Meliponini biodiversity and medicinal uses of pot-honey from El Oro province in Ecuador

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INTRODUCTION

Ecuador has a surface of almost 300,000 km² divided into 24 provinces with the highest biodiversity in the planet. El Oro province is divided into 14 cantones, and belongs to the region 7 of Ecuador, located in the South West of the country, besides Loja and Zamora Chinchipe provinces (Fig. 1). El Oro’s population is 559,846 inhabitants living in 5,850 km²—roughly 1/50 the country surface; the capital city Machala is internationally known as the banana capital of the world. Besides the ecologically controversial exploitation of shrimp farming and intensive banana plantations, El Oro province has protected areas: Arenillas Ecological Reserve, Buenaventura National Park and Isla Santa Clara Wildlife Sanctuary. This coastal province is home to the Mullopungo, Chilla and Tioloma foothills, Hummingbird Sanctuary, and stingless bees.

Las Lajas is a 300 Km² Southern West canton of El Oro province, capital La Victoria, known for the production of cocoa, corn, and livestock. The temperature of 19 to 30°C, and altitudes between 80 and 900 m.a.s.l. are good for stingless bee life, indeed few species are currently kept.

Stingless bees (Hymenoptera; Apidae; Meliponini) are a tropical group with more than 500 known species, and perhaps 100 more to be named (Michener, 2013). This great biodiversity is mostly represented by Neotropical Meliponini with almost 400 species group (Camargo and Pedro, 2007; Camargo, 2013). Different species of stingless bees thrive in El Oro province, and some of them are used in traditional meliponiculture. The following species of stingless bees were previously reported in this province (Ramírez et al., 2012): Cephalotrigina capitata Smith, 1854; Geotrigona fumipennis, Camargo & Moure, 2066; Oxytrigona sp. cf. postica, Scaptotrigona sp., Trigona fulviventris, Trigona matera, Trigonisca sp. 1 and sp. 2.

“Stingless bees process honey and pollen in cerumen pots” is the title of an e-book, to reflect on differences from and similarities to honey and pollen processed in beeswax...
Knowledgeable medicinal properties of honey produced by stingless bees from Guatemala, Mexico and Venezuela were informed (Vit et al., 2004). Achuars from the Amazonian forest of Ecuador treat throat inflammation with pot-honey (Guerrini et al., 2009). Honey—as an effective curative product with religious and mythical powers—was pinpointed in a retrospective review on the medicinal uses of Melipona beecheii pot-honey by the ancient Maya to restore balance of ill patients (Ocampo Rosales, 2013). Pot-honey was a name suggested to group honey produced by Meliponini because stinglessness—intellectual term used by Michener (2013)—possibly gives no input to think on the process by which honey is made inside cerumen containers, a component that may explain bioactive properties (Vit et al., 2013).

Natives from South America, such as the Kayapós, from southern Pará, Brazil, use the products of stingless bees in food and medicine, and also as a model for social organization for their own communities (Posey and Camargo, 1985; Camargo and Posey, 1990). Local knowledge on medicinal use, management and ecological aspects were studied in a contribution of ethnoentomology for eight stingless bee species from Michoacan, Mexico (Reyes-González et al., 2014).

In this work we studied Ecuadorian meliponines from Las Lajas, Balsas, Piñas, and Zaruma cantons from El Oro province and the different medicinal uses of their honey produced in cerumen pots, to retrieve the relation man-bee-environment-health.

MATERIALS AND METHODS

Stingless bee keepers—named meliponicultors in Latin America—were visited in four cantons (Las Lajas, Balsas, Piñas, and Zaruma) from Provincia El Oro in Ecuador. Questionnaires were used with seventeen meliponicultors, six female and eleven male, to inform medicinal uses of pot-honey by themselves and pot-honey consumers. The questionnaire consisted in 15 structured questions on Personal Identification (1. Name, 2. Surname, 3. Age, 4. Location, 5. Phone, 6. Email); Meliponiculture (7. Years of experience, 8. Ethnic names of species kept, 9. Origin of the Nests, 10. Rational or traditional meliponary, 11. Number of hives, 12. Products extracted, 13. Method of honey extraction, 14. Conservation of the honey); 15. Medicinal uses of pot-honey were elicited by...
enumeration and listening cases. Data on medicinal uses of pot-honey were analyzed and summarized by using Microsoft Excel to determine relative frequencies (%) of citations so as to identify the most common and popularly uses in the studied area.

The behavior of the bees was observed, and information on type of meliponary, and shape of the nest entrance was recorded. Ethnic names of the stingless bees were taken in each sampling, and used for preliminary identification (Ramírez et al., 2013). Stingless bees were collected in isopropyl alcohol, kept in boxes, and sent to Dr. S.R.M. Pedro, Camargo’s Collection, Biology Department, Universidade de São Paulo, Ribeirão Preto, Brazil, for entomological identification. Another set was sent to Prof. J. Ramírez for subsequent mounting to be deposited in entomological boxes at Universidad Nacional de Loja, Loja, Ecuador. Further duplicates were sent to Professor Charles D. Michener at the University of Kansas, Lawrence, USA; to Dr. Clifford Keil, Director of the Invertebrates Museum, Pontificia Universidad Católica de Ecuador, Quito, Ecuador; and Dr. David W. Roubik, Smithsonian Tropical Research Institute; Panama.

RESULTS AND DISCUSSION

Stingless bees kept by seventeen visited Ecuadorian meliponicultors, aged 12 to 76-7-0 in El Oro province are “bermeja” Melipona mimetica Cockerell, 1914; “cananambo” Melipona indecisa, Cockerel, 1919; “catiana” or “catana” Scaptotrigona ederi Schwarz, unpublished; “pirunga” Paratrigona aff. eutaeniata Camargo & Moure, 1994, “piton” Nannotrigona cf. perilampoides (Gresson, 1878). All of them commented on decrease of “bermejo” and “cananambo” nests as a more sensitive bee in frank decrease.

The dark Scaptotrigona ederi has variable defensive behavior, generally entangles in the hair and bites, therefore the use of the veil is advised for harvesting. The other species mentioned here are gentle bees, Nannotrigona sp. hides easily inside the nest. Two of the interviewed meliponicultors kept more than one type of stingless bee species, namely Melipona indecisa and Scaptotrigona ederi, whereas a female meliponicultor kept Nannotrigona cf. perilampoides, Paratrigona aff. eutaeniata and Scaptotrigona ederi. In Table 1 we show the ethnomedicinal uses of pot-honey produced by these five species of stingless bees, with healing properties known by producers and consumers in the locality. In this work the simple expressions were chosen to group the way honey is used, instead of systemic categorizations of medicinal interventions. The use of mixtures with plants would deserve another work by its own, therefore only the pot-honey is considered here.

Pot-honey is widely used alone or mixed with medicinal plants to treat tumors, eyes (ocular cataracts, pterygium), inflammation, sour throat infections, blood (bruises, varicose veins, purifying blood, cleaning blood after childbirth), kidney diseases, wound healing, and soothing balm before sleeping. The most frequent medicinal use was related to blood in 27% of the reported uses.

Their sensory qualities are appreciated by meliponicultors, who perceive floral smell and enticing sour flavor. In Table 1, the ethnic and scientific names of five stingless bee species from El Oro province are given with the medicinal uses of the pot-honey attributed by meliponicultors investigated here. Eight healing effects were registered, and besides being the most frequent, “catiana” or “catana” pot-honey has all these putative medicinal properties. Generally meliponicultors do not keep Apis mellifera, but the uses of honey are similar as a sweetener in plant infusions with antiinflammatory, emollient, against colds, and invigorative properties, as reported in the Granada study (Benítez, 2011). In the review on edible insects of Ecuador (Onore, 2005) and in our study, medicinal uses of stingless bee bodies were not informed by stingless bee keepers. However, whole body extracts of bees are used as anticancer and antibacterial agents, namely for their antimicrobial properties (Ratcliffe et al., 2011).

Insects represented the major animal group (23%) of folk medicinal bio-resources in the study of Bahia, Brazil (Costa-Neto, 2004). Therefore entomotherapy has implications for public health and biological conservation.

Table 1: Ethnomedicinal uses of pot-honey produced by five types of stingless bees in El Oro province

<table>
<thead>
<tr>
<th>Ethnic name</th>
<th>Scientific name</th>
<th>n</th>
<th>Canton location</th>
<th>Healing uses (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>bermeja”</td>
<td>Melipona mimetica</td>
<td>1</td>
<td>Las Lajas</td>
<td>Balm 2.7, Blood 2.7, Kidney 2.7, Eye 2.7, Inflammation 2.7, Sour throat 2.7, Tumor - Wound healing -</td>
</tr>
<tr>
<td>‘cananambo”</td>
<td>Melipona indecisa</td>
<td>1</td>
<td>Piñas</td>
<td>-</td>
</tr>
<tr>
<td>‘catiana”</td>
<td>Scaptotrigona ederi</td>
<td>13</td>
<td>Balsas, Las Lajas, Piñas, Zaruma</td>
<td>Blood 27.1, Kidney 5.4, Eye 8.1, Inflammation 13.5, Tumor 10.8, Wound healing 5.4, Sour throat 2.7, Wound healing 2.7</td>
</tr>
<tr>
<td>‘pirunga”</td>
<td>Paratrigona aff. eutaeniata</td>
<td>1</td>
<td>Las Lajas</td>
<td>-</td>
</tr>
<tr>
<td>‘piton”</td>
<td>Nannotrigona cf. perilampoides</td>
<td>1</td>
<td>Las Lajas</td>
<td>-</td>
</tr>
</tbody>
</table>

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(Alves and Alves, 2011); in their review 18 species of stingless bees were retrieved in studies on medicinal properties. However, compared to fitotherapy, the number of studies on zootherapy is very limited. Antibacterial and antioxidant activity of honey vary according to the botanical and entomological (Rodríguez-Malavaer et al., 2007) origin. The bioactive properties of honey are ascribed to specific factors such as the synergistic action of sugar and hydrogen peroxide for wound healing (Kwakman et al., 2010).

Further ongoing studies are of interest to identify the megabiodiversity of stingless bees in Ecuador, the traditional meliponiculture, and medicinal uses of pot-honey as ancestral knowledge. Although these pot-honeys were produced and used before Columbus, they are not yet considered in the honey regulations (Vit, 2008). This joint effort besides the characterization of pot-honeys, and its inclusion in the honey standards of the INEN 1572 regulation (Vit et al., unpublished), using the Melipona favosa pot-honey model (Vit, 2013), would increase its current value in the market up to USD 27/kg, promote the study of its medicinal properties and praise the activity of meliponicultors. The role of honey is perceived therapeutic in 90% of multispecies medicinal recipes.

Traditional medicine (TM) remains a simple therapy for health care in low income countries because it is the most available and affordable form of healing, as well as for the naturism philosophy, and combined with allopathic medicine as complementary alternative medicine (CAM) (WHO, 2000). It is readily available in ethnic groups such as Pankararé from Brazil who use Frieseomelitta sp., Cephalotrigona cf. capitata, Melipona sp., Melipona scutellaris, Partamona cf. capira, Tetragonisca sp., Trigona (Trigona) spinipes, Plebeia sp., pot-honey or pollen eaten or mixed with plants (Costa-Neto, 2002). The fact that pot-honey has cultural value connecting with ancient curative skills, does not exclude its use as raw material in the preparation of industrial drugs.

The ecological contribution of stingless bees as organisms is encapsulated in their pollinating service to about 50% of flowering plant species in the Neotropics (Biesmeijer, 1997) and Australia (Heard, 1999). The role of honey is perceived as therapeutic in 90% of multispecies medicinal recipes from Misiones, Argentina (Kujawsca, 2012).

Stingless bee keepers from Zona Maya in Mexico experienced colony losses of Melipona beecheii due to competition for food (Villanueva-Gutiérrez et al., 2013), especially in meliponaries with more than 100 nests. Besides the rescue of tradition, environmental protection is needed to achieve sustainable meliponiculture. To protect wild populations of stingless bees, the Ecuadorian Ministry of Environment started to fine extractions of nests from wild logs five years ago in Las Lajas canton from El Oro province, as informed by a meliponicultor from Amarillos, parish La Libertad (M. Estrada, personal communication). Besides the nutritional, organoleptic and sanitary values of a medicinal food like honey, an enterprising concept on the quality of the agri-food systems—as reviewed by Monastria and Crisponi (2013), considers animal welfare and defence of the ecosystem, as practiced by stingless bee keepers in modern days.

CONCLUSIONS

Honey is a medicinal food product of plant-animal-based pharmacopeia used in entomotherapy. Seventeen meliponicultors provided information on the honey produced in cerumen pots by five types of stingless bees from El Oro province from Ecuador. Pot-honey is mostly harvested from “catana” or “catiana” because the other bees –“bermeja”, “canambo”, “pirunga” anf “piton”– are less frequent. This described knowledge has ecological and sanitary implications, and deserves careful considerations.

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Author contributions
V. P. made a major contribution to design the research and collect the data. I.T. contributed with field work in Las Lajas. V. O. and M. V. F. were involved in overall supervision as Prometeo Counterparts. All authors read and approved the final manuscript.

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