Supplementary TEXT S1 Vit et al. biblio SBH 2023

Mapping six decades of stingless bee honey research: Chemical quality and Bibliometrics

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Continues from **Most prolific authors in scientific publications on pot-honey or stingless bee honey**

Four of the top ten authors in Table II were from Universidade Federal de Santa Catarina, Florianopolis, Brazil. Note that Biluca F.C., Gonzaga L.V. and Costa A.C.O. had the same number of topical citations because they shared co-authorship of nine documents on stingless bee honey published in the period 2014-2021. The Mexican author ranked 8th, with topical citations (18) much lower than authors ranked 9th (305) and 10th (160). It was explained because six of the nine documents for the Scopus ranking were chapters from one book that were never cited, or if they were cited, they were not recorded in the Scopus database. This is a case illustrating that ranking by number of publications is not the best metric, and further alphabetical order either. Accomplished authors on pot-honey research were looking at the composition of their aliphatic organic acids (AOA) spectra by targeted ^{1}H-NMR in Ecuadorian pot-honey (Vit et al., 2023), and by capillary electrophoresis in Brazilian pot-honey (dos Santos et al., 2022). New authors in pot-honey research were recently attracted on spectroscopic studies of Tanzanian pot-honey (Popova et al., 2021), and chemo-sensory profiles of pot-honey of the Thai *Tetragonula pagdeni* complex enhanced by a *Torulaspora. delbrueckii* yeast fermentation (Sooklim et al., 2022).

The dataset for Vit P in the supplementary Table SII was analyzed, and few minor discrepancies were detected. First, from the 24 documents 2 of them No. 19 and 20 (1997) and No. 16 and 17 (1998) that were published in English in the German journal Zeitschrift fur Lebensmittel –Untersuchung und –Forschung, were counted twice in the ranking because this journal also has a name in English: European Food Research and Technology. Both have the same doi and of course volume, number and page number, but the number of citations is different between the English and German journals. For this reason, it is not possible to delete one of them. Second, document No. 13 Interciencia lacks page numbers, which was added manually to the dataset. Third, Document No. 6 was published in year 2013 together with the other chapters of the book Pot-honey. A legacy of stingless bees, but in the Scopus database the informed year was 2012, which was the year of the submission of the book manuscript. The number of pages is correct but the ISBN of the e-book visible for the other chapters in the dataset, is missing here, thus it was added manually, as well as the correction of the year. A complementary data with the abstracts of each publication was inserted in the supplementary Table SII.

Author local citations

The function local citations generated frequency tables and plots of the most cited authors (Aria and Cuccurullo, 2017). Citations were named 'local' regarding to the dataset of references retrieved in the search. How many times an author or a document included in the retrieved collection have been cited by other authors from the same dataset.

Authors' dominance ranking was based on H index for the dataset. The k number of authors to consider in the analysis, for the ratio Dominance Factor indicating the fraction of multi-authored articles in which a scholar appears as the first author. The function H index calculates the authors' H-index or the sources' H-index and its variants G-index and M-index) in the bibliographic collection retrieved in the dataset. In Figure S2, the Bibliometrix plot for the author local impact by H index shows ranked authors surnames and initials. First position was for Vit P (15), second Roubik DW (8), third (7) shared by De Carvalho CAL and Hrncir M, and fourth position (6) shared by the remaining six authors.

Co-authors collaborative map

Aria and Cuccurullo (2017) explained the attributes of a document are connected to each other through the publication itself: The authors to a title, authors to a journal, keywords to publication date, and all metadata. The connections of different documents' attributes generate networks that can be represented as rectangular matrices of Manuscripts x Attributes. Additionally, the secondary references of each scientific publication generate a further network called co-citation, used to analyze the influence of underlying research systems from particular bibliometric units such as other scholars and journals. The number of publications versus authors, which is typical of a zeros-diagonal square matrix, served as the unit of analysis for the collaboration assessment. This study examined the relationships between authors who collaborated on publications on chemical quality of pot-honey or stingless bee honey research from 1962 to 2022. The visualization was based on Fruchterman's force-directed method (Aria and Cuccurullo, 2017). The co-authors collaborative network is presented in Figure S3.

Twelve clusters of collaborative research groups were identified in Figure S3. Cluster 1 (red) included 8 nodes mostly from Brazil: imperatriz-fonseca vl, hrncir m, roubik dw, menezes c, zucchi r, rosa ca, antonini y, and barth fg, Cluster 12 (lilac) with six large nodes: fett r, biluca fc, gonzaga lv, costa aco, braghini f, and vitali l; four of them are top ten authors and publish together since 2014, as previously informed in the analysis of Table II. An Indonesian team cluster 10 (pale blue) with 5 nodes: agus a, agussalim a, sahlan m, nurliyani n, and umami. Two four-node clusters, the Malaysian cluster 4 (violet): lani mn, mustafa mz, razak sba, ahmad f; and a Mexican team, cluster 11(celeste): ortiz-vázquez e, ramón-sierra jm, ruiz-ruiz jc, and magaña-ortiz di. Two three-node clusters were cluster 8 (grey): vit p from Venezuela, tomás-barberán fa from Spain, and heard ta from Australia; and the Malaysian cluster 9 (cyan): zawawi n, sabri s, chan kw. Five cluster with 2 nodes comprised: Cluster 2 (blue): yusof ya, chin nl; Cluster 3 (green): hashim n, maringgal b; Cluster 5 (orange): de souza el, magnani m; Cluster 6 (brown): absy ml, ferreira mg; Cluster 7 (pink): ávila s, beux mr.

Authors' keywords co-occurrence analysis

The map in Figure S4 was produced by co-word analyzing the authors' keywords present in the dataset using the Bibliometrix package (Aria and Cucurullo, 2017) in R Version 4.2.1. According to Jacobs (2002) and Chen et al. (2019), the approach implemented the straightforward centres of co-word algorithm. The size of the nodes was proportional to the frequencies of keywords in the three clusters of Figure S4. In this co-occurrence map of authors' keywords, the highest frequency was for honey. In the same red cluster stingless bees (plural) and stingless bee (singular) were the second and third largest nodes, whereas the fourth largest node was in the blue cluster for stingless bee honey. It depended on author's choice to join the honey with the stingless bee producing it, or leaving both terms separated.

Having the singular or plural forms may indicate if the study consisted on honey produced by one or diverse stingless bee species.

The first cluster was the largest with more than half of the nodes. It included stingless bees, honey bees, and bumble bees, the largest node honey, and frequent keywords used for chemical composition, moisture, flavonoids, phenolics, melissopalynology or pollen analysis, and bioactive properties. Cluster 1 (red) consisted in 27 nodes: honey, stingless bees, stingless bee, meliponini, antioxidant, propolis, apis mellifera, flavonoids, meliponinae, melissopalynology, antibacterial, pollen analysis, antimicrobial, honey bees, phenolic compounds, physicochemical, apidae, tool use, venezuela, antioxidants, chemical composition, moisture, phenolics, anti-inflammatory, brazil, bumble bees, and honey bee. The second cluster was on quality control and bioactivity of the Asian bee *Geniotrigona thoracia* and the Neotropical *Melipona beecheii*, cluster 2 (blue) with 15 nodes: stingless bee honey, antioxidant activity, physicochemical properties, antimicrobial activity, antibacterial activity, kelulut honey, kelulut, chemometrics, adulteration, food composition, geniotrigona thoracica, melipona beecheii, physicochemical analysis, food analysis, honey quality. The third cluster was on *Apis*, *Melipona* and *Trigona* genera, nectar, pollen, and foraging; cluster 3 (green) included 8 nodes: meliponiculture, melipona, pollen, nectar, trigona, foraging, apis, and botanical origin.