladesh,[26] India,[27] Indonesia,[28] Korea,[29] and Nepal.[30] Similar activity has been demonstrated in Argentinian[31] and Brazilian plant species.[32]

In a study of the antityrosinase activity, extracts from 10 *Piper* species from Mesoamerica were evaluated, qual-

Table 1. Plants Used by the Mayas for Skin and Hair Care (Based on Batres and Batres[1])

Scientific Name	Popular Name	Part Used	Cosmetic Usage
Cocos nucifera	Coconut	Water	Skin cleansing
Loeselia mexicana	Espinosilla	Leaves	Skin cleansing
Persea americana	Avocado	Oil	Remove scars
Arracacia atropurpurea	Acocotli	Plant vine	Relieve chafing
Manihot utilissima	Yuca	Root	Chapped lips
Swietenia mahogani	Mahogany	Oil	Skin softener
Theobroma cacao	Cacao	Butter	Skin embellishment
Pouteria sapota	Zapote	Seed oil	Hair care
Ipomoea murucoides	Xiuhamolli	Leaves	Hair care
Spondias purpurea	Jocote	Milled leaves	Hair dye (light)
Indigofera suffructicosa	Añil	Leaves	Hair dye (indigo)
Dioscorea convolvulacea	Quilamul	Leaves	Hair dry (black)

Table 2. Antioxidant Activity of Edible, Culinary and Medicinal Plants From Different Parts of the World

Type 0f Extract From Vegetable Material	Plants With Important Antioxidant Activity	Reference
Methanol extract of cereals (18), fruits (27), seeds and berries (25), vegetables (32), pulses, roots and tubers (21) used as dietary plants in Norway	*Rosa canina, Empetrum hermaphroditum, Vaccinium myrtillus, Ribes nigrum, Juglans regia, Prunus cerasus, Punica granatum*	Halvorsen et al, 2002 [4]
Aqueous extract of 104 vegetables, fruits, oils and beverages consumed in Italy	*Spinacea oleracea, Capsicum annum, Rubus* spp., *Olea europea, Asparagus pofficinalis*	Pellegrini et al, 2003 [5]
Essential oil, ethanolic extracts and decoction of 10 medicinal plants consumed in Portugal	*Melissa officinalis, Hypericum undulatum, Laurus nobilis, Lavandula angustifolia*	Ferreira et al, 2006 [6]
Infusion of 70 medicinal plants used in Croacia	*M. officinalis*	Katalinic et al, 2006 [7]
Vegetable and spices from the data bases from United States Department of Agriculture	*Glycine max, Camellia sinensis, Foeniculum vulgare, Thymus vulgaris, Psidium gualava*	Suhaj, 2006 [8]
Methanolic extracts of 35 species of fruits and vegetables from Uganda	*Syzigium cuminii, Punica granatum, Canarium schweinfurthii, P. guajava, Mangifera indica*	Stangeland et al, 2009 [9]
Aqueous extract of 10 Mexican medicinal plants	*Chiranthodendron pentadactylon*	Ibarra Alvarado et al, 2010[10]
Acidic methanol-water extracts of fresh pulp and seeds of 24 fruits from Colombia	*Anacardium occidentale, Eugenia estipitata, Callocarpum mammosum, Hymenaea courbaril*	Contreras-Calderón et al, 2011 [11]
Organic extracts of 12 medicinal plants from India	*Paltophorum ferrugineum*	Chandra et al, 2011 [12]
Methanol extract of 7 medicinal plants from Nigeria	*Landolphia owariensis, Irvingia gabonensis*	Awah et al, 2012 [13]
Ethanol extracts of 24 species traditionally used as food, condiment or medicine in Guatemala	*Smilax domingensis, Tagetes lucida, Litsea guatemalensis, Pimenta dioica, Phlebodium pseudoaureum, Piper auritum*	Cáceres et al., 2012 [18]

itatively by TLC (bioautography) and quantitatively by microcolorimetric methods. It was demonstrated that *P. variabile* has a good tyrosinase inhibition activity in the dichloromethane (CI_{50} 2.0 ± 0.1 µg/mL) and methanol (CI_{50} 2.1 ± 0.1 µg/mL) fractions, in a similar dose as kojic acid (CI_{50} 1.2 ± 0.07 µg/mL). *Piper jacquemontianum, P. psilorachis* and *P. umbellatum* had a moderate activity (CI_{50} 4.9-6.8 µg/mL) in dichloromethane or methanol extracts.[33] The potential of antityrosinase activity of *P. variabile* should be studied further from a phytochemical and pharmacological point of view.

Conclusions

The potential application of plants species from the Mesoamerican biodiversity with antioxidant, colorant, aromatic, solar protector and tyrosinase inhibition activity, can benefit the cosmetic industry.

Cultivation and conservation should lead into the massive production of these materials for ecologic utilization by the phytocosmetic industry, as well as a competitive and sustainable price.

A joint effort from the academic and industrial sectors for a multinational cooperation should be pursued in order to accomplish such tasks, and develop new phytocosmetic materials and products within an innovative and sustainable approach.

Acknowledgments

Data partially presented in this review received financial support from the National Council on Science and Technology (CONCYT, FODECYT projects 28-2007, 78-2008, 17-2009, 18-2009, 51-2009).

References

1. Batres L, Batres C. Ancestral Mesoamerican cosmetics: Plants for beauty and body practices. *Acta Hort*. 2012;964:169-179.
2. Brewer MS. Natural antioxidants: sources, compounds, mechanisms of action, and potential applications. *Comprehen Rev Food Sci Food*. 2011: 10:221-247. doi:10.1111/j.1541-4337.2011.00156.x
3. Alok S, Jain SK, Verma A, Kumar N, Mahor A, Sabharwal M. Herbal antioxidant in clinical practice: A review. *Asian Pac J Trop Biomed*. 2014;4:78-84. doi:10.1016/s2221-1691(14)60213-6
4. Halvorsen BL, Holte K, Myhrstad MC, et al. A systematic screening of total antioxidants in dietary plants. *J Nutr*. 2002;132:461-471.
5. Pellegrini N, Serafini M, Colombi B, et al. Total antioxidant capacity of plant foods, beverages and oils consumed in Italy assessed by three different in vitro assays. *J Nutr*. 2003;133:2812-2819. doi: 10.1002/mnfr.200600067
6. Ferreira A, Proença C, Serralheiro ML, Araújo ME. The in vitro screening for acetylcholinesterase inhibition and antioxidant activity of medicinal plants from Portugal. *J Ethnopharmacol*. 2006;108: 31-37. doi:10.1016/j.jep.2006.04.010
7. Katalinic V, Milos M, Kulisic K, Jukic M. Screening of 70 medicinal plant extracts from antioxidant capacity and total phenols. *Food Chem*. 2006;94, 550-557. doi:10.1016/j.foodchem.2004.12.004
8. Suhaj M. Spice antioxidants isolation and their antiradical activity: a review. *J Food Comp Anal*. 2006;19:531-537. doi:10.1016/j.jfca.2004.11.005
9. Stangeland T, Remberg SF, Lye KA. Total antioxidant

activity in 35 Ugandan fruits and vegetables. *Food Chem.* 2009;113:85-91. doi:10.1016/j.foodchem.2008.07.026

10. Ibarra-Alvarado C, Rojas A, Mendoza S, et al. Vasoactive and antioxidant activities of plants used in Mexican traditional medicine for the treatment of cardiovascular diseases. *Pharm Biol.* 2010;48:732-739. doi:10.3109/13880200903271280
11. Contreras-Calderón J, Calderón-Jaimes L, Guerra-Hernández E, García-Villatoro B. Antioxidant capacity, phenolic content and vitamin C in pulp, peel and seed from 24 exotic fruits from Colombia. *Food Res Internat*. 2011;44:2047-2053.
12. Chandra S, Dave R, Kaneria M. In vitro antioxidant property of some Indian medicinal plants. *Res J Med Plants*. 2011;5:160-179.
13. Awah FM, Uzoegwu PN, Ifeonu P, et al. Free radical scavenging activity, phenolic contents and cytotoxicity of selected Nigerian medicinal plants. *Food Chem*. 2012;131:1279-1286. doi:10.1016/j.foodchem.2011.09.118
14. Aquino R, Cáceres A, Morelli S, Rastrelli L. An extract of Tagetes lucida and its phenolic constituents as antioxidants. *J Nat Prod*. 2002;65:1773-1776.
15. Navarro MC, Montilla MP, Cabo MM, et al. Antibacterial, antiprotozoal and antioxidant activity of five plants used in Izabal for infectious diseases. *Phytother Res*. 2003;17:325-329. doi:10.1002/ptr.1134
16. Piccinelli AL, Arana S, Cáceres A, di Villa Bianca R, Sorrentino R, Rastrelli L. New lignans from the roots of Valeriana prionophylla with antioxidative and vasorelaxant activities. *J Nat Prod*. 2004;67:1136-1140. doi:10.1021/np049879c
17. Salazar J, Velásquez R, Quesada S, Piccinelli AL, Rastrelli L. Chemical composition and antinutritional factors of *Lycianthes synanthera* leaves (chomte). *Food Chem.* 2006;97:343-348.
18. Cáceres A, Lange K, Cruz SM, et al. Assessment of antioxidant activity of 24 native plants used in Guatemala for their potential application in natural product industry. *Acta Hort*. 2012; 946: 85-92.
19. Cáceres A, Cruz SM, Gaitán I, Guerrero K, Álvarez LE, Marroquín MN. Antioxidant activity and quantitative composition of extracts of Piper species from Guatemala with potential use in natural product industry. *Acta Hort*. 2012;946:77-84.
20. Cruz SM. Identificación y cuantificación de colorantes naturales de cinco especies vegetales nativas. Final report, project FODECYT 79-2008, Guatemala.
21. Cruz SM. Evaluación química y actividad biológica de aceites y extractos de especies de laurel (*Litsea* spp) distribuidas en Guatemala para su aprovechamiento a nivel industrial en la producción de aromas y/o fitomedicamentos. Final report project FODECYT 51-2009, Guatemala.
22. Cruz SM. Evaluación y diseño de una formulación a partir de extractos de Calahuala (*Phlebodium pseudoaureum*) para un posible uso en cosmética como agente antisolar Final report project FODECYT 16-2009.
23. Chen L, Hu JY, Wang SQ. The role of antioxidants in photoprotection: A critical review. *J Amer Acad Dermatol.* 2012;67:1103-1023.
24. Cestari T, Arellano I, Hexsel D, Ortonne JP. Melasma in Latin America: options for therapy and treatment algorithm. *J Europ Acad Dermatol Venerol*. 2009; 23:760-772. doi:10.1111/j.1468-3083.2009.03251.x
25. Fisk WA, Agbai O, Lev-Tov HA, Sivamani RK. The use of botanically derived agents for hyperpigmentation: A systemic review. *J Am Acad Dermatol*. 2013;70:75-79. doi:10.1016/j.jaad.2013.09.048
26. Khanom F, Kayahara H, Tadasa K. Tyrosinase inhibitory activity of Bangladesh indigenous medicinal plants. *Biosci Biotechnol Bhiochem*. 2000; 64:1967-1969. doi:10.1271/bbb.64.1967
27. Narayanswamy N, Duraisamy A, Balakrishnan KP. Screening of some medicinal plants for their antityrosinase and antioxidant activities. *Int J Pharm Tech Res.* 2011;3:1107-1112.
28. Batubara I, Darusman LK, Misunaga T, Rahminiwati M, Djauhari E. Potency of Indonesia medicinal plants as tyrosinase inhibitor and antioxidant agent. *J Biol Sci*. 2010;10:138-144.
29. Son KH, Heo MY. Inhibitory effect of Korean indigenous plants on tyrsoinase and melanogenesis. *J Soc Cosm Chem.* 2013;64:145-158.
30. Adhikari A, Devkota HP, Takano A, et al. Screening of Nepalese crude drugs traditionally used to treat hyperpigmentation: in vitro tyrosinase inhibition. *Int J Cosm Sci*. 2008;30:353-360. doi:10.1111/j.1468-2494.2008.00463.x
31. Baurin N, Arnoult E, Scior T, Do DT, Berbard P. Preliminary screening of some tropical plants for anti-tyrosinase activity. *J Ethnopharmacol*. 2002;82:155-158. doi:10.1016/s0378-8741(02)00174-5
32. Chiari M, Joray M, Ruiz G, Palacios S, Carpinella M. Tyrosinase inhibitory activity of native plants from central Argentina: Isolation of an active principle from *Lithrea molleoides*. *Food Chem*. 2010;120:10-14. doi:10.1016/j.foodchem.2009.09.061
33. Almeda F, Astorga L, Orellana A, et al. Antityrosinase activity by native species of Piper genus with potential application in phytocosmetics. *Int J Phytocosmet Nat Ingred.* 2015; In press.