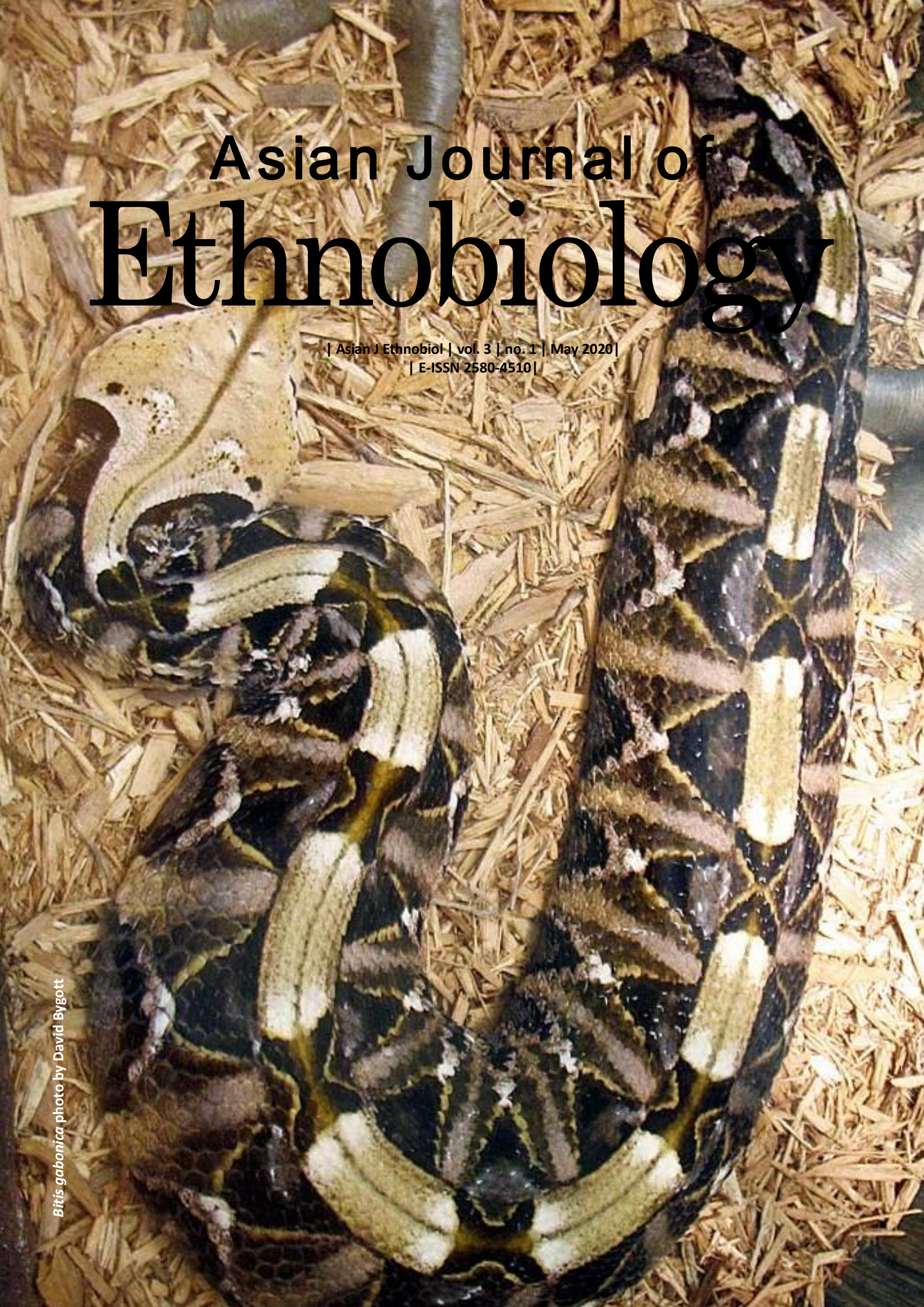
Asian Journal of Ethnobiology

| Asian J Ethnobiol | vol. 3 | no. 1 | May 2020|
| E-ISSN 2580-4510|



Bitis gabonica photo by David Bygott

Asian Journal of Ethnobiology

| Asian J Ethnobiol | vol. 3 | no. 1 | May 2020| E-ISSN 2580-4510 |

Published semiannually **PRINTED IN INDONESIA**

E-ISSN: 2580-4510

Asian Journal of Ethnobiology

| Asian J Ethnobiol | vol. 3 | no. 1 | May 2020|

ONLINE
http://smujo.id/aje

e-ISSN
2580-4510

PUBLISHER
Society for Indonesian Biodiversity

CO-PUBLISHER
Universitas Padjadjaran, Sumedang, Indonesia

OFFICE ADDRESS
Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Padjadjaran. Jl. Raya Bandung-Sumedang Km 21, Jatinangor, Sumedang 45363, West Java, Indonesia. Tel. +62-22-7796412 line 104, Fax. +62-22-7794545, email: aje@smujo.id, asianjethnobiol@gmail.com

PERIOD OF ISSUANCE
May, November

Society for Indonesian Biodiversity

Universitas Padjadjaran Sumedang, Indonesia

Published by Smujo International for The Society for Indonesian Biodiversity and Universitas Padjadjaran Sumedang, Indonesia

GUIDANCE FOR AUTHORS

Aims and Scope *Asian Journal of Ethnobiology* (**Asian J Ethnobiol**) encourages submission of manuscripts dealing with relationships between humans and their biological nature, including ethnobotany, ethnomycology, ethnozymology, ethnozoology, ethnoecology, traditional environmental/ ecological knowledge, ethnometereology, ethnoastronomy, ethnomedicine, ethnopharmacognosy, ethnoveterinary, ethnogastronomy, urban ethnobiology, linguistic ethnobiology, ethical and legal aspects of the biodiversity conservation and other related fields of study within anthropology and biology; as well as impact of economic activity on individuals in community and its social consequences.

Article types The journal seeks original full-length research papers, reviews, and short communication. Manuscript of original research should be written in no more than 8,000 words (including tables and picture), or proportional with articles in this publication number. Review articles will be accommodated, while, short communication should be written at least 2,000 words, except for pre-study.

Submission The journal only accepts online submission through system or email to the editors at **asianjebse@gmail.com**. Submitted manuscripts should be the original works of the author(s). The manuscript must be accompanied by a cover letter containing the article title, the first name and last name of all the authors, a paragraph describing the claimed novelty of the findings versus current knowledge. Submission of a manuscript implies that the submitted work has not been published before (except as part of a thesis or report, or abstract); and is not being considered for publication elsewhere. When a manuscript written by a group, all authors should read and approve the final version of the submitted manuscript and its revision; and agree the submission of manuscripts for this journal. All authors should have made substantial contributions to the concept and design of the research, acquisition of the data and its analysis; drafting of the manuscript and correcting of the revision. All authors must be responsible for the quality, accuracy, and ethics of the work.

Acceptance The only articles written in English (U.S. English) are accepted for publication. Manuscripts will be reviewed by editors and invited reviewers (double blind review) according to their disciplines. Authors will generally be notified of acceptance, rejection, or need for revision within 1 to 2 months of receipt. The manuscript is rejected if the content does not in line with the journal scope, does not meet the standard quality, inappropriate format, complicated grammar, dishonesty (i.e. plagiarism, duplicate publications, fabrication of data, citations manipulation, etc.), or ignoring correspondence in three months. The primary criteria for publication are scientific quality and biodiversity significance. **Uncorrected proofs** will be sent to the corresponding author as *.doc* or *.rtf* files for checking and correcting of typographical errors. To avoid delay in publication, corrected proofs should be returned in 7 days. The accepted papers will be published online in a chronological order at any time, but printed in May and November.

Ethics Author(s) must obedient to the law and/or ethics in treating the object of research and pay attention to the legality of material sources and intellectual property rights.

Copyright If and when the manuscript is accepted for publication, the author(s) still hold the copyright and retain publishing rights without restrictions. Authors or others are allowed to multiply article as long as not for commercial purposes. For the new invention, authors are suggested to manage its patent before published.

Open access The journal is committed to free-open access that does not charge readers or their institutions for access. Readers are entitled to read, download, copy, distribute, print, search, or link to the full texts of articles, as long as not for commercial purposes. The license type is CC-BY-NC-SA.

A charge The journal is committed to free of charge for submission and publication of non-institutional funded research (waiver).

Reprints The sample journal reprint is only available by special request. Additional copies may be purchased when ordering by sending back the uncorrected proofs by email.

Manuscript preparation Manuscript is typed on A4 (210x297 mm^2) paper size, **in a single column**, single space, 10-point (10 pt) Times New Roman font. The margin text is 3 cm from the top, 2 cm from the bottom, and 1.8 cm from the left and right. Smaller lettering size can be applied in presenting table and figure (9 pt). Word processing program or additional software can be used, however, it must be PC compatible and Microsoft Word based (*.doc* or *.rtf*; **not *.docx***). **Scientific names** of species (incl. subspecies, variety, etc.) should be written in italic, except for italic sentence. Scientific name (genera, species, author), and cultivar or strain should be mentioned completely for the first time mentioning it in the body text, especially for taxonomic manuscripts. Name of genera can be shortened after first mentioning, except generating confusion. Name of the author can be eliminated after first mentioning. For example, *Rhizopus oryzae* L. UICC 524, hereinafter can be written as *R. oryzae* UICC 524. Using trivial name should be avoided, otherwise generating confusion. **Biochemical and chemical nomenclature** should follow the order of the IUPAC - IUB. For DNA sequence, it is better used Courier New font. Symbols of standard chemical and abbreviation of chemistry name can be applied for common and clear used, for example, completely written butilic hydroxyl toluene (BHT) to be BHT herein after. **Metric measurement** use IS denomination, usage other system should follow the value of equivalent with the denomination of IS first mentioning. Abbreviations set of, like g, mg, mL, etc. do not follow by dot. Minus index (m^{-2}, L^{-1}, h^{-1}) suggested to be used, except in things like "per-plant" or "per-plot". **Equation of mathematics** does not always can be written down in one column with text, in that case can be written separately. **Number** one to ten are expressed with words, except if it relates to measurement, while values above them written in number, except in early sentence. The fraction should be expressed in decimal. In the text, it should be used "%" rather than "percent". Avoid expressing ideas with complicated sentence and verbiage, and used efficient and effective sentence.

Title of the article should be written in compact, clear, and informative sentence, preferably not more than 20 words. Name of author(s) should be completely written. **Name and institution** address should also be completely written with street name and number (location), postal code, telephone number (O), facsimile number (O), and personal email address. For Indonesian universities, use local name. Manuscript written by a group, author for correspondence along with address is required. First page of the manuscript is used for writing above information.

Abstract should not be more than 200 words. **Keywords** is about five words, covering scientific and local name (if any), research theme, and special methods which used; and sorted from A to Z. All important **abbreviations** must be defined at their first mention. **Running title** is about five words. **Introduction** is about 400-600 words, covering the background and aims of the research. **Materials and Methods** should emphasize on the procedures and data analysis. **Results and Discussion** should be written as a series of connecting sentences, however, for manuscript with long discussion should be divided into subtitles. Thorough discussion represents the causal effect mainly explains for why and how the results of the research were taken place, and do not only re-express the mentioned results in the form of sentences. **Concluding** sentence should be given at the end of the discussion. **Acknowledgments** are expressed in a brief; all sources of institutional, private and corporate financial support for the work must be fully acknowledged, and any potential conflicts of interest are noted.

Figures and Tables of maximum of three pages should be clearly presented. Title of a picture is written down below the picture, while title of a table is written above the table. Colored figures can only be accepted if the information in the manuscript can lose without those images; chart is preferred to use black and white images. Author could consign any picture or photo for the front cover, although it does not print in the manuscript. All images property of others should be mentioned source. **There is no appendix**, all data or data analysis are incorporated into Results and Discussions. For broad data, it can be displayed on the website as a supplement.

References Author-year citations are required. In the text give the authors name followed by the year of publication and arrange from oldest to newest and from A to Z. In citing an article written by two authors, both of them should be mentioned, however, for three and more authors only the first author is mentioned followed by et al., for example: Saharjo and Nurhayati (2006) or (Boonkerd 2003a, b, c; Sugiyarto 2004; El-Bana and Nijs 2005; Balagadde et al. 2008; Webb et al. 2008). Extent citation as shown with word "*cit*" should be avoided. Reference to unpublished data and personal communication should not appear in the list but should be cited in the text only (e.g., Rifai MA 2007, pers. com. (personal communication); Setyawan AD 2007, unpublished data). In the reference list, the references should be listed in an alphabetical order (better, if only 20 for research papers). Names of journals should be abbreviated. Always use the standard abbreviation of a journal's name according to the **ISSN List of Title Word Abbreviations** (www.issn.org/2-22661-LTWA-online.php). The following examples are for guidance.

Journal:

Saharjo BH, Nurhayati AD. 2006. Domination and composition structure change at hemic peat natural regeneration following burning; a case study in Pelalawan, Riau Province. Biodiversitas 7: 154-158.

Book:

Rai MK, Carpinella C. 2006. Naturally Occurring Bioactive Compounds. Elsevier, Amsterdam.

Chapter in book:

Webb CO, Cannon CH, Davies SJ. 2008. Ecological organization, biogeography, and the phylogenetic structure of rainforest tree communities. In: Carson W, Schnitzer S (eds) Tropical Forest Community Ecology. Wiley-Blackwell, New York.

Abstract:

Assaeed AM. 2007. Seed production and dispersal of *Rhazya stricta***.** 50th Annual Symposium of the International Association for Vegetation Science, Swansea, UK, 23-27 July 2007.

Proceeding:

Alikodra HS. 2000. Biodiversity for development of local autonomous government. In: Setyawan AD, Sutarno (eds.) Toward Mount Lawu National Park; Proceeding of National Seminary and Workshop on Biodiversity Conservation to Protect and Save Germplasm in Java Island. Universitas Sebelas Maret, Surakarta, 17-20 July 2000. [Indonesian]

Thesis, Dissertation:

Sugiyarto. 2004. Soil Macro-invertebrates Diversity and Inter-Cropping Plants Productivity in Agroforestry System based on Sengon. [Dissertation]. Universitas Brawijaya, Malang. [Indonesian]

Information from internet:

Balagadde FK, Song H, Ozaki J, Collins CH, Barnet M, Arnold FH, Quake SR, You L. 2008. A synthetic *Escherichia coli* predator-prey ecosystem. Mol Syst Biol 4: 187. www.molecularsystemsbiology.com. DOI:10.1038/msb.2008.24

THIS PAGE INTENTIONALLY LEFT BLANK

ASIAN JOURNAL OF ETHNOBIOLOGY
Volume 3, Number 1, May 2020 E-ISSN: 2580-4537
Pages: 1-9 DOI: 10.13057/asianjethnobiol/y030101

Perceptions, attitudes, and outcomes of human-snake encounters: A retrospective study of an online discussion community in Nigeria

OMOTOLA J. BABALOLA[1,4], HENRY O. JEGEDE[2,♥], BAMIDELE N. OGUNRO[3]
[1]Faculty of Veterinary Medicine, University of Ibadan. Main Rd., Ibadan, Oyo State, Nigeria
[2]Veterinary Teaching Hospital, University of Ilorin. P.M.B. 1515, Ilorin, Kwara State, Nigeria. Tel. +234-8038070602, ♥email: drlanrejeg@gmail.com
[3]Veterinary Teaching Hospital, University of Ibadan. Main Rd., Ibadan, Oyo State, Nigeria
[4]Winthrop Veterinary Services. Osogbo, Osun State, Nigeria

Manuscript received: 11 April 2020. Revision accepted: 21 April 2020.

Abstract. *Babalola OJ, Jegede HO, Ogundro BN. 2020. Perceptions, attitudes, and outcomes of human-snake encounters: A retrospective study of an online discussion community in Nigeria. Asian J Ethnobiol 3: 1-9.* The internet is a valuable tool for obtaining data needed to study factors that hinder snake conservation, especially in resource-limited settings. There is a lack of peer-reviewed research on the use of online communities to examine factors contributing to undesirable human-snake conflicts in Nigeria. A 12-month dataset (August 2016-July 2017) on human-snake encounters shared on Nairaland®- a popular online community forum in Nigeria - was retrieved and analyzed. Morphological characteristics observed in the snake photographs posted on the platform were used for species identification. A total of 203 human-snake encounters were recorded from 32/37 States of Nigeria. Men (*n*=133) reported more human-snake encounters than women (*n* =11), while 'reporters' of unspecified gender (*n* =59) accounted for the rest. Most postings were from the southern part of Nigeria, with the highest number of postings from Lagos State (*n* =34). Of the 24 snake species reported in the study, the African Rock Python was the most encountered. The months of May to July recorded the highest number of snake species reported by the respondents. 'Fear' and 'food' were the significant perceptions elicited by people during snake encounters. Human-snake conflicts resulted in snake deaths (*n* =182) irrespective of snake venomosity. Only 1.0% (n=2) of the snakes were protected from harm. This study revealed that data from online community forums are helpful for retrospective analyses of the perceptions and outcomes of human-snake encounters, the output of which policymakers and conservationists may find helpful.

Keywords: Conservation, human-wildlife interface, nairaland, snakes, social media

INTRODUCTION

Wildlife populations and their habitats are declining at an alarming rate due to increasing human populations, climate change, and rapid urbanization (Kinnaird et al. 2003; Root et al. 2003; Carrete et al. 2007; Gusset et al. 2009). Although human conservation efforts and awareness have helped mitigate their decline, attitudes towards wildlife vary across different species and countries. Reptiles and amphibians are some of the taxa of the least researched, under-reported, and poorly documented worldwide (Shine and Bonnet 2000; Magle et al. 2012). Among reptiles, snakes are prime examples of wildlife that have been negatively affected by environmental degradation and increased urbanization (Seigel and Mullin 2009; Bonnet et al. 2016). The animals and their by-products are helpful in medicine, religion, fashion, and the pet trade. Snakes provide ecosystem services in the form of predation (Alves and Filho 2007; Beaupre and Douglas 2009: 245; Herrel and van der Meijden 2014; Willson and Winne 2016).

Despite their importance, some species of snakes are under threat. A total of 185 snake species are listed in the IUCN red list of threatened species (IUCN 2013). This might result from various reasons - killed for food, out of fear, or for use in traditional medicine (Conant and Collins 1998; Soewu 2008; Pandey et al. 2016; IUCN 2018). Conservation efforts have shown varying impacts across species and countries. These varied conservational impacts can be due to the perceived socio-political construction and power determining how allocations benefited the endangered species (Czech et al. 1998; Shine and Bonnet 2000; Marešová and Frynta 2008; Magle et al. 2012; de Pinho et al. 2014). Unlike other vertebrates, the conservation towards snakes is poor due to their negative perception of humans. Their unappealing skin coloration and the innate, protective, evolutionary adaptation of the human brain - which influences the basic human emotions, are some of the factors that contribute to the negative perception of snakes by man (Prokop and Fancovicova 2013; Prokop and Randler 2017; Prokop et al. 2018). There is poor awareness of snakes' conservation status, especially in developing countries, due to preliminary survey research (Pandey et al., 2016).

Local and international laws have been enacted to protect wildlife. However, these laws are not all-encompassing in protecting snakes in their natural environments (Czech et al. 1998; Trouwborst et al. 2017). Cultural beliefs, especially myths and poor knowledge of the laws and snake classification based on venomously, are factors that hamper the protection of snake populations in the wild (Prokop et al., 2009; Ballouard et al. 2013). Fortunately, efforts have been made to create awareness of these animals via the use of documentaries, field trips,

zoos, and wildlife parks (Morgan and Gramann 1989; Ballouard et al. 2012; Idowu and Morenikeji 2015; Pandey et al. 2016). However, zoos and wildlife parks conserve only a tiny population of snakes (Conway 2011). In developing countries, snake and human habitat are not usually delineated due to increasing urbanization, migration of people, and hunting practices (Bitanyi et al., 2012).

Recent advances in information technology are essential in conservation by providing easier access to information which can aid better decision making. The internet is beneficial in understanding factors hindering snake conservation. It can also enhance understanding of people's socio-cultural background and motivation without undue interference by researchers (Gunther and Jeremy 2002; Arts et al. 2015). Social media, especially online communities, have been used in creating awareness of the reintroduction of fish and amphibians (Jachowski et al., 2016). However, there is a lack of peer-reviewed research involving online communities in understanding the perceptions, attitudes, and outcomes of snake-human interactions, especially in developing countries like Nigeria. This study hypothesizes that social media - online communities - can be used as a medium to explore the perceptions, attitudes, and outcomes of human-snake encounters in Nigeria. In addition, we hypothesized that human-snake encounters as posted on popular online forums reflect the actual nature and relative proportions of such encounters in the respective locations from which the posts were made. This study aims to evaluate the engagement of an online discussion community in snake conservation and management in Nigeria. In this paper, our objectives include: assessing the species and the conservation statuses of snakes posted on an online discussion community website in Nigeria, evaluating the geographical and monthly distribution of snakes reported in an online discussion community website in Nigeria, determining the perceptions, attitudes, and outcomes of human-snake encounters as reported in an online discussion community website in Nigeria, as well as evaluating the sex characteristics and location of respondents that reported the human-snake encounters online on a discussion community website in Nigeria.

MATERIALS AND METHODS

Study site

Nairaland® was the primary website used for this study. It is a highly rated website in Nigeria, with more than one million registered members engaged in various topics (Osewa 2018; Alexa 2018). Google™ was also used to trawl data linked to the website. The data analyzed for this study were not password-protected or prohibited by the site's policy. Also, the website members were anonymous (Eysenbach and Till 2001; Walther 2002; Gunther and Jeremy 2002; Herron et al. 2011; Harriman and Patel 2014).

Search terms

The search terms used ensured that the search was sensitive to capture all important details. The search terms used included: (i) Nairaland®: “snake(s)”; “snakes+2016”, “snakes AND 2016. (ii) Google™: “nairaland AND snake AND 2016”, snakes AND nairaland AND 2017.

The search was conducted retrospectively, spanning from August 2016 to July 2017. July 2017 was chosen as the end date of the study to coincide with the world snake day on 16 July, an occasion that highlights the need for snake conservation (Days of the week 2019). All the sections, images, and topics on Nairaland® were selected for review and analysis via the search filters.

Inclusion and exclusion criteria

We selected data based on the following inclusion criteria: snakes in Nigeria, pictures of the snakes being killed, snakes reportedly killed by Nigerians, the topics are written in English while the exclusion criteria include documentaries on snakes, snakes reported outside the country, no pictures of snakes, other sites not primarily Nairaland®, double entries by different profiles or same profile and snakes in established snake markets. Some data were classified as unknown/ unspecified/ uncertain if the respondents did not include their gender on the site or the snakes could not be identified using standard procedures by the authors.

Snakes displayed for sale in established markets were omitted because they could introduce sampling bias. Also, the location of the markets would be difficult to prove. The profile's characteristics that met the inclusion criteria were checked, while the other areas of interest were iteratively analyzed to ensure data validity.

Snake species identification and data analysis

We identified snake species based on morphological characteristics and appearance. We verified the conservation statuses of each snake species via relevant scientific literature and databases (Wallach et al. 2014; IUCN 2019; Uetz et al. 2017).

Data were collected and sorted with Microsoft Excel. The final dataset was transferred to SPSS 20 statistical computer software package. Description of the data was by frequency tables and charts. Multivariate logistic regression analysis was used to test if any of the following variables (sex of respondents, venomously of snakes, circumstance of encounter, taxonomic class of snake, and geopolitical zone from which posts were identified) were predictors of outcomes of human-snake encounters. Respondents’ perceptions towards snakes (fear, food, etc.) and snake-human interactions were measured by assessing the overall tone of the post. For example, one of the respondents used to write:

“How this snake crawled into our room, no one can possibly explain. My roommate was lucky. Cos he was trying to open the wardrobe and when he saw the snake he froze like a statue and all he could do was to keep shouting Jesus! …Cos Even me no get mind, we were lucky cos a guy from another room helped us kill it….”

To determine predictors for the outcome of human-snake encounters, States were grouped into the 6 geopolitical zones of Nigeria. "Sold" and "captured" were collapsed into one category "spared"; "uncertain outcome" and "found dead" were excluded from the analysis - making three possible outcomes viz: "killed," "eaten," and "spared." Fisher exact or Chi-square tests were carried out on the data using Epi Info 7.2.0. A *P*-value less than 0.05 was considered statistically significant.

RESULTS AND DISCUSSION

Sex characteristics of the respondents that reported snake encounters on Nairaland®

The final sample consisted of 203 respondents. There were 133 men (65.5%), 11 women (5.4%), and 59 respondents with unspecified gender (29.1%) that reported the human-snake encounters online.

Number of snakes and snake posts reported on Nairaland® per state

A total of 203 snakes were reported in 202 separate encounters that encompassed almost all the states in Nigeria (*n* =31). Of the total snakes reported, 16.7 % were from Lagos State (*n* =34) (Fig. 1).

The family Pythonidae accounted for 36.5 % of the snakes encountered (n=74) while 12.3% (n=25) were in Colubridae, 20.2% (n=41) in Elapidae, 19.7% (n=40) in Lamprophiidae, 9.9% (n=20) in Viperidae, and 1.5% (n=3) uncertain (Fig. 2). The non-venomous snakes (*n* =136) accounted for 67.0% of the snakes encountered, while 31.5% of the snakes were venomous (*n* =64), and 1.5% of the snakes could not be categorized (*n* =3). The conservation status of the African Rock Python was 'near threatened' while the other snake species were of the 'least concern' status (Table 1). The months of May (*n* =35), June (*n* =38), and July (*n* =27) recorded the highest number of snake encounters reported by Nairaland® users (Fig. 3).

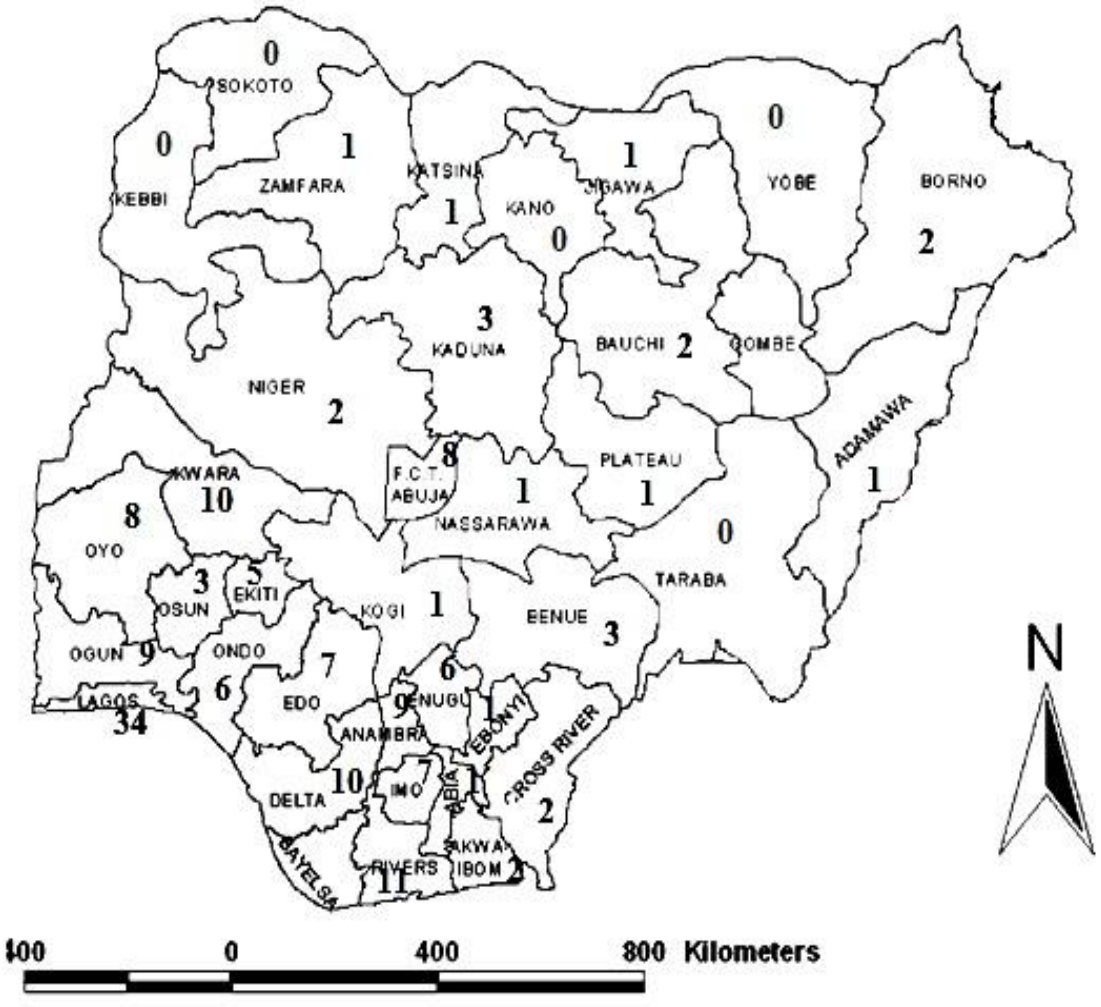


Figure 1. Map of Nigeria showing the distribution of snake classes by state encountered and posted on Nairaland® between August 2016-July 2017.

Table 1. Identity, frequency, and conservation status of snakes encountered and posted on Nairaland® between August 2016-July 2017 in order of frequency.

Common name	Scientific name	Number of snakes (%)	Conservation status
African Rock Python	*Python sebae* (Gmelin, 1789)	55(27.1)	Near threatened
House snakes	*Boaedon spp.* (Boulenger, 1893)	27(13.3)	Least Concern
Black-necked spitting cobra	*Naja nigricollis* (Reinhardt, 1843)	21(10.3)	Least Concern
Royal python	*Python regius* (Shaw, 1802)	19(9.4)	Least Concern
Bush snakes	*Philothamnus* spp. (Smith, 1840)	12(5.9)	Least Concern
Forest cobra	*Naja melanoleuca* (Hallowell, 1857)	12(5.9)	Least Concern
Gaboon viper	*Bitis gabonica* (Duméril, Bibron and Duméril, 1854)	8(3.9)	Least Concern
Puff adder	*Bitis arietans* (Merrem, 1820)	7(3.4)	Least Concern
Olive Grass Racer	*Psammophis phillipsii* (Hallowell, 1844)	7(3.4)	Least Concern
African Garter Snake	*Elapsoidea semiannulata moebiusi* (Broadley, 1971)	6(3.0)	Least Concern
Common egg eater	*Dasypeltis scabra* (Linnaeus, 1758)	4(2.0)	Least Concern
African night adder	*Causus rhombeatus* (Lichtenstein, 1823)	3(1.5)	Least Concern
Striped Sand Snake	*Psammophis sibilans* (Linnaeus, 1758)	3(1.5)	-
Uncertain	Uncertain	3(1.5)	-
Katian Spitting cobra	*Naja katiensis* (Angel, 1922)	2(1.0)	Least Concern
Elegant sand racer	*Psammophis elegans* (Shaw, 1802)	2(1.0)	Least Concern
Smith's African Water Snake	*Grayia smithii* (Leach, 1818)	2(1.0)	Least Concern
Forest file snake	*Mehelya poensis* (Smith, 1849)	2(1)	Least Concern
Blandings tree snake	*Toxicodryas blandingii* (Hallowell, 1844*)*	2(1.0)	-
West African Herald Snake	*Crotaphopeltis hippocrepis* (Reinhardt, 1843)	1(0.5)	Least Concern
West African Night Adder	*Causus maculatus* (Hallowell, 1842)	1(0.5)	Least Concern
Rufous Beaked Snake	*Rhamphiophis oxyrhynchus* (Reinhardt, 1843)	1(0.5)	Least Concern
West African carpet Viper	*Echis ocellatus* (Stemmler, 1970)	1(0.5)	Least Concern
Striped swamp snake	*Dromophis praeornatus* (Peters, 1869)	1(0.5)	Least Concern
Slender blind snake	*Myriopholis narirostris* (Peters, 1867*)*	1(0.5)	Least Concern
	Total	203(100.0)	

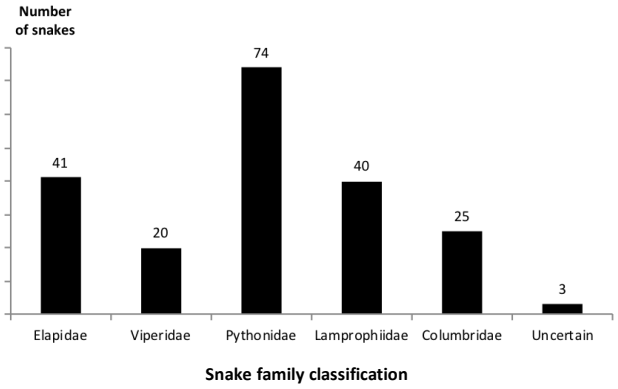


Figure 2. Family classification of snakes posted on Nairaland® between August 2016-July 2017

Places, perceptions, and outcomes of human-snake encounters

Most online posts reported an increased frequency of human-snake encounters at residential areas (*n* =118) while farms/forests (*n* =34), public places (*n* =19), and uncertain locations (*n* =32) accounted for the rest (Fig. 4). Snake encounters with humans elicited fear (*n* = 112) in 55.2% of the online posts, while 22.1% of the snakes (*n* = 45) encountered were killed for food. Conservation (*n* = 2) and display (*n* = 3) accounted for 1.0% and 1.5% of the reports respectively. There were 41 reports (20.2%) classified as unknown because the perceptions of snake encounters with humans could not be deduced from the posts (Fig. 5). Display in this context refers to the use of these snakes to attract pedestrians by snake charmers.

Human-snake encounters killed the snakes encountered by humans (*n* =156) while man ate 26 snakes. Other outcomes included being captured (*n* =8), uncertain (*n* =8), sold (*n* =1), found dead (*n* =3), and snake being left alone (*n* =1). Fisher's exact test showed no significant association between danger posed by snake regardless of venomously and outcome of the snake-human encounter (OR=0.73, CI=0.33-1.62, *P*=0.56). Venomous snakes were not more likely to be feared than non-venomous ones.

Multivariate logistic regression analysis revealed that none of the variables (sex of respondents, venomously, a circumstance of encounter, taxonomic class, and geopolitical zones from which the posts were identified) included in the model were predictors for the outcome human-snake encounters at 90% or 95% confidence intervals.

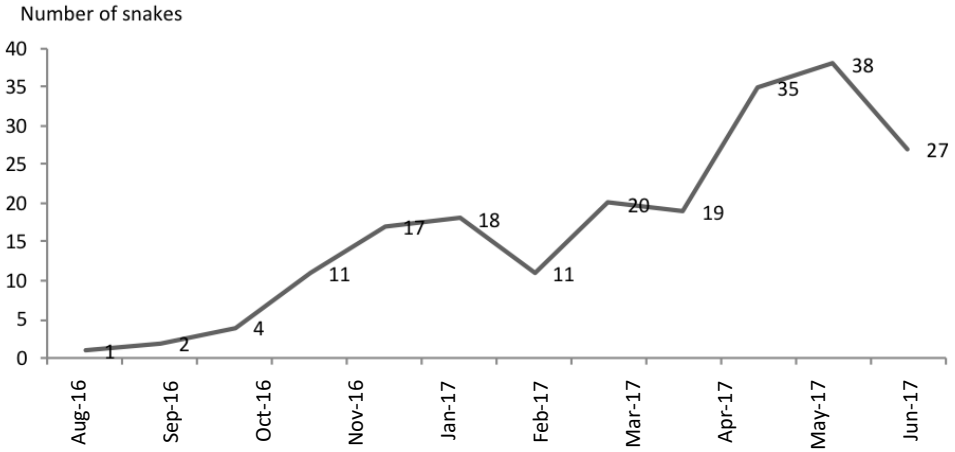


Figure 3. Monthly distributions of different individual snakes encountered as posted on Nairaland® between August 2016-July 2017

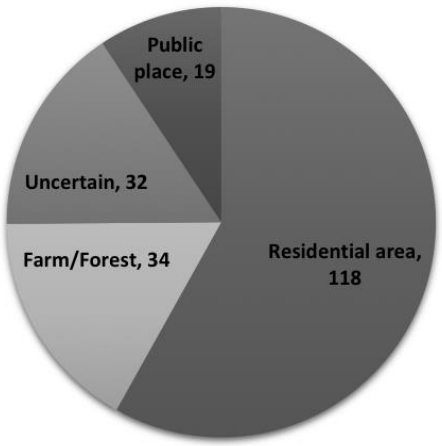


Figure 4. Site of human-snake encounters as posted on Nairaland® between August 2016-July 2017

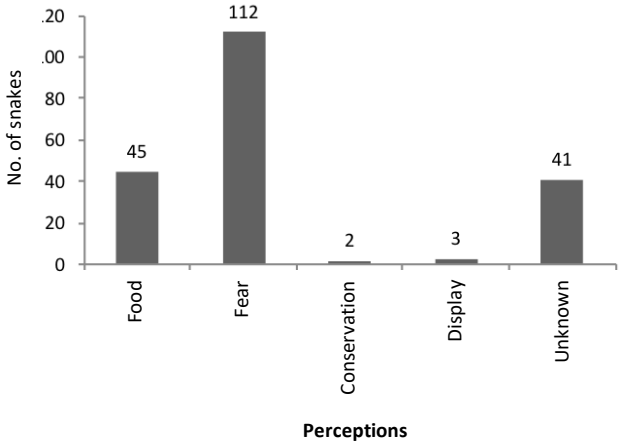


Figure 5. Perceptions towards snakes as posted on Nairaland® between August 2016-July 2017

Discussion

Conservation of animals in their natural habitat is an urgent issue that requires numerous interventions. The advent of new information technologies such as the internet serves as another opportunity to harness its advantages towards animal conservation. Some authors advocate the internet as a new interface in wildlife management, ecotourism, and collaboration among numerous stakeholders engaged in conservation (Prendergast et al. 1999; Yasuda and Kawakami 2002; Huettmann 2005; Lai and Shafer 2005; Gusset and Dick 2010). It has also been used to understand different perspectives and funding of animal conservation (Rastogi et al., 2013; Verissimo et al., 2017). Therefore, the internet provides a new avenue where the perceptions and attitudes of people toward conservation can be studied.

Snakes are good examples of poorly documented and understudied wildlife and benefit poorly from allocated resources that will aid their conservation in the wild. Numerous studies have been conducted to unravel the perceptions towards human-wildlife conflict (Treves and Karanth 2003; Lucherini and Merino 2008; Inskip and Zimmermann 2009). A study by Miranda et al. (2016) used internet videos to examine the ecology of the human-anaconda conflict. Their findings revealed another dimension of human-wildlife conflicts - anacondas were anticipatorily killed because humans negatively perceived them to be dangerous. Apart from this study, there is a scarcity of information on the internet to investigate the conflict of humans towards snakes, especially in developing countries like Nigeria. The choice of Nairaland® as the website for this study was the ease of access as a public forum in Nigeria. Nairaland® has been used to understand Nigerian pidgin's linguistic evolution in the digital world and public perceptions about some significant issues in Nigeria (Heyd and Mair 2014; Chiluwa and Odebunmi 2016). Therefore, this study used Nairaland® as a platform to understand the perceptions, attitudes, and outcomes of human-snake encounters.

Almost all the States in Nigeria were represented in the study via the snake posts uploaded online. This indicates that Nairaland® is a widely accessible forum in Nigeria. This agrees with Chiluwa and Odebunmi (2016)'s study, which revealed that the site serves as a meeting place for people in Nigeria. Therefore, Nairaland® can be a platform for delivering educational interventions on conservations to its users.

We found out that the snakes encountered in this study were reported from almost all parts of Nigeria. This indicates that the geographical distribution of snakes was all over Nigeria (Luiselli 2001; Molesworth et al. 2003; Akani et al. 2013). Therefore, comprehensive conservational interventions need to be carried out all over the country to protect snakes in their natural habitats. The online community website, Nairaland®, could serve as a valuable data source for mapping tools such as HerpMapper and iNaturalist, which could potentially benefit the conservation of snakes by providing new and readily accessible information on the distribution of different snake species in Nigeria.

Twenty-four snakes out of 125 species (19.2%) found in Nigeria were reported in our study (Uetz et al., 2017). The snake species encountered in this study were classified into the Colubridae, Elapidae, Viperidae, Pythonidae, and Lamprophiidae families. Some of these families were also encountered in the study by Akani et al. (2013). The distribution pattern indicates that the families are ubiquitous and represent various snake species in Nigeria.

The months of May to July recorded the highest distribution of snakes reported on Nairaland®. This distribution pattern agrees with the findings of Akani et al. (2013) and Sani et al. (2013), who reported that April to July were the months that witnessed high snake and human activities. The high incidence of human-snake encounters in these months might result from heavy rains in the rainy season that flood the habitats of these snakes, which drives them to seek shelter in warmer human residences. It could also be because the number of people accessing and posting to Nairaland peaks in May-July.

The African Rock Python, *Python sebae*, was the snake species encountered most in the study. It was killed mainly as a result of its intrinsic value as bushmeat. This agrees with the research findings of Mallon et al. (2015), which showed that pythons were widely hunted for consumption, traditional, and commercial purposes. This implies that bush meat and free international wildlife trade significant barriers to conservation in developing countries.

The conservation statuses of the snake species reported in the study varied from" least concerned" to "near threatened" according to the IUCN classification. However, the study of Reading et al. (2010) indicated that some of the snake species encountered in our research - the Gaboon Viper, *Bitis gabonica*, and the Royal Python, *Python regius* - have been undergoing some population decline in Nigeria. This shows that our knowledge of the conservation status of snake species is doubtful. Even though the IUCN lists only one species as near threatened, there could be a high chance other snake species are also of conservation concern. Most snake species are listed as 'Data Deficient' by the IUCN, and many species are not listed at all (IUCN 2019). Therefore, further studies should be conducted to ascertain the accurate population statuses of each snake species in the wild to designate and enact the correct conservation status and laws, respectively, thereby protecting the snake species.

In our present study, females reported fewer human-snake encounters online. Recent studies showed that females were less tolerant of snakes than males (Pinheiro et al. 2016; Liordos et al. 2017, 2018). This might be due to the complex biological and evolutionary roles that natural selection play in ensuring that females with lower bodily conditions have increased self-protection systems - which is manifested as fear - to combat potential physical dangers (Røskaft et al. 2003; Prokop and Fančovičová, 2010, 2013). Conversely, males reported a higher number of human-snake encounters online. Men's perception could explain that displaying dead snakes online will be viable means of showing off and boosting their masculine egos and online profiles to increase their physical attractiveness to the female members of the online discussion community. Escasa et al. (2010)'s study of male attractiveness rankings in a small-scale Amazonian society showed that females were attracted to male traits such as status, gallantry, and hunting ability. However, the finding of this study cannot be generalized to other study settings, especially in a complex and ever-changing world.

Our study also revealed that the most frequent site of human-snake encounters was in residential areas. This agrees with Purkayastha et al.'s (2011) finding that some snake species such as *Lycodon aulicus* were found in residential areas. Apart from residential areas, our study also revealed that farms, forests, and public places were the other locations of high human-snake encounters. The studies of Whitaker and Shine (1999) and Carter et al. (2014) revealed that agricultural lands and recreational parks increased the chances of human encounters with the Australian brown snakes, *Pseudonaja textilis*, and copperhead snakes. Increased destruction and degradation of the snake's natural habitats, increased human population growth, and rapid urbanization is some of the reasons that could explain the above-described findings.

We found out that the perceptions of humans to snakes elicited fear regardless of their venomous nature. This agrees with the works of Alves et al. (2014) and Pandey et al. (2016), who found that fear was a natural cause that hindered snake conservation. This might result from poor awareness in distinguishing venomous and non-venomous snakes. However, Corbett et al. (2005) found that most people can correctly identify local venomous snakes. The sampling of interested people at a local snake street fair imparted sampling bias that might have restricted the generalization of the study findings to the entire population. Also, our study showed that venomous snakes were not more likely to be feared than non-venomous snakes. Local folklore and reported harms - mortalities may accentuate the negative perception of snakes. However, some traditional beliefs might positively protect some snake species from harm. A study by Rim-Rukeh et al. (2013) revealed that the reverence of pythons in some areas

of Delta State, Nigeria boosted their local populations within those communities. Similarly, Sasaki et al. (2010) recommended the preservation of the vanishing Japanese traditional beliefs - the adoration of snakes as gods - very critical to the conservation of snakes in Japan. Nevertheless, most snakes encountered in this study were killed out of fear and food. Therefore, indiscriminate killing of snakes without proper awareness of their importance might lead to their decline in the world, which might negatively affect the balance of the ecosystem.

It is alarming that only a few snakes were captured alive in our study. Most respondents reported and posted killed snakes to get placement in a more prominent section - front page - of the online discussion community forum; this means that Nigerians' attitudes towards conservation are relatively weak. Therefore, conservationists and other significant stakeholders should make more efforts to raise awareness of the need to conserve wild herpetofauna among the Nigerian people.

A significant limitation of this study is the non-representativeness of the samples. The snakes reported in our study are mainly those found in residential areas or those with dietary value (pythons). Although other snakes were not reported, it does not imply the absence of these snakes in Nigeria. Still, it suggests their absence, low relative abundance, low detection probability in residential areas, or lack of dietary value. For instance, unreported species like *Calabaria* and blind snakes are burrowing forest snakes rarely encountered. At the same time, *Dendroaspis* (Tree Mambas) and *Dispholidus* (Boomslangs) are arboreal dwellers found mostly atop palm trees and very tall trees. Even though some snake species, such as the Mambas and the Boomslangs, are not hard to see, the photographs of these snake species are scarce because they are fast-moving and dangerous. This limits the studying of snakes from data taken from online communities because some important snake species might be excluded. However, because people's perceptions of snakes were examined, the accurate representation of the snake populations in the wild did not influence the study's validity.

Another limitation of the study is that the community studied is an online community. This limits the data to only internet savvy and active members of the Nairaland® forum (as this was the only site checked). The study is also limited to people who own a device capable of taking a photo: a camera, smartphone, or other phones with a camera, and those that have the financial ability to purchase and access the data subscription needed to upload a photo. Although those in rural areas have an increased chance of encountering these snakes, the poor internet coverage and the low socioeconomic statuses of those living in the rural areas of Nigeria might hinder the taking and uploading of pictures of these snakes.

The inclusion criteria used during the methodology aspect were written in English. This biased the results towards Nigerian users of this online discussion community forum with higher levels of education (Hargittai 2007, 2010; Duggan and Brenner 2013). However, because the scope of this study was limited to the internet, this might not affect its validity. Perceptions toward snakes were measured by assessing the overall tone of the posts. This might introduce a measurement bias due to the subjective nature of interpreting the posts. However, the uploaded snake photographs, the locations, and the outcomes of the human-snake encounters assisted in minimizing this bias.

This study was the first to our knowledge to retrospectively use social media to examine the perceptions and outcomes of human-snake encounters in a developing country. Policymakers and conservationists should consider social media, especially online discussion forums, as an avenue to deliver targeted educational interventions. The use of data from social media could aid in changing the perceptions and attitudes of these particular sets of internet-oriented Nigerian populations and educating them on the need to conserve snakes and other wildlife.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the input of Babasola O. Olugasa of the Department of Veterinary Public Health and Preventive Medicine, University of Ibadan, Ibadan, for his information into the GIS design of the map of Nigeria. The contributions of Victor Ladipo of the 21st Century Environmental Consultants Inc, Calgary, in making the manuscript better in terms of grammar and clarity of words were appreciated. We would also like to appreciate the website users where the data used for this paper were obtained.

REFERENCES

Akani GC, Ebere N, Franco D, Eniang EA, Petrozzi F, Politano E, Luiselli L. 2013. Correlation between annual activity patterns of venomous snakes and rural people in the Niger Delta, southern Nigeria. J Venomous Animals and Toxins including. Tropic Dis 19: 2. DOI: 10.1186/1678-9199-19-2.

Alves RR, Silva VN, Trovão DM, Oliveira JV, Mourão JS, Dias TL, Alves AG, Lucena RF, Barboza RR, Montenegro PF, Vieira WL. 2014. Students' attitudes toward and knowledge about snakes in the semiarid region of Northeastern Brazil. J Ethnobiol and Ethnomedicine 10: 30. DOI: 10.1186/1746-4269-10-30.

Alves RRN, Filho GAP. 2007. Commercialization and use of snakes in North and Northeastern Brazil: implications for conservation and management. Biodiv Conserv 16: 969-985. DOI: 10.1007/978-1-4020-6320-6_9.

Arts K, Van Der Wal R, Adams WM. 2015. Digital technology and the conservation of nature. Ambio 44: 661-673. DOI: 10.1007/s13280-015-0705-1.

Ballouard JM, Ajtic R, Balint H, Brito JC, Crnobrnja-Isailovic J, Desmonts D, Elmouden EH, Erdogan M, Feriche M, Pleguezuelos JM, Prokop P. 2013. Schoolchildren and one of the most unpopular animals: are they ready to protect snakes?. Anthrozoös 26: 93-109. DOI: 10.2752/175303713X13534238631560.

Ballouard JM, Provost G, Barré D, Bonnet X. 2012. Influence of a field trip on the attitude of schoolchildren toward unpopular organisms: an experience with snakes. J Herpetol 46: 423-428. DOI: 10.1670/11-118.

Beaupre SJ, Douglas LE. 2009. Snakes as indicators and monitors of ecosystem properties. In: Seigel RA, Mullin SJ (eds). Snakes, Ecology, and Conservation. Cornell University Press, Ithaca, New York, USA.

Bitanyi S, Nesje M, Kusiluka LJ, Chenyambuga SW, Kaltenborn BP. 2012. Awareness and perceptions of local people about wildlife

hunting in western Serengeti communities. Trop Conserv Sci 5: 208-224. DOI: 10.1177/194008291200500209.
Bonnet X, Lecq S, Lassay JL, Ballouard JM, Barbraud C, Souchet J, Mullin SJ, Provost G. 2016. Forest management bolsters native snake populations in urban parks. Biol Conserv 193: 1-8. DOI: 10.1016/j.biocon.2015.11.001.
Carrete M, Grande JM, Tella JL, Sánchez-Zapata JA, Donázar JA, Díaz-Delgado R, Romo A. 2007. Habitat, human pressure, and social behaviour: partialling out factors affecting large-scale territory extinction in an endangered vulture. Biol Conserv 136: 143-154. DOI: 10.1016/j.biocon.2006.11.025.
Carter ET, Attum O, Eads BC, Hoffman AS, Kingsbury BA. 2014. Reducing the potential for human-snake encounters in a recreational park. Human-Wildlife Interactions 8: 158-167. DOI: 10.26077/ggt7-vr34.
Chiluwa I, Odebunmi A. 2016. On terrorist attacks in Nigeria: stance and engagement in conversations on Nairaland. Commun Public 1: 91-109. DOI: 10.1177/2057047315624926.
Conant R, Collins JT. 1998. A field guide to reptiles & amphibians: eastern and central North America. Vol. 12. Houghton Mifflin Harcourt. 12: 11-12.
Conway WG. 2011. Buying time for wild animals with zoos. Zoo Biol 30: 1-8. DOI: 10.1002/zoo.20352.
Cooper C, Dickinson J, Phillips T, Bonney R. 2007. Citizen science as a tool for conservation in residential ecosystems. Ecol Soc 12: 11. DOI: 10.5751/ES-02197-120211.
Corbett SW, Anderson B, Nelson B, Bush S, Hayes WK, Cardwell MD. 2005. Most lay people can correctly identify indigenous venomous snakes. The Am J Emergency Med 23: 759-762. DOI: 10.1016/j.ajem.2005.03.008.
Czech B, Krausman PR, Borkhataria R. 1998. Social construction, political power, and the allocation of benefits to endangered species. Conserv Biol 12: 1103-1112. DOI: 10.1046/j.1523-1739.1998.97253.x.
De Pinho JR, Grilo C, Boone RB, Galvin KA, Snodgrass JG. 2014. Influence of aesthetic appreciation of wildlife species on attitudes towards their conservation in Kenyan agropastoralist communities. PloS ONE 9 (2): e88842. DOI: 10.1371/journal.pone.0088842.
Duggan M, Brenner J. 2013. The demographics of social media users, 2012. (Vol.14). Washington, DC: Pew Research Center's Internet & American Life Project.
Escasa M, Gray PB, Patton JQ. 2010. Male traits associated with attractiveness in Conambo, Ecuador. Evolution and Human Behavior 31: 193-200. DOI: DOI: 10.1016/j.evolhumbehav.2009.09.008.
Eysenbach G, Till JE. 2001. Ethical issues in qualitative research on internet communities. British Medical Journal 323: 1103-1105. DOI: 10.1136/bmj.323.7321.1103.
Gunther E, Jeremy W. 2002. Using the Internet for surveys and health research. J Med Internet Res 4 (2): e13. DOI: 10.2196/jmir.4.2.e13.
Gusset M, Dick G. 2010. 'Building a Future for Wildlife'? Evaluating the contribution of the world zoo and aquarium community to in situ conservation. Intl Zoo Yearbook 44: 83-191. DOI: 10.1111/j.1748-1090.2009.00101.x.
Gusset M, Swarner MJ, Mponwane L, Keletile K, Mcnutt JW. 2009. Human-wildlife conflict in northern Botswana: livestock predation by endangered African wild dog *Lycaon pictus* and other carnivores. Oryx 43: 67-72. DOI: 10.1017/S0030605308990475.
Hargittai E. 2007. Whose space? Differences among users and non-users of social network sites. J Computer-mediated Commun 13: 276-297. DOI: 10.1111/j.1083-6101.2007.00396.x.
Hargittai E. 2010. Digital na (t) lives? Variation in internet skills and uses among members of the "net generation." Sociol Inquiry 80: 92-113. DOI: 10.1111/j.1475-682X.2009.00317.x.
Harriman S, Patel J. 2014. The ethics and editorial challenges of internet-based research. BMC Med 12: 124. DOI: 10.1186/PREACCEPT-1753356481135356.
Herrel A, Van Der Meijden A. 2014. An analysis of the live reptile and amphibian trade in the USA compared to the global trade in endangered species. Herpetol J 24: 103-110.
Herron M, Sinclair M, Kernohan WG, Stockdale J. 2011. Ethical issues in undertaking internet research of user-generated content: a review of the literature. Evid Based Midwifery 9: 9-15.
Heyd T, Mair C. 2014. From vernacular to the digital ethnolinguistic repertoire: the case of Nigerian Pidgin. Indexing Authenticity: Sociolinguistic Perspectives. de Gruyter, Berlin.
Huettmann F. 2005. Databases and science-based management in the context of wildlife and habitat: toward a certified ISO standard for objective decision-making for the global community by using the internet. J Wildl Manag 69: 466-472. DOI: 10.2193/0022-541X(2005)069[0466:DASMIT]2.0.CO;2.
Idowu MA, Morenikeji OA. 2015. Wild Fauna Conservation in Nigeria. Environ Nat Resour Res 5 (3): 98-108. DOI: 10.5539/enrr.v5n3p98.
Inskip C, Zimmermann A. 2009. Human-felid conflict: a review of patterns and priorities worldwide. Oryx 43: 18-34. DOI: 10.1017/S003060530899030X.
International Union for the Conservation of Nature (IUCN). 2013. Year of the Snake: an online reference. https://www.iucn.org/content/year-snake.
IUCN [International Union for the Conservation of Nature]. 2018. The IUCN Red List of Threatened Species, 2018. https://www.iucnredlist.org/search?page=2.
IUCN [International Union for the Conservation of Nature]. 2019. The IUCN Red List of Threatened Species, Version 2019-1. https://www.iucnredlist.org/.
Jachowski DS, Millspaugh JJ, Angermeier PL, Slotow R. 2016. Reintroduction of Fish and Wildlife Populations. University of California Press, Berkeley, California, USA. DOI: 10.1525/9780520960381.
Kinnaird MF, Sanderson EW, O'Brien TG, Wibisono HT, Woolmer G. 2003. Deforestation trends in a tropical landscape and implications for endangered large mammals. Conserv Biol 17: 245-257. DOI: 10.1046/j.1523-1739.2003.02040.x.
Lai PH, Shafer S. 2005. Marketing ecotourism through the Internet: an evaluation of selected ecolodges in Latin America and the Caribbean. J Ecotourism 4: 143-160. DOI: 10.1080/JET.v4.i3.pg143.
Liordos V, Kontsiotis VJ, Anastasiadou M, Karavasias E. 2017. Effects of attitudes and demography on public support for endangered species conservation. Sci Total Environ 595: 25-34. DOI: 10.1016/j.scitotenv.2017.03.241.
Liordos V, Kontsiotis VJ, Kokoris S, Pimenidou M. 2018. The two faces of Janus, or the dual-mode of public attitudes towards snakes. Sci Total Environ 621: 670-678. DOI: 10.1016/j.scitotenv.2017.11.311.
Lucherini M, Merino MJ. 2008. Perceptions of human-carnivore conflicts in the high Andes of Argentina. Mt Res Dev 28: 81-85. DOI: 10.1659/mrd.0903.
Luiselli L. 2001. The ghost of a recent invasion in the reduced feeding rates of spitting cobras during the dry season in a rainforest region of tropical Africa? Acta Oecologica 22: 311-314. DOI: 10.1016/S1146-609X(01)01113-4.
Magle SB, Hunt VM, Vernon M, Crooks KR. 2012. Urban wildlife research: past, present, and future. Biol Conserv 155: 23-32. DOI: 10.1016/j.biocon.2012.06.018.
Mallon DP, Hoffmann M, Grainger MJ, Hibert F, Van Vliet N, Mcgowan PJK. 2015. An IUCN situation analysis of terrestrial and freshwater fauna in West and Central Africa. Occasional paper of the IUCN species survival commission, 54, Gland. DOI: 10.2305/IUCN.CH.2015.SSC-OP.54.en.
Marešová J, Frynta D. 2008. Noah's Ark is full of common species attractive to humans: The case of boid snakes in zoos. Ecol Econ 64: 554-558. DOI: 10.1016/j.ecolecon.2007.03.012.
Miranda EB, Ribeiro RP Jr., Strüssmann C. 2016. The ecology of human-anaconda conflict: A study using internet videos. Trop Conserv Sci 9: 43-77. DOI: 10.1177/194008291600900105.
Molesworth AM, Harrison R, David R, Theakston G, Lalloo DG. 2003. Geographic information system mapping of snakebite incidence in northern Ghana and Nigeria using environmental indicators: a preliminary study. Trans R Soc Trop Med Hygiene 97: 188-192. DOI: 10.1016/S0035-9203(03)90115-5.
Morgan JM, Gramann JH. 1989. Predicting the effectiveness of wildlife education programs: A study of students' attitudes and knowledge toward snakes. Wildlife Society Bulletin 17: 501-509.
Pandey DP, Pandey GS, Devkota K, Goode M. 2016. Public perceptions of snakes and snakebite management: implications for conservation and human health in southern Nepal. J Ethnobiol Ethnomed 12 (1): 22. DOI: 10.1186/s13002-016-0092-0.
Pinheiro LT, Rodrigues JFM, Borges-Nojosa DM. 2016. Formal education, previous interaction, and perception influence the attitudes of people toward the conservation of snakes in a large urban center of northeastern Brazil. J Ethnobiol Ethnomed 12 (1): 25. DOI: 10.1186/s13002-016-0096-9.

Prendergast JR, Quinn RM, Lawton JH. 1999. The gaps between theory and practice in selecting nature reserves. Conserv Biol 13: 484-492. DOI: 10.1046/j.1523-1739.1999.97428.x.

Prokop P, and Randler C. 2018. Biological predispositions and individual differences in human attitudes toward animals. 447-466 In: Alves RRN, Albuquerque UP. (eds). Ethnozoology: Animals in Our Lives, 1st ed. Academic Press, Cambridge, MA. DOI: 10.1016/B978-0-12-809913-1.00023-5.

Prokop P, Fančovičová J, Kučerová A. 2018. Aposematic colouration does not explain fear of snakes in humans. J Ethol 36: 35-41. DOI: 10.1007/s10164-017-0533-9.

Prokop P, Fančovičová J. 2010. Perceived body condition is associated with fear of a large carnivore predator in humans. Annales Zoologici Fennici 47: 417-425. DOI: 10.5735/086.047.0606.

Prokop P, Fančovičová J. 2013. Does color matter? The influence of animal warning coloration on human emotions and willingness to protect them. Anim Conserv 16: 458-466. DOI: 10.1111/acv.12014.

Prokop P, Özel M, Uşak M. 2009. Cross-cultural comparison of student attitudes toward snakes. Soc Anim 17: 224-240. DOI: 10.1163/156853009X445398.

Purkayastha J, Das M, Sengupta S. 2011. Urban herpetofauna: a case study in Guwahati City of Assam, India. Herpetol Notes 4: 195-202.

Pyron RA, Burbrink FT, Wiens JJ. 2013. A phylogeny and revised classification of Squamata, including 4161 species of lizards and snakes. BMC Evol Biol 13: 93. DOI: 10.1186/1471-2148-13-93.

Pyron RA, Burbrink FT. 2012. Extinction, ecological opportunity, and the origins of global snake diversity. Evolution 66: 163-178. DOI: 10.1111/j.1558-5646.2011.01437.x.

Rastogi A, Hickey GM, Badola R, Hussain SA. 2013. Diverging viewpoints on tiger conservation: A Q-method study and survey of conservation professionals in India. Biol Conserv 161: 182-192. DOI: 10.1016/j.biocon.2013.03.013.

Reading CJ, Luiselli LM, Akani GC, Bonnet X, Amori G, Ballouard JM, Filippi E, Naulleau G, Pearson D, Rugiero L. 2010. Are snake populations in widespread decline? Biol Lett 6: 777-780. DOI: 10.1098/rsbl.2010.0373.

Rim-Rukeh A, Irerhievwie G, Agbozu IE. 2013. Traditional beliefs and conservation of natural resources: Evidence from selected communities in Delta State, Nigeria. Intl J Biodiv Conserv 5: 426-432.

Root TL, Price JT, Hall KR, Schneider SH, Rosenzweig C, Pounds JA. 2003. Fingerprints of global warming on wild animals and plants. Nature 421: 57. DOI: 10.1038/nature01333.

Røskaft E, Bjerke T, Kaltenborn BP, Linnell JDC, Andersen R. 2003. Patterns of self-reported fear towards large carnivores among the Norwegian public. Evol Human Behav 24: 184-198. DOI: 10.1016/S1090-5138(03)00011-4.

Sani UM, Jiya NM, Ibitoye PK, Ahmad MM. 2013. Presentation and outcome of snakebite among children in Sokoto, North-Western Nigeria. Sahel Med J 16: 148. DOI: 10.4103/1118-8561.125557.

Sasaki K, Sasaki Y, Fox S. 2010. Endangered traditional beliefs in Japan: influences on snake conservation. Herpetol Conserv Biol 5: 474-485

Seigel RA, Mullin SJ. 2009. Snake conservation, present, and future. Pp 281-290 In: Seigel RA, Mullin SJ (eds). Snakes, Ecology, and Conservation. Cornell University Press, Ithaca, New York, USA. DOI: 10.7591/9780801459092-015.

Shine R, Bonnet X. 2000. Snakes: a new 'model organism' in ecological research?. Trends Ecol Evol 15: 221-222. DOI: 10.1016/S0169-5347(00)01853-X.

Snyder, NF, Derrickson SR, Beissinger SR, Wiley JW, Smith TB, Toone WD, Miller B. 1996. Limitations of captive breeding in endangered species recovery. Conserv Biol 10: 338-348. DOI: 10.1046/j.1523-1739.1996.10020338.x.

Soewu DA. 2008. Wild animals in ethnozoological practices among the Yorubas of southwestern Nigeria and the implications for biodiversity conservation. Afr J Agric Res 3: 421-427.

Treves A., and K.U. Karanth. 2003. Human-carnivore conflict and perspectives on carnivore management worldwide. Conserv Biol 17: 1491-1499. DOI: 10.1111/j.1523-1739.2003.00059.x.

Trouwborst A, Blackmore A, Boitani L, Bowman M, Caddell R, Chapron G, Cliquet A, Couzens E, Epstein Y, Fernández-Galiano E, Fleurke FM. 2017. International wildlife law: understanding and enhancing its role in conservation. BioScience 67: 784-790. DOI: 10.1093/biosci/bix086.

Uetz P, Hallermann J, Hosek J. 2017. The Reptile Database, 2017. http://www.reptile-database.org/.

Veríssimo D, Vaughan G, Ridout M, Waterman C, Macmillan D, Smith RJ. 2017. Increased conservation marketing effort has major fundraising benefits for even the least popular species. Biol Conserv 211: 95-101. DOI: 10.1016/j.biocon.2017.04.018.

Wallach V, Williams KL, Boundy J. 2014. Snakes of the World: A Catalogue of Living and Extinct Species. CRC Press, FL. DOI: 10.1201/b16901.

Walther JB. 2002. Research ethics in Internet-enabled research: Human subjects issues and methodological myopia. Ethics Inform Technol 4: 205-216. DOI: 10.1023/A:1021368426115.

Whitaker PB, Shine R. 1999. When, where, and why do people encounter Australian brown snakes (*Pseudonaja textilis*: Elapidae)? Wildlife Res 26: 675-688. DOI: 10.1071/WR98043.

Willson JD, Winne CT. 2016. Evaluating the functional importance of secretive species: A case study of aquatic snake predators in isolated wetlands. J Zool 298: 266-273. DOI: 10.1111/jzo.12311.

Yasuda M, Kawakami K. 2002. The new method of monitoring remote wildlife via the Internet. Ecol Res 17: 119-124. DOI: 10.1046/j.1440-1703.2002.00467.x.

ASIAN JOURNAL OF ETHNOBIOLOGY
Volume 3, Number 1, May 2020 E-ISSN: 2580-4537
Pages: 10-15 DOI: 10.13057/asianjethnobiol/y030102

Medicinal trees from home gardens of urban areas in Madurai District of Tamil Nadu, Southern India

S. SHANMUGAM♥, G. JEYAPRABAKARAN, K. RAJENDRAN
Post Graduate and Research Department of Botany, Thiagarajar College. 139-140, Kamarajar Road, Teppakulam, Madurai 625009, Tamil Nadu, India,
♥email: shanmugambotany@gmail.com

Manuscript received: 1 March 2020. Revision accepted: 25 April 2020.

Abstract. *Shanmugam S, Jeyaprabakaran G, Rajendran K. 2020. Medicinal trees from home gardens of urban areas in Madurai District of Tamil Nadu, Southern India. Asian J Ethnobiol 3: 10-15.* Home gardens provide a diverse and stable supply of socio-economic products. They serve as conservation spots of many valuable and rare medicinal plants. Present research work aims to elucidate the medicinally important trees growing in home gardens and their role in the health care of the inhabitants living in four urban areas of Madurai District, Tamil Nadu, India. Data was collected by interviewing 20 informants (14 male and 6 female) regarding the ethnomedicinal uses of plants prescribed to treat several ailments in total. We recorded 63 medicinal remedies prepared from 54 tree species belonging to 52 genera and 27 families to treat 35 illnesses. It was found that the most dominant family was Apocynaceae (5 species). Leaf was the most used plant part (28.56%), and using raw material (20.64%) was the most way to treat a particular disease. Phytochemical and pharmacological values of these medicinally essential trees should be tested. Awareness programs should also encourage people to grow many more valuable plants in their home gardens.

Keywords: Home gardens, Madurai urban, Medicinal trees, Tamil Nadu

INTRODUCTION

Home gardens are traditional agroforestry systems characterized by the complexity of their structure and multiple functions. Home gardens can be defined as land use systems involving deliberate management of multipurpose trees and shrubs in intimate association with annual and perennial crops and invariably livestock within the compounds of individual houses, the whole tree-crop animal unit being intensively managed by family labor (Fernandes and Nair 1986).

Home gardens have attracted considerable research attention during the past three decades mainly due to the following reasons: (i) they contain characteristics that make them an exciting model for research and the design of sustainable agroecosystems, including efficient nutrient cycling, high biodiversity, low use of external inputs and soil conservation potential; and (ii) home gardens have been shown to provide a diverse and stable supply of socio-economic products and benefits to the families that maintain them (Jose and Shanmugaratnam 1993).

Home gardens are important *in situ* conservation sites. According to the Convention of Biological Diversity Article 7,8 and 10(c), inventory of such areas can help identify and conserve biodiversity while assessing the system's sustainability (Jose and Shanmugaratnam 1993). To understand the structure and function of home gardens, it is necessary to analyze both socio-economic and biophysical aspects of these systems.

The rapid disappearance of some wonderful medicinal plants due to over-exploitation and continuous extraction has led to the urgent need to protect such medicinal plants (Jain 1976). In the last few decades, several factors, including population growth, expansion of large urban areas, construction activities such as dams, building, roads, encroachments on vast areas of forest land, shifting cultivation, mining operations, and industrialization, have been affected depleted robust ancient medicinal plants.

At the same time, home gardens located in urban areas of large cities, like in Madurai District, Tamil Nadu, India, serve as conservation spots of many valuable and rare medicinal plants. They are to be growing by the homeowners inside/outside of their residential areas. However, there was no detailed study about medicinal trees present in urban areas of Madurai District. Having these facts in mind, the current research work was carried out to explore the medicinal trees growing in home gardens in urban areas of Madurai District.

MATERIALS AND METHODS

Study area

The present study was conducted in four urban areas, i.e., Teppakulam, Anna Nagar, K.K. Nagar and Anupanadi of Madurai District in Tamil Nadu, India. Geographically, the entire area of Madurai District lies between 9º 39' – 10º 30' N latitude and 77º 00' – 78º 30' E longitude. The district is spread over about 6500 sq. km, bounded on the north and northeast by Pudukkottai District, on the south by Virudhunagar District, and on the southwest by Theni District, on the west by Dindigul District, and the east by Sivagangai District. The district receives an annual rainfall

of about 600 – 850 mm with temperature varies between 18º and 40º C.

Field study

An extensive survey was carried out in the urban areas of Madurai District for 6 months period, from July – December 2019. The known and familiar plants were recorded on the spot, while the unknown and doubtful plants were collected and brought to the laboratory for identification. All the plants were botanically identified with the help of Flora of Tamil Nadu Carnatic (Matthew 1983) and An Excursion Flora of Central Tamil Nadu (Matthew 1991).

Data collection

Informants were interviewed individually in the local language (Tamil). Semi-structured interviews addressed questions regarding medicinal data on trees. Its uses included local plant name, name of disease treated, plant parts used, other parts or herbs used along with (if any), methods of remedy preparation, and mode of administration (Cotton 1996). The Prior Informed Consent (PIC) was obtained verbally before commencing each interview. The total number of informants involved in the ethnomedicinal survey was 20 (14 male and 6 female). The age of the individuals ranged from 30 to 95 years. Answers of respondents were translated into English and noted down by the interviewers.

RESULTS AND DISCUSSION

Diversity of medicinal trees

A total of 54 tree species belonging to 52 genera distributed among 27 families were recorded. The list of the plants recorded in the study area with their family name, local name, and uses are presented in Table 1. Among 54 species, dicotyledons were represented by 47 species of 49 genera belonging to 25 families, and monocotyledons were 5 species of 5 genera belonging to 2 families (Table 2).

Among the 27 families listed, Apocynaceae was the most dominant family comprising 5 species from 4 genera. Arecaceae, Caesalpiniaceae, and Fabaceae shared the second largest family represented by 4 species each. The third-largest families were Meliaceae, Moraceae, Rubiaceae, and Sapindaceae; all were represented by 3 species, followed by Annonaceae, Euphorbiaceae, Mimosaceae, Myrtaceae, and Verbenaceae (2 species of each). The rest of the 13 families were represented by single species only (Table 2). Among the genus of the medicinal trees reported, *Phyllanthus* of Euphorbiaceae and *Plumeria* of Apocynaceae were represented by 2 species that were the dominant genus (Table 1).

Quantitative ethnomedicinal analyses

During the present investigation, the informants in the study area prepared 63 medicinal remedies from 54 plants used to treat 35 different illnesses (Table 3). The plants obtained were fully grown in the home gardens of the urban areas of Madurai District.

Plant parts used

Regarding the plant parts used, it was observed that leaf is the most used plant part (28.56%) to treat a particular disease followed by stem bark and fruit (19.05 % of each), stem (6.35%), root (6.34%), seed (4.77%), flower (4.76%), fruit pulp (4.76%) and root bark (3.18%). Corm and seed coat is the least used part (each 1.59%) (Table 4). Most of the earlier ethnobotanical studies confirmed that leaves are the central portion of the plant used in the treatment of diseases (Arinathan et al. 2003; Subramanian et al. 2003; Ayyanar et al. 2008; Ignacimuthu et al. 2008; Mohan et al. 2008; Rajendran et al. 2008; Shanmugam et al. 2007; 2008; Alagesaboopathi 2011; 2012; Shanmugam et al. 2011a, b; 2012; Alagesaboopathi et al. 2018).

The reasons behind the extensive use of leaves are probably attributable to their easy availability throughout the year. Leaves were active in photosynthesis, where the production and storage of secondary metabolites, which are responsible for the remedy of a particular ailment, is in high concentration compared to other parts of the plants (Ayyanar and Ignacimuthu 2005; Shanmugam et al. 2007).

Table 1. List of medicinally important trees present in home gardens of Madurai District, Tamil Nadu, Southern India, with their family name, local name, and medicinal uses

Botanical name	Family name	Local name	Medicinal use(s)
Achras zapota L.	Sapotaceae	Sappottaa	Fruits are eaten raw for stomach ulcers.
Aegle marmelos (L.) Corr. Serr.	Rutaceae	Vilvam	Stem bark powder is boiled with goat milk and filtered. This liquid is taken orally two times for three days to relieve stomach pain during menstruation. The fruit pulp is mixed with honey and eaten to reduce body heat.
Ailanthus excelsa Roxb.	Simaroubaceae	Theekuchi maram	Root bark decoction is recommended for asthma.
Albizia lebbeck (L.) Benth.	Mimosaceae	Vaagai	Leaf paste is applied for eczema.
Alstonia scholaris (L.) R.Br.	Apocynaceae	Yealilaippaalai	Stem latex is applied to the wound.
Annona squamosa L.	Annonaceae	Seethaapazham	Fruit powder with pepper powder is used to cure fever.

Anthocephalus cadamba Miq.	Rubiaceae	Kadambam	Stem bark juice with common salt is prescribed for eye inflammation.
Areca catechu L.	Arecaceae	Paakku	Seed is eaten raw to improve digestion.
Artocarpus heterophyllus Lam.	Moraceae	Palaa	Fruit pulp is eaten for anemia.
Azadirachta indica Adr. Juss.	Meliaceae	Vaembu	Stem bark paste is applied for skin eruption. Leaf decoction is taken orally for ulcers.
Bauhinia purpurea L.	Caesalpiniaceae	Mandhaarai	Root bark paste is applied for boils.
Bombax ceiba L.	Bombacaceae	Yilavam	Stem exudate is given for diarrhea and dysentery.
Carica papaya L.	Caricaceae	Pappaali	Milky latex of fruit is applied to teeth to relieve toothache.
Caryota urens L.	Arecaceae	Koondhalpanai	Leaf ash is used for inflammation.
Casuarina equisetifolia Forster & Forster	Casuarinaceae	Savukku	Decoction of leaves is used to cure fever.
Citrus medica L.	Rutaceae	Yelumichai	Fruit juice mixed with milk is taken two times a day for dysentery.
Cocos nucifera L.	Arecaceae	Thennai	Fruit endosperm is eaten raw for dysentery.
Crateva religiosa auct. non-Forster	Capparidaceae	Maavilangam	Stem bark extract is used to enhance eat appetite.
Dalbergia sissoo Roxb.	Fabaceae	Yeetti	Stem bark paste is mixed with pepper paste and taken orally for fever.
Delonix regia (Hook.f.) Raf.	Caesalpiniaceae	Kaattuthee maram	Leaf paste is applied for skin dryness.
Erythrina suberosa Roxb.	Fabaceae	Mullmurungai	Leaves are cooked and eaten for cold and cough.
Eucalyptus globulus Labill.	Myrtaceae	Thailamaram	Leaves are boiled, and the vapor is inhaled for cold and cough.
Ficus religiosa L.	Moraceae	Arasu	Stem bark decoction is used for jaundice.
Gmelina arborea L.	Verbenaceae	Kumizh	Root decoction is used in rheumatism.
Lawsonia inermis L.	Lythraceae	Marudhaani	Leaf paste is applied for cracks on foot.
Madhuca indica J. F. Gmel.	Sapotaceae	Yiluppai	Seed decoction is taken orally for rheumatism.
Mangifera indica L.	Anacardiaceae	Maamaram	Stem bark paste is applied for hemorrhage. Latex obtained from the stem is used to the wound.
Melia azedarach L.	Meliaceae	Malaivaembu	Juice of stem bark is taken internally for stomach pain.
Millingtonia hortensis L.f.	Bignoniaceae	Panneermaram	Flower juice is applied to the wound.
Mimusops elengi L.	Sapotaceae	Makizham	Fruit juice is used for diarrhea and dysentery.
Morinda tinctoria Roxb.	Rubiaceae	Manjanathi	Leaf extract is taken orally to cure dysentery.
Moringa oleifera Lam.	Moringaceae	Murungai	Cooked leaves are eaten to increase fertility in men. Stem bark juice is used to cure stomach pain.
Morus alba L.	Moraceae	Musukkottai	Fruit is eaten raw for sore throat.
Musa paradisiaca L.	Musaceae	Vaazhai	Corm extract is given for snake bites. Fruit is eaten raw for intestinal worms.
Parkinsonia aculeata L.	Caesalpiniaceae	Sudukaatu maram	Stem bark decoction is taken orally to cure dysentery.
Phoenix sylvestris (L.) Roxb.	Arecaceae	Yeecham	Root juice is prescribed for indigestion.
Phyllanthus acidus (L.) Skeels	Euphorbiaceae	Sirunelli	Fruits are eaten raw for body heat.
Phyllanthus emblica L.	Euphorbiaceae	Nelli	Fruits are eaten raw to cure anemia.
Pithecellobium dulce (Roxb.) Benth.	Mimosaceae	Kodukkaappuli	Leaf juice is mixed with onion juice and applied for hair growth.
Plumeria alba L.	Apocynaceae	Perumaal arali	Latex is applied to the wounds.
Plumeria rubra L.	Apocynaceae	Yeelathalari	Flower paste is applied to the wound.
Polyalthia longifolia (Sonn.) Thwaites	Annonaceae	Nettilingam	Root decoction is used for fever.
Pongamia glabra Vent.	Fabaceae	Pungam	Juice of leaves is prescribed for diarrhea. Root juice is used for ulcers. Fresh stem bark is given to chew for piles.
Psidium guajava L.	Myrtaceae	Koyyaa	Stem decoction is given for diarrhea.
Sapindus emarginatus Vahl	Sapindaceae	Poondhikkottai	Fruit decoction is taken internally for asthma.
Sesbania grandifolia (L.) Poiret	Fabaceae	Agathi	Leaves are cooked and eaten for stomach ulcers.
Swietenia mahagoni (L.) Jacq.	Meliaceae	Makhaagani	Leaf extract is given to drink for diabetes.
Syzygium cumini (L.) Skeels	Myrtaceae	Naaval	Seed powder is used for diabetes.
Tamarindus indica L.	Caesalpiniaceae	Puli	Seed coat paste is applied on the spot of scorpion bite to relieve pain.
Tectona grandis L.f.	Verbenaceae	Thaekku	Flower juice is used in urinary pain. Stem bark paste is used in bronchitis.
Thevetia peruviana L.	Apocynaceae	Visha arali	Latex obtained from leaves is diluted and taken internally for white discharge.
Thespesia populnea L.	Malvaceae	Poovarasu	Leaf paste is applied for leprosy.
Wrightia tinctoria (Roxb.) R.Br.	Apocynaceae	Paalai	Leaf paste mixed with neem oil is applied for eczema.
Ziziphus jujuba (L.) Gaertner, non Miller	Rhamnaceae	Yilandhai	Dried leaves are burnt, and the smoke is inhaled for cold and cough. Fruits are eaten raw for stomachache.

Table 2. List families with several genera and species

Family	Number of genus	Number of species
Anacardiaceae	1	1
Annonaceae	2	2
Apocynaceae	4	5
Arecaceae†	4	4
Bignoniaceae	1	1
Bombacaceae	1	1
Caesalpiniaceae	4	4
Capparidaceae	1	1
Caricaceae	1	1
Casuarinaceae	1	1
Euphorbiaceae	1	2
Fabaceae	4	4
Lythraceae	1	1
Malvaceae	1	1
Meliaceae	3	3
Mimosaceae	2	2
Moraceae	3	3
Moringaceae	1	1
Musaceae†	1	1
Myrtaceae	2	2
Rhamnaceae	1	1
Rubiaceae	3	3
Rutaceae	2	2
Sapindaceae	1	1
Sapotaceae	3	3
Simaroubaceae	1	1
Verbenaceae	2	2

Note**:** †Monocot families: others are dicots

Medical preparations and their admission

The medical remedies followed by the local inhabitants of Madurai urban to cure disease were based on many kinds of preparations which are as follows. Ash – the plant material is burnt and then powdered. This powder is used as ash for medicinal preparation. Cooked – the plant material is cooked and eaten with a regular diet. Decoction – a decoction is obtained by boiling the plant in water until the volume of liquid is reduced to more than 1/2 or 3/4 of the original amount of liquid. Extract – the plant material is grind with action water as needed and filtered. The filtrate is used as an extract. Exudate – the plant's stem portion is scratched out using sharp tools like a knife, and the outcome fluid is used for medicine as exudate. Juice – the juice is obtained by grinding the plant material, and this preparation was administered wholly (not filtered). Latex – latex is obtained by detaching the leaf or young stem at the nodal region of the plant and used. Paste – the paste is prepared by grinding fresh or dried material with water. Powder – the powder is prepared by grinding dried material. Raw – the plant material is also used in natural form, was used immediately after harvesting. Vapor – the fresh plant material is boiled, and the fume generated from it is inhaled.

From the present research work, it was also noted that the local people living in Madurai urban used the medicinal preparation mainly in the form of raw (20.64%), followed by paste (17.46%), juice (15.56%), decoction (14.29%), latex (7.94%), extract (6.35%), cooked (6.34%), powder (4.77%) and vapor (3.17%). Some medicines were also used in ash form (1.59%) and exudate (1.59%) (Table 4). Such a wide array of preparations was also reported by various studies carried out in different regions of Tamil Nadu like Theni district (Ignacimuthu et al. 2008), Shenbagathope (Shanmugam et al. 2008), Pachalur (Shanmugam et al. 2011a), Sivagangai district (Shanmugam et al. 2011b; 2012), Red Hills (Francisca and Rajendran 2012), Yercaud hills (Parthipan et al. 2017), etc.

Medicinal species with great use versatility

The present study showed that the local inhabitants used many collected plants to treat multiple diseases. *Pongamia glabra* (diarrhea, piles, and ulcer) and *Ziziphus jujuba* (cold, cough, and stomach-ache) are used for the treatment of these three diseases; *Aegle marmelos* (menstrual pain and body heat), *Azadirachta indica* (skin eruption and ulcer), *Bombax ceiba* (diarrhea and dysentery), *Erythrina suberosa* (cold and cough), *Eucalyptus globulus* (cold and cough), *Mangifera indica* (hemorrhage and wound), *Mimusops elengi* (diarrhea and dysentery), *Moringa oleifera* (male infertility and stomach pain), *Musa paradisiaca* (snake bite and intestinal worms) and *Tectona grandis* (urinary pain and bronchitis) were used for two diseases. The rest of the plants treat only one disease (Table 1).

Extensively used plants for illness

The local people of the study area used the herbal preparations made from the traditional medicinal plants used primarily for the treatment of dysentery (6 species: *Bombax ceiba*, *Citrus medica*, *Cocos nucifera*, *Mimusops elengi*, *Morinda tinctoria*, and *Parkinsonia aculeata*), wound (5 species: *Alstonia scholaris*, *Mangifera indica*, *Millingtonia hortensis*, *Plumeria alba* and *Plumeria Rubra*), diarrhea (4 species: *Bombax ceiba*, *Mimusops elengi*, *Pongamia glabra* and *Psidium guajava*), fever (4 species: *Annona squamosa*, *Casuarina equisetifolia*, *Dalbergia sissoo*, and *Polyalthia longifolia*), ulcer (4 species: *Achras zapota*, *Azadirachta indica*, *Pongamia glabra*, and *Sesbania grandifolia*), cold (3 species: *Erythrina suberosa*, *Eucalyptus globulus*, and *Ziziphus jujuba*), cough (3 species: *Erythrina suberosa*, *Eucalyptus globulus*, and *Ziziphus jujuba*) and stomach pain (3 species: *Melia azedarach*, *Moringa oleifera* and *Ziziphus jujuba*) (Table 3). Use of medicines with ingredients

Generally, the informants used a medicinal preparation made from a plant alone to treat a disease. In some cases, they used medicinal preparation, other plant products, and other substances like milk or honey to cure a particular illness. For example, stem bark powder of *Aegle marmelos* is boiled with goat milk, and this liquid is taken orally, two times for three days to get relief from stomach pain during menstruation; fruit pulp of *Aegle marmelos* is mixed with honey and eaten to reduce body heat, fruit juice of *Citrus medica* with milk is taken two times a day for dysentery, leaf paste of *Wrightia tinctoria* mixed with neem oil, is applied for eczema and stem bark paste of *Dalbergia sissoo* is mixed with pepper paste and taken orally for fever (Table 1).

Table 3. List of illness, number of remedies, and name of the plants used by the informants of the study area in Madurai District, Tamil Nadu, Southern India

Name of the illness	Number of remedies used	Botanical name of the plants used
Anemia	2	*Artocarpus heterophyllus* and *Phyllanthus emblica*
Appetite	1	*Crateva religiosa*
Asthma	2	*Ailanthus excelsa* and *Sapindus emarginatus*
Body heat	2	*Aegle marmelos* and *Phyllanthus acidus*
Boils	1	*Bauhinia purpurea*
Bronchitis	1	*Tectona grandis*
Cold	3	*Erythrina suberosa*, *Eucalyptus globulus* and *Ziziphus jujuba*
Cough	3	*Erythrina suberosa*, *Eucalyptus globulus* and *Ziziphus jujuba*
Crack	1	*Lawsonia inermis*
Diabetes	2	*Swietenia mahagoni* and *Syzygium cumini*
Diarrhea	4	*Bombax ceiba*, *Mimusops elengi*, *Pongamia glabra* and *Psidium guajava*
Dysentery	6	*Bombax ceiba*, *Citrus medica*, *Cocos nucifera*, *Mimusops elengi*, *Morinda tinctoria* and *Parkinsonia aculeata*
Eczema	2	*Albizia lebbeck* and *Wrightia tinctoria*
Fever	4	*Annona squamosa, Casuarina equisetifolia, Dalbergia sissoo* and *Polyalthia longifolia*
Hemorrhage	1	*Mangifera indica*
Hair growth	1	*Pithecellobium dulce*
Indigestion	2	*Areca catechu* and *Phoenix sylvestris*
Inflammation	1	*Anthocephalus cadamba* and *Caryota urens*
Intestinal worms	1	*Musa paradisiaca*
Jaundice	1	*Ficus religiosa*
Leprosy	1	*Thespesia populnea*
Male infertility	1	*Moringa oleifera*
Menstrual pain	1	*Aegle marmelos*
Piles	1	*Pongamia glabra*
Rheumatism	2	*Gmelina arborea* and *Madhuca indica*
Scorpion sting	1	*Tamarindus indica*
Skin dryness	1	*Delonix regia*
Snake bite	1	*Musa paradisiaca*
Sore throat	1	*Morus alba*
Stomach pain	3	*Melia azedarach, Moringa oleifera* and *Ziziphus jujuba*
Stomach ulcer	4	*Achras zapota, Azadirachta indica, Pongamia glabra* and *Sesbania grandifolia*
Tooth-ache	1	*Carica papaya*
Urinary pain	1	*Tectona grandis*
White discharge	1	*Thevetia peruviana*
Wound	5	*Alstonia scholaris, Mangifera indica, Millingtonia hortensis, Plumeria alba,* and *Plumeria Rubra*

Table 4. Percent distribution of parts used and mode of treatment followed by the informants of the study area in Madurai District, Tamil Nadu, Southern India

Parts used	Mode of treatment											Total (%)
	Ash	Cooked	Decoction	Extract	Exudate	Juice	Latex	Paste	Powder	Raw	Vapour	
Corm	-	-	-	1.59	-	-	-	-	-	-	-	1.59
Flower	-	-	-	-	-	3.17	-	1.59	-	-	-	4.76
Fruit	-	-	1.59	-	-	3.17	1.59	-	1.59	11.11	-	19.05
Fruit pulp	-	-	-	-	-	-	-	-	-	4.76	-	4.76
Leaf	1.59	6.34	1.59	3.17	-	1.59	1.59	7.93	-	1.59	3.17	28.56
Root	-	-	3.17	-	-	3.17	-	-	-	-	-	6.34
Root bark	-	-	1.59	-	-	-	-	1.59	-	-	-	3.18
Seed	-	-	1.59	-	-	-	-	-	1.59	1.59	-	4.77
Seed coat	-	-	-	-	-	-	-	1.59	-	-	-	1.59
Stem	-	-	-	-	1.59	-	4.76	-	-	-	-	6.35
Stem bark	-	-	4.76	1.59	-	4.76	-	4.76	1.59	1.59	-	19.05
Total (%)	1.59	6.34	14.29	6.35	1.59	15.86	7.94	17.46	4.77	20.64	3.17	100

It is believed that a medicine prepared using multiple plant parts and other products like milk, honey contains a range of pharmacologically active compounds and has more healing power than single plant products (Teklehaymanot and Giday 2007).

In conclusion, the findings of this study may become bare leads for chemical, pharmacological, clinical, and biochemical investigations, which ultimately may lead to drug discovery. Therefore, these medicinally essential plants' phytochemical and pharmacological values should be tested. Further studies must be carried out to explore Madurai District's entire floral wealth of urban forestry. The best occurrence information we have suggests that large numbers of plant occurrences remain in urban areas of Madurai. Further, most species have at least one event on public lands. It appears plausible that the most vulnerable plant species can be preserved in natural environments, even within the urban context of Madurai. Otherwise, there may be a possibility of the extinction of that particular plant species.

Home gardens are essential sites for *in situ* conservation of plant diversity and serve as gene pools for eroding indigenous tree species. Many wild, rare tree species like *Anthocephalus cadamba*, *Caryota urens*, and *Swietenia mahagoni* are also conserved in home gardens because of their high commercial value. It is to be mentioned that the management of such trees in home gardens is often used as an indicator of social status among the local inhabitants. It was observed that there is an increasing interest in cultivating the plant among local inhabitants in the study area. Therefore, encouraging programs should be conducted to the homeowners to grow many more valuable plants in their home gardens and make them biodiversity conservation spots.

ACKNOWLEDGEMENTS

The authors are cordially grateful to the people inhabiting different localities of urban areas in Madurai District in Madurai District, Tamil Nadu, Southern India, because of their kind support and co-operation during the field trips.

REFERENCES

Alagesaboopathi C, Prabakaran G, Subramanian G, Vijayakumar RP. 2018. Ethnomedicinal studies of plants growing in the Salem district of Tamil Nadu, India. Int J Pharma Biol Sci 8 (3): 503-511.

Alagesaboopathi C. 2011. Ethnobotanical studies on useful plants of Kanjamalai hills of Salem district of Tamil Nadu, Southern India. Arch Appl Sci Res 3: 532-539.

Alagesaboopathi C. 2012. Ethnobotanical survey of medicinal plants used by Malayalitribals and rural people in Salem district of Tamil Nadu, India. J Pharma Res 5 (12): 5248-5252.

Arinathan V, Mohan VR, John de Britto A, Chelladurai V. 2003. Studies on food and medicinal plants of Western Ghats. J Econ Taxon Bot 27: 750-753.

Ayyanar M, Ignacimuthu S. 2005. Traditional knowledge of Kani tribals in Kouthalai of Tirunelveli hills, Tamil Nadu, India. J Ethnopharmacol 102: 246-255. DOI: 10.1016/j.jep.2005.06.020.

Ayyanar M, Sankarasivaraman K, Ignacimuthu S. 2008. Traditional herbal medicines used for the treatment of diabetes among two major tribal groups in South Tamil Nadu, India. Ethnobot Leafl 12: 276-280.

Cotton CM. 1996. Ethnobotany: Principles and Applications. John Wiley and Sons Ltd., New York.

Fernandes ECM, Nair PKR. 1986. An evaluation of the structure and function of tropical home gardens. Agricult Syst 21: 279-310. DOI: /10.1016/0308-521X(86)90104-6.

Francisca GB, Rajendran A. 2012. Ethnobotany of Irular tribes in Red hills, Tamil Nadu, India. Asian Pacific J Trop Dis S874-S877. DOI: 10.1016/S2222-1808(12)60283-7.

Ignacimuthu S, Ayyanar M, Sankarasivaraman K. 2008. Ethnobotanical study of medicinal plants used by Paliyar tribals in Theni district of Tamil Nadu, India. Fitoterapia 79: 562-568. DOI: 10.1016/j.fitote.2008.06.003.

Jain SK. 1976. A Handbook of Field and Herbarium Methods. Today and Tomorrow Printers and Publishers, New Delhi, India.

Jose D, Shanmugaratnam N. 1993. Traditional homegardens of Kerala: A sustainable human ecosystem. Agrofor Syst 24: 203-213. DOI: 10.1007/BF00706892.

Matthew KM. 1983. Flora of Tamil Nadu Carnatic. The Rapinat Herbarium, St. Joseph's College, Tiruchirapalli, Tamil Nadu, India.

Matthew KM. 1991. An Excursion Flora of Central Tamil Nadu. Oxford-IBH Publishing Co. Pvt. Ltd., New Delhi, India.

Mohan VR, Rajesh A, Athiperumalsami T, Sutha S. 2008. Ethnomedicinal plants of the Tirunelveli district, Tamil Nadu, India. Ethnobot Leafl 12: 79-95.

Parthipan M, Aravindhan V, Rajendran A. 2017. Medico-botanical study of Yercaud hills in the Eastern Ghats of Tamil Nadu, India. Anc Sci Life 30: 104-109.

Rajendran K, Balaji P, Jothibasu M. 2008. Medicinal plants and their utilization by villagers in Southern districts of Tamil Nadu. Indian J Trad Knowl 7 (3): 417-420.

Shanmugam S, Annadurai M, Rajendran K. 2011a. Ethnomedicinal plants used to cure diarrhea and dysentery in Pachalur hills of Dindigul district in Tamil Nadu, Southern India. J Appl Pharmaceut Sci 1 (8): 94-97.

Shanmugam S, Kalaiselvan M, Selvakumar P, Suresh K, Rajendran K. 2011b. Ethnomedicinal plants used to cure diarrhea and dysentery in Sivagangai district of Tamil Nadu, India. Int J Res Ayur Pharm 2 (5): 991-994.

Shanmugam S, Rajagopal V, Rajendran, K. 2007. Multipurpose usable plants in Thalaiyanai hills of Tirunelveli forest division in southern part of Western Ghats. J Non-Tim For Prod 14 (4): 297-306.

Shanmugam S, Rajendran K, Suresh K. 2012. Traditional uses of medicinal plants among the rural people in Sivagangai district of Tamil Nadu, Southern India. Asian Pacific J Trop Biomed 2 (1): S429-S434.10.1016/S2221-1691(12)60201-9.

Shanmugam S, Ramar S, Ragavendhar K, Ramanathan R, Rajendran K. 2008. Plants are used as medicine by Paliyar tribes of Shenbagathope in Virudhunagar district of Tamil Nadu. J Econ Taxon Bot 32 (4): 922-929.

Subramanian A, Mohan VR, Kumaresan S, Chelladurai V. 2003. Medicinal plants used by the valaiyans of Madurai District. Tamil Nadu. J Econ Taxon Bot 27: 785-787.

Teklehaymanot T, Giday, M. 2007. Ethnobotanical study of medicinal plants used by people in Zegie Peninsula, Northwestern Ethiopia. J Ethnobiol Ethnomed 3: 12. DOI: 10.1186/1746-4269-3-12.

ASIAN JOURNAL OF ETHNOBIOLOGY
Volume 3, Number 1, May 2020
Pages: 16-22

E-ISSN: 2580-4537
DOI: 10.13057/asianjethnobiol/y030103

Ethnobotany of food plant used by Sundanese Ethnic in Nyangkewok Hamlet, Kalaparea Village, Sukabumi District, Indonesia

KEN DARA CITA♥
Faculty of Forestry, Universitas Nusa Bangsa. Jl. Sholeh Iskandar Km. 4, Cimanggu, Tanah Sareal, Bogor 16166, West Java, Indonesia.
Tel.: +62-251-7533189. Fax.: +62-251-8340217, ♥email: kendarac@gmail.com

Manuscript received: 24 November 2019. Revision accepted: 26 April 2020.

Abstract. *Cita KD. 2020.Ethnobotany of food plant used by Sundanese Ethnic in Nyangkewok Hamlet, Kalaparea Village, Sukabumi District, Indonesia. Asian J Ethnobiol 3: 16-22.* Food insecurity is an important threat in West Java Province. Ethnobotany in Food Plant of Sundanese Ethnic can be an alternative to a food crisis. In this study, we looked for insights on how Sundanese Ethnic inhabiting around the Gede Mountain, Nyangkewok Village, interact with their environments and how they use ecological knowledge on plants for their existence. This study used the exploration and in-depth interview method with 30 respondents from March until June 2019 and analyzed with the Cultural Food Cultivated Significant Index. This study recorded 101 species of valuable plants, 48 families, dominated by Cucurbitaceae. The highest Cultural Food Cultivated Index is pare (*Oryza sativa*). Sundanese Ethnic living in the Nyangkewok Village has been undergoing extreme changes in both social and ecological conditions. This study recommends conservation plans that include traditional environmental knowledge, plant monitoring, and participation with Nyangkewok communities.

Keywords: Ethnobotany, food security, plants, Sukabumi, Sundanese

INTRODUCTION

Research studies on food plants have been carried out with various objectives, to identify new food sources (Campos et al. 2018), conserve food plants and gene diversity as alternative food sources in the food crisis (Nesbitt et al. 2010), bioprospection (Rizza et al. 2017) and cultural preservation (Surata et al. 2015). Previous studies recorded that 80% of the population in developing countries used plants (World Health Organization, 1999). The use of plants for food may be vital for human beings, followed by medicine (Wiryono et al., 2017). Based on (Zuhud 2009), Indigenous people in Indonesia utilize more than 239 species of food plants. Various studies state that ethnobotany is a significant aspect for developing plant utilization models that can help policy planning, support the conservation of local food crops, and improve the food welfare of local communities. Ethnobotany can function as a platform to study the special relationship between community culture in utilizing local food plants (Iswandono et al., 2015; Moteetee et al., 2018; Rodríguez et al., 2018). Traditional ecological knowledge is still important for daily needs, especially for rural people, and for better future conservation (Wiryono et al., 2019).

Food plants are plants that have nutrients for human energy needs. (Morin et al. 2019) Local food is food that local people consume by the potential and local knowledge (Law of the Republic of Indonesia No. 18 of 2012 concerning Food). Each region has different local food advantages according to production and consumption. Local food development has a strategic role in developing food security and independence (Syarief et al., 2017).

Food Security is a condition for the fulfillment of food for households which is reflected in the availability of sufficient food, both in quantity and quality, safe, equitable, and affordable. According to the Ministry of Trade of the Republic of Indonesia, 85% of food comes from plants. Selection of food based on plants has several advantages compared to animals, among others: healthier and relatively protected from the risk of diabetes, obesity, cancer, cheaper, easier to obtain, and easier to process, so choosing the type of food correlates with health (Cramer et al. 2017; Cui et al. 2019).

Ethnobotany is commonly found in traditional communities in various tribes in Indonesia (Iswandono et al., 2015). Batak ethnic utilize tinuktuk (traditional ingredients of different species of Zingiberaceae and Rutaceae) (Silalahi et al. 2015) Kanum ethnic communities in Papua utilize Dioscorea spp to fulfill their carbohydrate needs (Rauf and Lestari, 2009). Sukabumi District is included in a food-crisis area; the products obtained cannot meet household consumption needs until the next harvest. The results of research on food security in Sukabumi stated that food availability was insufficient, stability was less stable, food affordability was low, and food quality in the village was lacking (Bangsawan 2012).

Based on Syarief and Fatciya (2014) research, empowering food crisis to communities shows that the development of agriculture to support food security is the most appropriate option; the experience of the community in agriculture becomes the initial capital to build independence. Nyangkewok Village is one of the villages located in the Sukabumi District. It is near the Gunung Gede Pangrango National Park area, so the interaction between the community and plants is still close.

Nyangkewok Hamlet community has traditional knowledge of meeting food needs by utilizing food plants. However, the use and spread of food plants by the people of Kampung Nyangkewok has not been well documented. For this reason, research on the ethnobotany of food plants by the Nyangkewok Village Community is essential.

Meanwhile, researches on the ethnobotany of Sundanese ethnic in Nyangkewok Hamlet have not been intensively carried out. For that purpose, this research on the ethnobotany of Sundanese ethnic in Nyangkewok Hamlet was to understand the local knowledge by CFCI Index and retention index of food plants in Nyangkewok Hamlet.

MATERIALS AND METHODS

Study area

The research was carried out in Nyangkewok Hamlet, Kalaparea Village Sukabumi District, West Java Province, Indonesia, in March-June 2019. Kalaparea Village, Sukabumi District of West Java Province, Indonesia, has an area of 638.08 ha, and Nyangkewok Hamlet is one of the parts of Kalaparea Village. The map area of Kalaparea Village is shown in Figure 1.

In general, the topography of this area is surging with steep slopes of approximately 25°. The altitude of the study area is 550 meters above sea level (masl.). Based on the classification of Schmidt and Ferguson (1951), the climate in this region has a category of climate B with an average rainfall of 2,000-3,000 mm/year, with temperatures at 20° - 45 ° C. The western, eastern, southern, and northern regions of the village are Balekambang Village, Darmareja Village, Babakan Panjang village, and Gunung Gede Pangrango National Park. There are about 8,747 people and 2,616 households residing in this village. Education of people in Kalaparea Village was recorded in the dominant primary school, while the main livelihood of people as farmers and farm workers (Kalaparea Village Report 2019)

Procedures

The method used in this study was mixed-methods, between qualitative and quantitative with the ethnobotanical approach (Campos et al. 2018; Martin 1995), semi-structured interviews, structured interviews were carried out to gather information on local names, parts of the plants, benefits of plants and how plants are used. Informants were selected using the snowball sampling method. Snowball sampling is used to collect data obtained from the primary sources that can be branched into multiple sources of information (Bernard 2006). Informants were determined based on data from community leaders, tribal leaders, village heads, heads of family, and other reliable sources who know things that are strictly related to the research. The number of informants consisted of 3 respondents.

Data analysis

The collected data were analyzed descriptively and presented in tables and graphs. Quantitative data analysis used Cultural Food Cultivated Index (CFCI). Local knowledge data on food plants in Nyangkewok Hamlet were analyzed using qualitative and quantitative descriptive methods based on primary and secondary data. Qualitative descriptive is used to describe data from interviews, whose data analysis includes data reduction (selection, simplification, and making abstraction) and data presentation. Data collection is arranged and analyzed; they are presented in narrative forms supported by pictures, tables, and charts to obtain conclusions. Secondary data, relevant to the purpose of the study, compared with the data from structured interviews for primary data. Meanwhile, quantitative description analysis describes the data derived from structured data interviews, which are then Analyzed with simple statistics (Creswell 2016; Iskandar and Iskandar 2017; Suryana et al. 2018).

Figure 1. Location of Nyangkewok Hamlet, Kalaparea Village, Sukabumi District, West Java, Indonesia

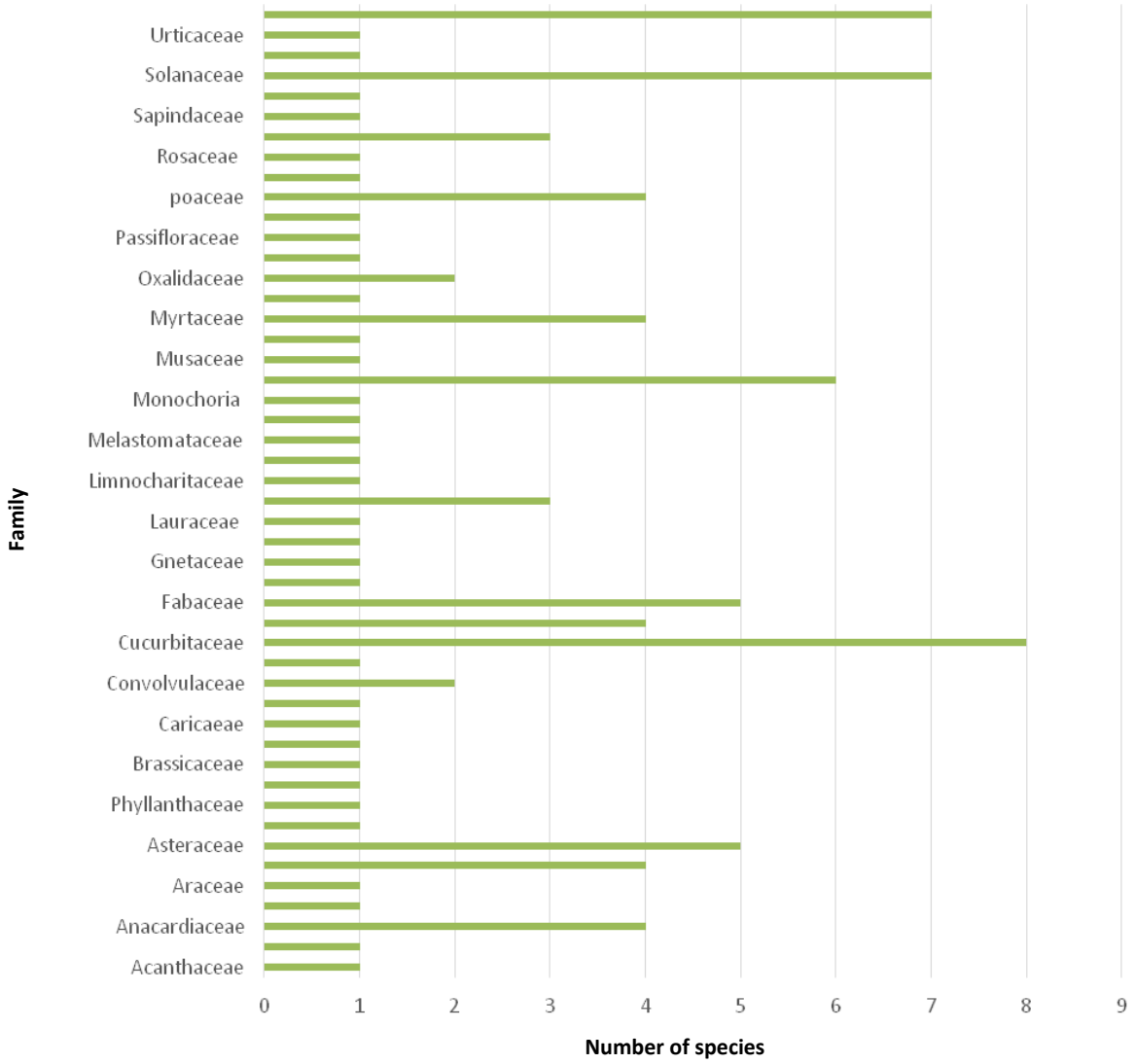


Figure 2. Diversity of Family in food plant in Nyangkewok Hamlet, Kalaparea Village, Sukabumi District, West Java, Indonesia

CFCI = QI x (Ai + Ful + CoL) x EI
CFCI: Cultural Food Cultivated Index;
QI: Quotation Index
AI: Availability Index;
CoI: Commercial Index
FuI: Food Use Index; and
EI: Exclusivity Index

Determining the category of food cultivation are classified into three categories which are less important (<130), is important 130- 38 2, and very important (> 38 2 modified. (Pieroni 2001)

RESULTS AND DISCUSSION

Diversity of food plant

Food plants become the primary source of life in rural communities. The results showed 101 types of food plants with 48 families and were dominated by cucurbitae (Figure 2). Cucurbitaceae is a type of family widely used by the local people in Nyangkewok Hamlet as the primary source of food.

Correlation between age and retention index of food plant

Based on the results of the study (Figure 3), it can be seen that the respondents at the age of KU 40-69 years have higher knowledge about traditional food plants than others with the number MG value (0.916).

Cultural Food Cultivated Index (CFCI)

CFCI of Food Plant is a quantitative method used by ethnobotanists to determine the cultural value of food plants used by indigenous people. The index value of the Food Plant in Nyangkewok Hamlet varied between Very Important-Important and Less Important (Table 1).

Table 1. Cultural food cultivated index in Nyangkewok Hamlet, Kalaparea Village, Sukabumi District, West Java, Indonesia

Local Name	Scientific Name	F	CFCI
Padi	*Oryza sativa* L.	Poaceae	422
Jagung	*Zea mays* L.	Poaceae	418
Singkong	*Manihot utilissima* Pohl.	Euphorbiaceae	410
Ubi jalar	*Ipomoea batatas* Poir.	Convolvulaceae	408
Bonteng	*Cucumis sativus* L.	Cucurbitaceae	408
Buncis	*Phaseolus vulgaris* L.	Fabaceae	408
Kacang panjang	*Phaseolus radiatus* L.	Fabaceae	408
Pisang	*Musa paradisiaca* L.	Musaceae	408
Cacim	*Brassica rapa* var. parachinensis L.	Brassicaceae	404
Bayam	*Amaranthus tricolor* L.	Amarantaceae	402
Kangkung	*Ipomoea reptana* Poir.	Convolvulaceae	402
Cabe rawit	*Capsium frutescens* L.	Solanaceae	380
Bawang merah	*Allium cepa* L.	Liliaceae	376
Bawang putih	*Allium sativum* L.	Liliaceae	370
Supa lemer	*Auricularia polytricha*	Auriculariaceae	368
Mangga	*Mangifera indica* L.	Anacardiaceae	368
Sereh	*Andropogon nardus* L.	Arecaceae	368
Duku	*Lansium domesticum* Corr	Meliaceae	368
Pala	*Myristica fragrans* Houtt.	Myristicaceae	368
Rambutan	*Nephelium lappaceum* L.	Sapindaceae	368
Cabe merah	*Capsium annum* L.	Solanaceae	368
Kemiri	*Aleurites moluccana* (L.) Willd.	Euphorbiaceae	368
Jambu biji	*Psidium guajava*	Myrtaceae	366
Duren	*Durio zibethinus* Murr	Bombacaceae	366
Kupa	*Eugenia polycephala* Miq.	Myrtaceae	364
Nanas	*Ananas comosus* (L.) Merr	Bromeliaceae	364
Pepaya	*Carica papaya* L.	Caricaeae	364
Manggis	*Garcinia mangostana* L.	Clusiaceae	364
Tebu	*Saccharum officinarum* L.	Poaceae	362
Tomat	*Solanum Lycopersicum* L.	Solanaceae	362
Antanan	*Ficus quercifolia* BI	Moraceae	360
Jahe	*Zingiber officinale* Rosc.	Zingiberaceae	360
Kelapa	*Cocos nucifera*	Arecaceae	358
Terong	*Solanum melongena* L.	Solanaceae	356
Gamas	*Sechium edule* (Jacq.) Sw.	Cucurbitaceae	354
Paria	*Momordica charantia* L.	Cucurbitaceae	352
Kol	*Brassica oleracea*	Cruciferae	352
Oyong	*Luffa cylindrica* Rum.	Cucurbitaceae	352
Talas	*Colocasia esculenta* Schott.	Araceae	352
Kawung	*Arenga pinnata* Merr.	Arecaceae	352
Genjer	*Limnocharis flava* (L.) Buch	Limnocharitaceae	352
Nangka	*Artocarpus heterophyllus* Lamk.	Moraceae	352
Salam	*Syzygium polyanthum* Wight.	Myrtaceae	352
Pedes	*Piper nigrum* L.	Piperaceae	352
Takokak	*Solanum torvum* Swartz.	Solanaceae	352
Koneng	*Curcuma domestica* Val.	Zingiberaceae	352
Laja	*Alpinia galanga* (L.) Willd.	Zingiberaceae	352
Lengkuas	*Alpinia galanga* SW.	Zingiberaceae	352
Cikur	*Kaemferia galanga* L.	Zingiberaceae	352
Sirsak	*Annona muricata* L.	Annonaceae	350
Bawang Daun	*Allium fistulosum* L.	Liliaceae	350
Jambu air	*Syzygium aquea* Burm. F	Myrtaceae	350
Honje	*Etlingera elatior* (Jack.) R.M. Sm.	Zingiberaceae	350
Katuk	*Sauropus androgynus* (L.) Merr.	Euphorbiaceae	350
Jarak	*Jatropha curcas* L.	Euphorbiaceae	346
Waluh gede	*Lagenaria leucantha* (Duch.) Rusby	Cucurbitaceae	344
Sawo	*Manilkara zapota* L	Sapotaceae	342
Teh	*Camellia sinensis* (L). O. K	Theaceae	342
Randa midang	*Cosmos coudatus* Kunth.	Asteraceae	342
Sukun	*Artocarpus communis* Forst.	Moraceae	330
Labu	*Lagenaria leucantha* Rusby.	Cucurbitaceae	322
Salak	*Zalacca edulis* Reinw.	Arecaceae	320
Jengkol	*Pithecolobium lobatum* Benth.	Fabaceae	320
Alpukat	*Persea Americana* Mill	Lauraceae	300

Jeruk nipis	*Citrus aurantifolia* (Christm.) Swing	Rutaceae	300
Bunut	*Ficus relgiiosa* L.	Moraceae	288
Jeruk limo	*Citrus decumana*	Rutaceae	288
Campedak	*Artocarpus champeden* (Lour.) Stokes	Moraceae	278
Sintrong	*Erechtites valerianifolia* Raf.	Asteraceae	258
Surawung	*Ocimum sanctum* L.	Lamiaceae	252
Pakis	*Diplazium esculentum* Swartz	Ophioglossaceae	220
Belimbing wuluh	*Averrhoa bilimbi*	Oxalidaceae	202
Leunca	*Solanum nigrum* L.	Solanaceae	202
Kedondong	*Spondias dulcis* Forst.	Anacardiaceae	200
Jeruk bali	*Citrus maxima* Merr.	Rutaceae	188
Markisa	*Passiflora edulis* Sims	Passifloraceae	180
Pandan	*Pandanus amaryllifolius* Roxb	Pandanaceae	178
Eceng	*Monochoria vaginalis* (Burm.) Presi	Monochoria	140
Calicingcing	*Oxalis barrelier*i L.	Oxalidaceae	132
Kemang	*Mangifera caesia* Jack.	Anacardiaceae	130
Limus	*Mangifera foetida* Lour.	Anacardiaceae	130
Delima	*Punica granatum* L.	Punicaceae	130
Arben	*Fragaria chiloensis*	Rosaceae	130
Pohpohan	*Pilea trinervia* Wight.	Urticaceae	130
Rebung	*Gigantochloa apus* Kurz.	Poaceae	128
Melinjo	*Gnetum gnemon* L.	Gnetaceae	124
Menteng	*Baccaurea racemosa* Mell. Arg.	Phyllanthaceae	118
Kacang suuk	*Arachis hypogeae* L.	Fabaceae	116
Coklat	*Teobroma cacao* L.	Malvaceae	106
Kalingsir	*Gynura sarmentosa* DC.	Asteraceae	102
Reundeu	*Staurogyne elongata* (BI.) O. Kuntze	Acanthaceae	100
Kukuk	*Lagenaria leucantha*	Cucurbitaceae	100
Palanding	*Leucaena glauca* Benth.	Fabaceae	100
Bolostrok	*Erechtites hieracifolia* L.	Asteraceae	98
Jocong jotang	*Spilanthes acmella* Murr	Asteraceae	98
Cecenet	*Physalis angulata* L.	Solanaceae	98
Tepus	*Etlingera solaris* (Blume) R. M. Sm.	Zingiberaceae	98
Jaat	*Psophocarpus tetragonolobus* L.	Fabaceae	92
Picung	*Pangium edule* Reinw.	Flacourtiaceae	92
Harendong	*Melastoma polyanthum* BL.	Melastomataceae	90
Tereup	*Artocarpus elastica* Reinw.	Moraceae	90

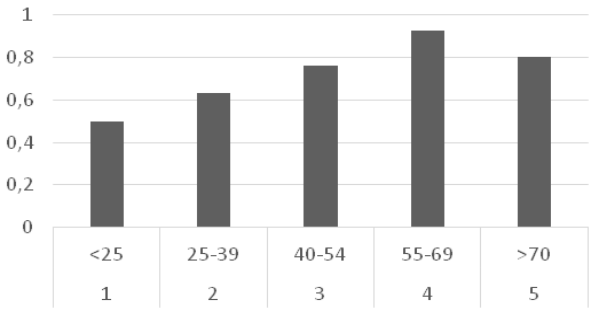


Figure 3. Retention index of food plant

Discussion

Traditional food is an essential instrument in rural development at the local level. Each region has different local food advantages according to production and consumption. Local food development has a strategic role in the development of food security. Cucurbitaceae family is a type of family that is widely used by the community in the village of Nyangkewok as the primary commodity in their food needs. Cucurbitaceae or pumpkins are widely used because of their diverse species and wide distribution in the tropics. (Cui et al. 2019) This species of the Cucurbitaceae family, for example, squash, pumpkin, has a high protein content and is very important to support the process of metabolism because it has a range of terpenoids, carotenoids, steroids, and alkaloids, which are sources of secondary metabolites (Jeffrey C 1980).

The result shows that KU IV is respondents with the highest score, considered the most mastery of ethnobotany knowledge. KU V lives with the most extended period that controls overall ethnobotany knowledge by life experience. Through trial and error, knowledge is relatively stored well; for example, determine a type of plant that can or cannot be consumed. Still, the knowledge of plant names and uses was not affected by gender, as it's related to previous research in Bengkulu. The regression analyses showed that knowledge of plant names and plant uses was positively correlated with age but was not determined by gender. The t-test in local people in Bengkulu showed no difference between males' and females' knowledge. On average, male respondents correctly identified 70% of the plants and females 71% (Wiryono et al. 2017). The second highest knowledge begins to decline at the age of > 69 years; this is caused by decreased brain memory with age. However, for the age of 60-69 years tended to decline, it is predicted that the older people do not have adequate

memory (Iswandono et al., 2015). Increased age underlies the existence of memory deficits within the nerve mechanisms. In addition, local food plants' knowledge tends to decrease in young age classes. It indicated that the lifestyle of young people is changed in line with the theory of evolutionary ethnobiology (EE) and the idea of cultural evolution (CE), which is altered in information flow and lifestyle phenomena in young age groups. The knowledge possessed by ancestors (old age groups) is not necessarily applied to the younger generation's behavior, resulting in younger groups tending less understanding of ethnobotany (Santoro et al., 2018). MG values of KU I and II respondents are relatively low because their interaction with food plants is still low. In addition, the learning process as a life experience has not become the most crucial part in maintaining traditional knowledge of the Nyangkewok Hamlet. It shows that respondents in KU I and II were affected by the many types of modernization and technology, causing a lack of interest in traditional food plant species, such as mobile phones in the younger generation.

Some respondents in the KU I age group failed to name even single plant food, indicating that local knowledge on the use of food plants is not being passed from one elderly to the next by word of mouth as expected. It suggests that the current means of passing local knowledge orally from one generation to another is not practical. A study carried out by (Amir et al. 2019) in Ethnobotany of *Aloe* found that above 45 age groups have significantly higher knowledge on the use of *Aloe* species than those in 15-20 age. It suggests that local knowledge must be integrated into the formal education system because most young people attend formal training at this lower age. The ecological knowledge can be maintained among young people if they are involved in activities that allow them to interact with the plants (Wiryono et al., 2019). This result is also similar to the ethnobotany of tree fern in Pasir Menyan Hamlet that has increased from the ages of 20-29, 60-69, and 50-59 years, but for the age of 60-69 years tended to decrease (Suryana et al. 2018) Based on previous research, it can be revealed that knowledge of indigenous people, some factors impact on the varying understanding of indigenous people such as age, subsistence practice, gender, and bilingualism (Crepaldi et al. 2016). However, decreasing local knowledge is due to (1) difficulty in passing this information orally to the young generation (Silalahi et al. 2018; Silalahi et al. 2015), and (2) Changes in cultural value. Knowledge in local communities is one of the important indicators of efforts to conserve food plants because the decline in ethnobotany knowledge will reduce plant genetic diversity. Decreasing ethnobotany knowledge is the beginning of lowering gene conservation of plants due to the declining role of local institutions for plant conservation. This condition causes the source of wild food plants to be limited to areas of inland forest communities or indigenous peoples who use it in a tiny scope (Zuhud 2011). According to Neelo et al. (2015), the local communities have to be educated on conserving plants, especially those commonly used for various important activities. Pare, Jagong, Singkomg are species that have the highest CFCI category of carbohydrate as a source of carbohydrates, as the primary food source. Pare is the main source of livelihood for Nyangkwok Village, and it is the most important staple food in more than half of the world's population (Lee et al., 2018). Other carbohydrate sources, namely jagong and singkong The interview results stated that after consuming jagong or singkong, the people did not consume rice for the next meal, that is indicated that jagong and singkong had great potential as a secondary processed staple food. Meanwhile, cengek, bawang beureum, and bawang bodas are utilized in small amounts to supplement the staple food that provides added value to food. Some supplementary, flavoring, or complementary ingredients. Such as; Rebung, Melinjo, and menteng are underutilized only as a source of vegetables and fruits. Research states (Widiarti 2017) that rebung contain vitamins, minerals, and essential amino acids needed for the digestive system and energy. Consuming rebung regularly is a preventive measure to inhibit various diseases, including cancer (Rachmadi 2011).

A total of 101 food plants (48 families) were used by Sundanese ethnic Nyangkewok Hamlet of West Java. Index of retention showed that the local knowledge of food plants was lower in the younger generation than the older group (>50 years old). Pare (*Oryza sativa*) is the highest Cultural Food Cultivated Index. Environmental conservation depends not only on ecological values but also on socio-cultural, political, and Econo.

ACKNOWLEDGEMENTS

The author would like to thank the Ministry of Research, Technology, and Higher Education for funding this research and the local informants of Nyangkewok Hamlet in Sukabumi District, Indonesia, for participating in the surveys and sharing their knowledge on the use of plants.

REFERENCES

Amir HM, Grace OM, Wabuyele E, Manoko MLK. 2019. Ethnobotany of *Aloe* L. (Asphodelaceae) in Tanzania. South African J Bot 122: 330-335. DOI: 10.1016/j.sajb.2019.01.038.

Bangsawan I. 2012. Hutan sebagai penghasil pangan untuk ketahanan pangan masyarakat: Studi kasus di Kabupaten Sukabumi. J Penelit Sos Ekonomi Kehutan 9 (4): 185-197. DOI: 10.20886/jsek.2012.9.4.185-197. [Indonesian]

Bernard HR. 2006. Research methods in anthropology: Qualitative and quantitative approaches Fourth Edition. Alta Mira Press, Oxford.

Campos LZ, Nascimento ALB, Albuquerque UP, Araújo EL. 2018. Use of local ecological knowledge as phenology indicator in native food species in the semiarid region of Northeast Brazil. Ecol Indicat 95: 75-84. DOI: 10.1016/j.ecolind.2018.07.016.

Cramer H, Kessler CS, Sundberg T, Leach MJ, Schumann D, Adams J, Lauche R. 2017. Characteristics of Americans choosing vegetarian and vegan diets for health reasons. J Nutr Educat Behavior 49 (7): 561-567. DOI: 10.1016/j.jneb.2017.04.011.

Crepaldi CG, Campos JLA, Albuquerque UP, Sales MF. 2016. Richness and ethnobotany of the family Euphorbiaceae in a tropical semiarid landscape of Northeastern Brazil. South African J Bot 102:157-165. DOI: 10.1016/j.sajb.2015.06.010.

Creswell JW. 2016. Research design: qualitative, quantitative, and mixed methods approaches. Pelajar, Yogyakarta.

Cui X, Wang B, Wu Y, Xie L, Xun P, Tang Q, Shen X. 2019. Vegetarians have a lower fasting insulin level and higher insulin sensitivity than matched omnivores: A cross-sectional study. Nutr Metab Cardiovasc Dis 29 (5): 467-473. DOI: 10.1016/j.numecd.2019.01.012.

Iswandono E, Muhammad Zuhud EA, Hikmat A, Kosmaryandi N. 2015. The ethnobotany knowledge of manggarai tribe and the implication utilization of forest plants in The Mountains of Ruteng. J Ilmu Pertan Indonesia 20 (3): 171-181. DOI: 10.18343/jipi.20.3.171.

Jeffrey, C. 1980. A review of the Cucurbitaceae. Botanical Journal of the Linnean society 81(3): 233-247. DOI: 10.1111/j.1095-8339.1980.tb01676.x.

Iskandar J, Iskandar BS. 2017. Various plants of traditional rituals: Ethnobotanical research among The Baduy Community. Biosaintifika 9 (1): 114-125. DOI:10.15294/BIOSAINTIFIKA.V9I1.8117.

Lee TK, Kang HR, Kim KH. 2018. A new feruloyl glyceride from the roots of Asian rice (*Oryza sativa*). Brazilian J Pharmacogn 28 (4): 421-424. DOI: 10.1016/j.bjp.2018.05.004.

Martin GJ. 1995. Ethnobotany: A methods manual. Ethnobotany: A Methods Manual. Springer Science+Business Media, Dordrecht.

Morin É, Michaud-Létourneau I, Couturier Y, Roy M. 2019. A whole-food, plant-based nutrition program: Evaluation of cardiovascular outcomes and exploration of food choices determinants. Nutrition 66: 54-61. DOI: 10.1016/j.nut.2019.03.020.

Moteetee A, Moffett RO, Seleteng-Kose L. 2019. A review of the ethnobotany of the Basotho of Lesotho and the Free State Province of South Africa (South Sotho). South African J Bot 122: 21-56. DOI: 10.1016/j.sajb.2017.12.012.

Neelo J, Kashe K, Teketay D, Masamba W. 2015. Ethnobotanical survey of woody plants in Shorobe and Xobe Villages, Northwest Region of Botswana. J Plant People Appl Res 14: 367-379. DOI: 10.17348/era.14.0.367-379.

Nesbitt M, McBurney RPH, Broin M, Beentje HJ. 2010. Linking biodiversity, food, and nutrition: The importance of plant identification and nomenclature. J Food Composition Anal 23 (6): 486-498. DOI:10.1016/J.JFCA.2009.03.001.

Pieroni A. 2001. Evaluation of the cultural significance of wild food botanicals traditionally consumed in Northwestern Tuscany, Italy. J Ethnobiol 21 (1): 89-104.

Rachmadi AT. 2011. Pemanfaatan Fermentasi Rebung Untuk Bahan Suplemen Pangan Dan Tepung Serat. J Ris Industri Has Hutan 3 (1): 37. DOI: 10.24111/jrihh.v3i1.1187.

Rauf AW, Lestari MS. 2009. Pemanfaatan komoditas pangan lokal sebagai sumber pangan alternatif di Papua. J Penelit Pengemb Pertan 28 (2): 54-62. DOI: 10.21082/jp3.v28n2.2009.p54%20-%2062.

Rizio AA, Dennis NA. 2014. The cognitive control of memory : Age differences in the neural correlates of successful remembering and intentional forgetting. PLoS ONE 9 (1). DOI: 10.1371/journal.pone.0087010

Rizza LS, Smachetti MES, Do Nascimento M, Salerno GL, Curatti L. 2017. Bioprospecting for native microalgae as an alternative source of sugars for the production of bioethanol. Algal Res 22: 140-147. DOI: 10.1016/j.algal.2016.12.021.

Rodríguez MA, Angueyra A, Cleef AM, Van Andel T. 2018. Ethnobotany of the Sierra Nevada del Cocuy-Güicán: Climate change and conservation strategies in the Colombian Andes. J Ethnobiol Ethnomed 14 (1): 1-12. DOI: 10.1186/s13002-018-0227-6.

Santoro FR, Luiz A, Nascimento B, Soldati GT, Soares W, Júnior F, Albuquerque UP. 2018. Evolutionary ethnobiology and cultural evolution : opportunities for research and dialog. J Ethnobiol Ethnomed 14 (1): 1-14. DOI: 10.1186/s13002-017-0199-y.

Schmidt, F. H dan Ferguson, J. H. A. 1951. Rainfall Types Based On Wet and Dry Period Rations for Indonesia With Western New Guinea. Kementrian Perhubungan Meteorologi dan Geofisika, Jakarta.

Silalahi M, Nisyawati, Anggraeni R. 2018. Studi etnobotani tumbuhan pangan yang tidak dibudidayakan oleh masyarakat lokal Sub-Etnis Batak Toba, di Desa Peaudungdung Sumatera Utara, Indonesia. Universitas Sebelas Maret, Surakarta, 16 Desember 2018. [Indonesian]

Silalahi M, Supriatna J, Walujo EB, Nisyawati. 2015. Local knowledge of medicinal plants in sub-ethnic Batak Simalungun of North Sumatra, Indonesia. Biodiversitas 16 (1): 44-54. DOI: 10.13057/biodiv/d160106.

Surata IK, Gata IW, Sudiana IM. 2015. Studi etnobotanik tanaman upacara Hindu Bali sebagai upaya pelestarian kearifan lokal. J Kajian Bali 5 (2): 265-284.

Suryana, Iskandar J, Parikesit, Partasasmita R. 2018. Ethnobotany of tree ferns in pasir menyan hamlet, Sukamandi village, Subang, West Java, Indonesia. Biodiversitas 19 (6): 2044-2051. DOI: 10.13057/biodiv/d190609.

Syarief R, Fatchiya A. 2014. Kajian Model Pemberdayaan Ketahanan Pangan di Wilayah Perbatasan Antar Negara (Assessment of Food Security Empowerment Modelin Inter-State Border). Jurnal Ilmu Pertanian Indonesia 19 (1), 9-13. [Indonesian]

Syarief R, Sumardjo, Kriswantriyono A, Wulandari YP. 2017. Food security through community empowerment in conflict prone area Timika Papua. J Ilmu Pertanian Indonesia 22 (3): 163-171. 10.18343/jipi/22.3.163.

Widiarti A. 2017. Pengusahaan rebung bambu oleh masyarakat, studi kasus di Kabupaten Demak dan Wonosobo. J Penel Hutan Konservasi Alam 10 (1): 51-61. DOI: 10.20886/jphka.2013.10.1.51-61. [Indonesian]

Wiryono, Japriyanto, Erniwati. 2017. The diversity of locally utilized plants and local botanical knowledge in Central Bengkulu District, Bengkulu Province, Indonesia. Biodiversitas 18 (4): 1589-1595. DOI:10.13057/BIODIV/D180436.

Wiryono, Wanandi Y, Ilahi AK, Deselina, Senoaji G, Siswahyono. 2019. The local knowledge of plant names and uses by Semende Tribe Peope in Kaur District, Bengkulu Province Indonesia. Biodiversitas. 20 (3): 754-761. DOI: 10.13057/biodiv/d200320.

World Health Organization. 1999. WHO monographs on selected medicinal plants volume 1. World Health Organization, Geneva

Zuhud EA. 2009. Kebijakan pembangunan kesehatan masyarakat indonesia yang "Bhineka Tunggal Ika" dengan pengembangan potensi lokal Ethno-Forest-Pharmacy (Etno-Wanafarma) pada setiap wilayah sosio-biologi satu-satuan masyarakat kecil. Seminar POKJANAS TOI XXXVI, Yogyakarta. [Indonesian]

Zuhud EAM. 2011. Pengembangan desa konservasi hutan keanekaragaman hayati untuk mendukung Kedaulatan Pangan dan Obat Keluarga (POGA) Indonesia dalam menghadapi ancaman krisis baru ekonomi dunia di era globalisasi. IPB, Bogor. [Indonesian]

ASIAN JOURNAL OF ETHNOBIOLOGY
Volume 3, Number 1, May 2020 E-ISSN: 2580-4537
Pages: 23-29 DOI: 10.13057/asianjethnobiol/y030104

Diversity of plants as a food supplement and medicine for livestock: Local culture in cattleman communities

HARMEN♥
Animal Product Quality Assurance Laboratory, Animal Husbandry, and Animal Health Service of West Sumatra Province. Jl. Rasuna Said 68, Padang 25139, Sumatera Barat, Indonesia. Tel./fax.: +62-751-28060, ♥email: harmendisnak@gmail.com

Manuscript received: 15 October 2019. Revision accepted: 18 May 2020.

Abstract. *Harmen. 2020. Diversity of plants as a food supplement and medicine for livestock: Local culture in cattleman communities. Asian J Ethnobiol 3: 23-29.* Various types of plants can be used as food for livestock. In addition to its function as feed, several types of plants can also be used as medicines for livestock. The research aims to record the types of plant species that farmers traditionally used as feed supplements and medicinal for livestock. Observations were made using a survey method in three regions in West Sumatra, namely Tanah Datar, Solok, and Limapuluh Kota District. Sampling was carried out randomly (random selection) by picking up breeders considered successfully (breeder having more than five cows) and familiar with traditional medicines as a sample. Interviews were conducted to obtain information on the plants used as supplements or medicinal. Furthermore, the plant types were recorded in their location of growing. All kinds of plants were documented in the form of photographs. Data were displayed descriptively, i.e., images with supporting information. The observations found more than 15 types of plants commonly used by cattlemen to increase growth, reproductive capacity, and medicinal if livestock had health problems.

Keywords: Livestock, local culture, supplement, plants medicine

INTRODUCTION

West Sumatra (Indonesia) is an agricultural area with a flat topographical structure and moderately steep slope. The agriculture and animal husbandry sector has been developing in West Sumatra from ancient times, so there is a philosophy in the community, i.e., "*Padi Manguniang Jaguang Maupiah Taranak Bakambang biak.*" This means the community also has livestock breeding for their savings other than growing rice and corn as a food source. That's why agriculture has been a culture of the society in West Sumatra for generations.

West Sumatra has a population of 5.48 million and 255.525 farming houses in the district/city. The populate of large ruminant livestock consists of 393,491 beef cattle and 110,236 buffaloes, while the poultry consists of 9,222,765 laying breeds, 4,054,846 dual-purpose breeds (non-race chicken), and 26,232,909 meat breeds (broiler/race chicken) (BPS of West Sumatra, 2018). The area of West Sumatra is 42,229.64 km^2 with an area of cultivation land of 23,356.85 km^2, which strongly supports the development of the livestock sector. Geographically, the location of West Sumatra Province is 0º 54' NL - 3º 30' SL and -98º 36' WL - 101º 53' WL with a height of about 2 m to 2,912 m asl. Agro-climatically, West Sumatra has a temperate climate with temperatures ranging from 17 to 27 C and high rainfall levels ranging from 1,980 to more than 5,000 mm/year (BMKG 2019).

West Sumatra has many mountains and rivers so that the soil is fertile, and it has the potential for a diverse species of plants. The complete institutional infrastructure in West Sumatra Province supports the acceleration of animal husbandry development. Some supporting infrastructure such as Animal Husbandry and Animal Health Service, Faculty of Animal Husbandry, Snakma, BPPV Bukittinggi, BPTU Padang Mengatas, BPTP Sukarami, Quarantine, Keswan Post, Pus IB, UPTD BIB Tuah Sakato, UPTD Poultry Simpang Empat, RPH, Livestock Market, UPTD Beef Cattle Air Rundiang, Breeder Club. In a forum, these institutions work together in the International Breeding Center for Cattle (IBCfC), West Sumatra. Regarding the Synergy Team of the Faculty of Animal Husbandry of Andalas University study, agricultural land capacity for the development of ruminants in West Sumatra was 3,250,000 animals.

Along with the development progress of animal husbandry, there is a demand that all production costs must be optimized to produce the expected outputs. The high cost of production, mainly commercial feed and medicine, requires other alternatives to overcome the problem. In addition, the increasing public awareness of the importance of food safety can encourage breeders to utilize various plants traditionally used as feed supplements and medicines.

A plant having medicinal properties is one of the alternatives in the supply of feed ingredients with multiple functions. The parts of this plant are used as additional food for the growth and productivity of livestock and as a control of animal health for both poultry and ruminant animals. Some breeders have already used natural ingredients to feed their animals. Therefore it is necessary to record and expand medicinal plants available in the local area. Many plants around the local environment can be used as feed supplements and medicinal for livestock, such as rambutan leaves, areca leaves, katuk leaves, moringa leaves, betel leaves, and hibiscus leaves. The use of this

plant can be singly, or as a mixture in various forms (powder or concoction), that can be given to poultry and ruminants. Its use is done in multiple ways, including drinking water or mixed feed as supplement food. This local wisdom in the farming community needs to be inventoried.

Based on the above, observations have been made to record and obtain information on plant diversity as feed supplements and medicines for livestock.

MATERIALS AND METHODS

Observation location

Sampling and sources of information came from farmers in the Solok District, Tanah Datar District, Limapuluh Kota District of West Sumatra Province, Indonesia, and were conducted from January to August 2019. The map of the observed locations can be seen in the picture below (figure 1). This research uses stationery, a camera, GPS, and a questionnaire.

Methods

The method used in this observation is a survey method. The survey was conducted to record the types of plants used by farmers by inventorying and interviewing. The interviewed farmers are farmers who have knowledge in the use of plants as medicine for livestock and are usually to using these plants, even from generation to generation. At each location, one farmer was determined to be interviewed. The farmers interviewed were owners of livestock breeding with a minimum of five cows.

Interviews were conducted to obtain information on plant species regularly used as feed ingredients/feed supplements and medicines for livestock, how to process them, and their application to livestock.

Data analysis

The results of observation were analyzed descriptively and displayed in tables and pictures.

RESULTS AND DISCUSSION

General description of the observation location

Plant sampling locations are at an altitude of 500 - 750 m above sea level. In the sampling area, there are many animal husbandry locations around the valley and the foothills of the three mountains, namely the Merapi, Talang, and Sago. Farmers regularly use plants as supplement food and medicine when the livestock's health got a problem. At the research location, it's common to find breeders who understand these matters. The study area is the center of beef cattle in West Sumatra. A general description of the site can be seen in Table 1.

Types of plants that are used as feed supplements and medicines for livestock

The results of interviews with farmers and observations of plant species used as medicinal and supplements for breeders come from the types of trees and shrubs found in the area around the farm. This type of plant has been used for medicinal, both for humans and animals. Plant species are named accordingly to where they are found, which is sometimes different from common Indonesian names (Table 2).

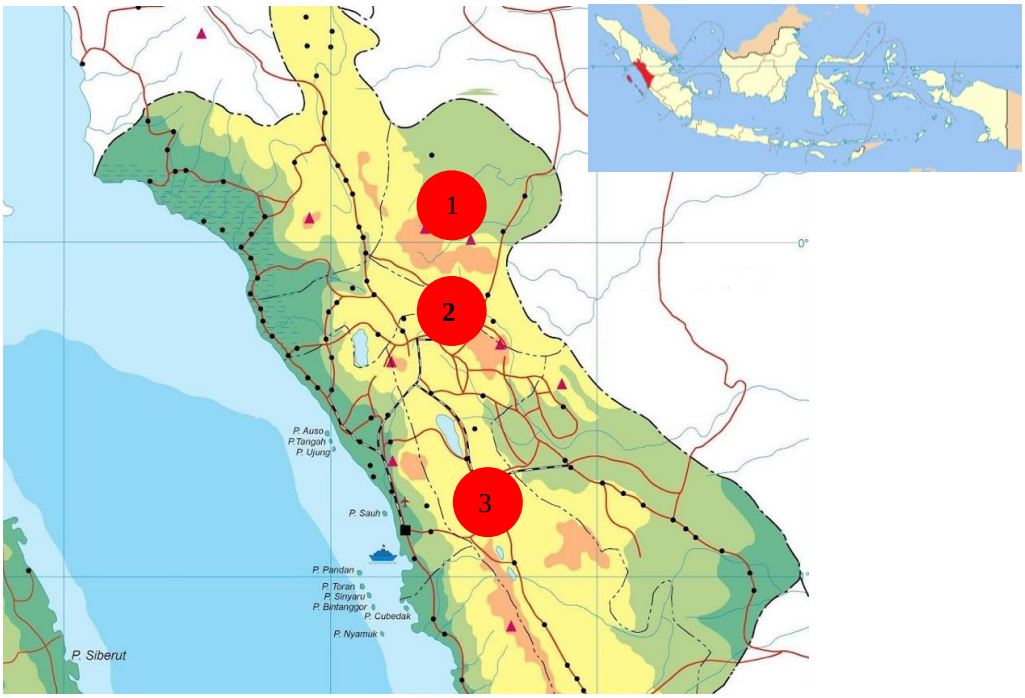


Figure 1. Map of observation location in West Sumatra, Indonesia. 1. Lima Puluh Kota 2. Tanah Datar 3. Solok

Tabel 1. General description of research locations

Location	Parameter	
	Altitude (m. asl)	Location Coordinates
Tanah Datar, Kecamatan Salimpaung, Nagari Tanjung Lurah	750-1000 m	0°20'58.8"S 100°31'43.9"E
Limapuluh Kota, Kecamatan Lareh Sago Halaban, Nagari Labuah Gunuang	450-1000	0°20'16.8"S 100°42'44.2"E
Kabupaten Solok, Kecamatan Kubung, Nagari Saok Laweh	402-420	0°46'20.0"S 100°40'53.2"E

Table 2. Types of plants used as medicinal materials and feed supplements by farmers

Scientific name	Indonesian name	Regional name (Minang)
Areca catechu	Pinang	Pinang
Moringa oleifera	Kelor	Marunggai
Annona muricata	Sirsak	Durian Balando
Manilkara zapota	Sawo	Saus
Carica papaya	Pepaya	Kaliki
Toona Sureni	Suren	Surian
Psidium guajava	Jambu biji	Jambu Peraweh
Bambuseae spp	Bambu	Batuang
Hibiscus Sinensis	Kembang sepatu	Bungo rayo
Nephelium lappaceum	Rambutan	Rambutan
Gliricidia sepium	Gamal	Dadok medan
Curcuma longa	Kunir	Kunyit
Citrus aurantifolia	Jeruk nipis	Asam kapeh
Piper betel	Sirih	Siriah
Tithonia diversifolia.	Daun paitan	Bungo paik

From the table, it can be seen that some plants can be used as food, medicine, or supplements for livestock. These plants have their regional names based on the location of the plants found. Generally, all plants were found in all observed areas and were named in the Minang language.

The function and use of plants that farmers use as medicine and food supplements

Areca nut (pinang)

Areca nut tree is a tree-shaped plant and grows in various regions in Indonesia. Its scientific name is *Areca catechu* (English: Betel palm or Betel nut tree), and it is a type of monocot plant classified as a palm tree. Areca tree belongs to the Arecaceae family in the order Arecales (Heyne 1987). According to the area where it grows or its colors, Areca nut is named according to where it grows, such as Irian areca nut, yellow areca nut, *pinang*, and others. *Pinang* also has a different name in each region, such as in Aceh, it is called "*pineung*"; in Batak/Toba, "*pining*"; in Sunda or Java, it is called "*jambe*."

Areca nut has many benefits, especially in the food and energy industries (as biofuel). The use of areca nuts as an ingredient, eaten with piper betel leaf, has become a custom for generations in certain regions in Indonesia, but the consumers are limited. Empirically the seed of the areca nut can overcome various types of diseases. Multiple benefits that can be obtained from the use of kernel of areca nut are as follows: basic need, energy source, and ingredient in traditional ceremonies (i), substitute for cigarettes, digestion regulator, and component to prevent sleepiness (ii), cosmetic and slimming ingredient (iii), ingredient of a standard drug (iv), and antidepressant (v) (Barlina 2007).

Almost all parts of areca nut plants can be used. The functions and benefits of areca nut differ according to their intended use. Areca nuts can be used as ingredients by breeders for their livestock, such as poultry and large animals or ruminants. Ruminant breeders, for example, have used young areca leaves and ripe areca nuts as medicines for cattle (Figure 2).

Breeders assume that areca nuts are helpful as an energy booster for their livestock. Breeders provide areca nut concoctions with other ingredients for cattle that have just given birth. Breeders offer cattle that have just given birth to this herb to accelerate the release of the placenta.

Use areca nut by processing and adding it with other materials or plants, such as bamboo leaves, honey, duck eggs, and water. While the leaf part is used, it means the young areca nut leaves. This leaf mixture was added with bamboo leaves, one duck egg, two tablespoons of honey, and ½ liter of water. This mixture is blended with a blender; then, it is given to cattle.

Another areca nut beneficial to livestock is the ripe areca nut (Figure 2. B). The processed ripe betel nut is used as a tapeworm medicine (*Taenia saginata*) and liver worms (*Fasciola gigantica*). To use it, some mature betel seeds are ground into areca nut powder mixed with *piladang* leaves (*Solenostemon scutellarioides* (L.) Codd) sufficiently and added with ½ liter of water. After that, the mixture is squeezed, and the concoction is given to the cattle three times a day, starting in the morning.

There are so many benefits of areca nut that humans can take. The processing of ripe fruit is also a source of income for farmers. Ripe fruit is taken seeds, dried, and then marketed (Kristina et al. 2007).

Moringa

Moringa is a type of plant from the Moringaceae tribe, with its scientific name *Moringa oleifera*. This plant tall-increase, live long, bloom throughout the year, and withstand extreme heat conditions. Moringa is a shrub that can have a trunk with a height of 7 -11 m (Amzu 2014).

A **B**

Figure 2. Areca palm (A) and ripe betel nut (B)

In West Sumatra, the moringa tree is called merunggai, which is usually planted as a border plant for hedge and yard and has medicinal properties. The Marunggai tree's trunk is not so big. The wood trunk is brittle (easily broken), and its branches are rare but have strong roots. The leaves are oval-shaped with small sizes arranged compound in a single stalk.

In human life, the moringa tree is beneficial. This tree has many benefits for humans as herbal medicine, which is considered could overcome various types of diseases, including cancer (Mardiana et al., 2012). From the results of the analysis of nutrient content, it can be seen that the merunggai leaf has outstanding potential to complement the nutritional needs of the body. By consuming merunggai leaves, the healthy balance in the body will be fulfilled. Human consuming merunggai leaves will be helped to increase their energy and endurance. In addition, merunggai leaf is also efficacious to overcome the various complaints caused by lack of vitamins and minerals, such as vitamin A deficiency (visual impairment) and Choline deficiency (accumulation of fat in the liver) (Amina et al. 2015).

As for livestock, Moringa can be used as high-quality feed ingredients with complete nutritional content and efficaciously as medicinal such as improved reproduction of animals, treating malaria, supplementary feeds, and others. Based on the experience of breeders, almost all parts of Moringa plants can be used as nutritious and medicinal feed for ruminants. Young leaves and twigs/leaf stems can be used as a feed supplement in the ration because they contain high nutritional elements. Even moringa leaves can be used as a substitute for Starbio in the manufacture of fermented feed. Moringa leaves for meals are usually added by several other elements such as *paitan* grass leaves, *Gamal* leaves, *lamtoro* leaves, *rumen* contents, bran, and molasses, as shown in Figure 3.

Figure 3. A. *Paitan* flower tree, B. *Marunggai*/Moringa tree, C. *Gamal* tree, D. *Paitan* leaf stalk, E. *Marunggai* tree shoot, F. *Gamal* leaf stalk, G. *Lamtoro*,H. Bran, I. Molases

A **B** **C** **D**

Figure 4. A. Soursop tree, B. Soursop fruit, C. *Rambutan* tree, D. *Rambutan* leaves

Moringa leaves and other ingredients are dried in the sun and made into a powder to make fermented feed. Mix the powder ingredients with bran plus Starbio, molasses and then dry them all, and at last, they are all ready to be used/utilized. As a probiotic in straw fermentation, 2 kg of the mixture can be added into 1 ton of feed. This mixture can also prevent and treat malaria, intestinal worms, bloating, decreased appetite, and reproductive disorders in cattle.

Soursop

Soursop's scientific name is *Annona muricata* L, and it is commonly called *Durian balando* in the area of West Sumatra. Soursop is a valuable plant originating from the Caribbean, Central America, and South America. In Indonesia, soursop can grow well at 1000 m above sea level. Soursop trees can reach a height of 9 m.

Soursop fruit is widely consumed and used for treatment. In soursop leaves, there can be found acetogenin compounds helpful in treating various diseases (Puspitasari 2016). An excellent benefit for the health and treatment of livestock is to reduce the body temperature of animals. Then it can also be utilized as a calming agent, especially for cattle that have just traveled or are recently moved from specific places/locations.

The way to use soursop leaves as a medicine for reducing the body temperature of cattle is by adding 1 ounce of rambutan leaves (Figure 4) into 1 ounce of soursop leaves and then adding them with 3 ounces of palm sugar and ½ liter of water. Give the concoction to the cattle.

Turmeric

Turmeric is a native plant of Southeast Asia and has its scientific name of *Curcuma domestica* Val. It is one of the Zingiberaceae plants widely planted in woods and gardens. The word *Curcuma* is derived from the Arabic *Corkum*, which means yellow (Winarto 2005). This plant is widely grown or cultivated as a supplement to herbs or medicinal herbs; However, it is considered traditional, but turmeric has been studied in the laboratory globally to determine the content of substances and their effects on health (Ghofur et al. 2016).

Turmeric adds a bright or reddish yellow color to the yolk in animal husbandry. When mixed into the chicken ration, turmeric can eliminate the smell of chicken excrement and increase chicken weight (Said 2001). Turmeric parts used to increase appetite and flatulence in cattle are the rhizome.

The way to use it is by processing turmeric rhizome into powder and then adding other ingredients such as lime juice and one duck egg then blended with a blender. The mixture is given to cattle before breakfast for three days.

Hibiscus.

In Indonesian, this flower is called *kembang sepatu*, with the scientific name of *Hibiscus rosa-sinensis*. Hibiscus leaves (Figure 6. A) are used to reduce body heat, a symptom of fever in humans and livestock. It also smoothens the process of birth and fetal growth in the uterus for livestock. Sweet potato leaves are usually added to hibiscus (Figure 6. C) and water derived from burned *kalek* banana midrib as a medicinal content (Figure 6. B).

To prepare those medicinal herbs is as follows: the stem of the *kalek* banana is burned and squeezed to take water out. The water is collected in a pail. Hibiscus leaves and sweet potato leaves are added to the water then pressed. This water is given to the livestock as a drink, and the pulp is given to livestock as food.

Guava

The Guava plant's Latin name is *Psidium guajava*, better known as *jambu paraweh* (Minang language). It can flourish in low areas up to 1200 m above sea level, but it cannot grow well in a too hot or too cold area. The size of this plant reaches 3-10 m (Mursito 2002). Traditionally, all parts of this plant are beneficial and have medicinal properties such as the leaves, the stems, the fruit flesh, and the roots. To compare, Ethanol extract of guava white fruit flesh has a more vigorous activity against *Salmonella typhi* than ethanol extract of red guava fruit flesh. Thus ethanol extract of guava white fruit flesh could be more effective for treating diarrhea caused by *S. typhi* bacteria (Adnyana et al. 2004).

Some symptoms of disease in cattle are treated with this guava. Breeders use this plant to treat cattle suffering from indigestion with symptoms of diarrhea.

The simple use of this fruit is as follows: the bark, the leaves, the fruit flesh, and the roots added by fruit sauce/sapodilla and salt. It is crushed/chopped and then is boiled. This mixture is drunk on sick cattle.

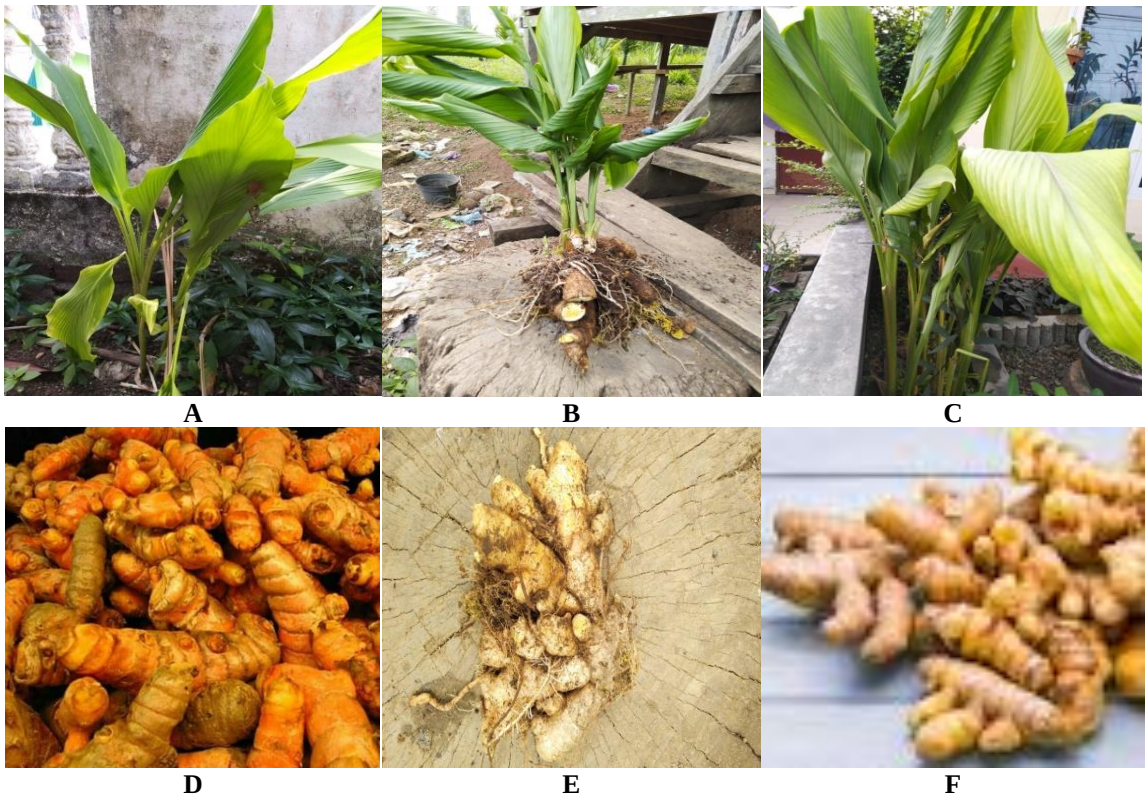


Figure 5. A. Ordinary turmeric plants, B. White turmeric, C. Charcoal turmeric, D. Rhizomes of ordinary turmeric plants, E. Rhizomes of white turmeric, F. Rhizomes of charcoal turmeric (Private collection 2019; Rafikasari 2019)

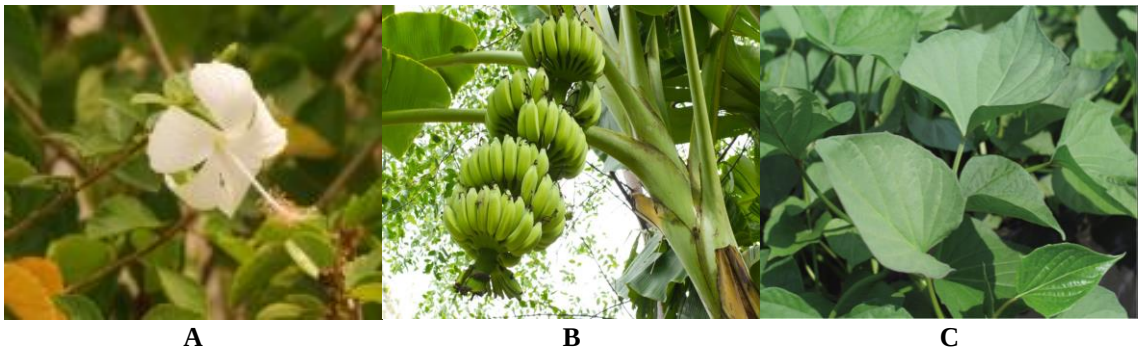


Figure 6. A. *Hibiscus*, B. *Kalek* banana, C. Sweet potato leaves

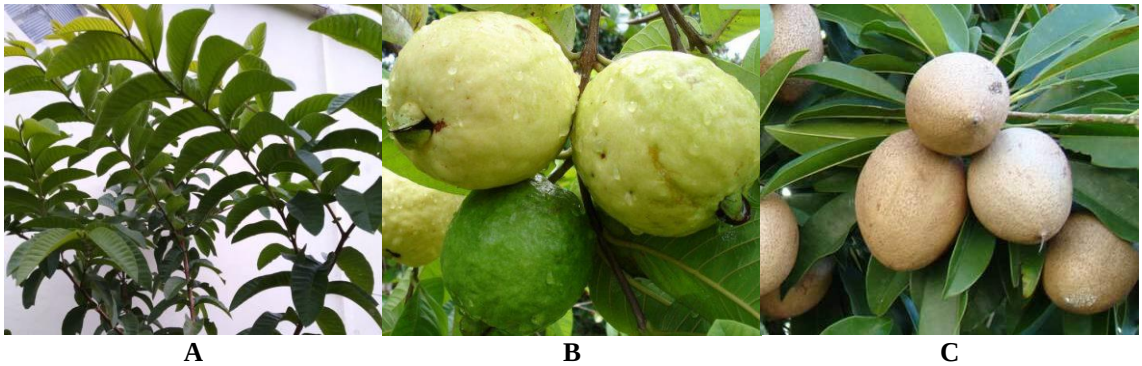


Figure 7. A. Guava tree, B. Guava fruit, C. Sapodilla

A **B**

Figure 8. A. Betel plants, B. Betel leaves

Betel

Betel is a native plant of Indonesia with its scientific name of *Piper betle*. It grows by creeping or leaning against other tree trunks (Mursito 2002). Betel leaf is known for its antiseptic, anti-inflammatory, and skin conditioning properties. For humans, its benefits are not only for the outer part of the body but also for the inner part of the human, such as the health of digestive and reproductive organs. Betel leaf is one of the herbal leaves with many benefits that humans can utilize. The properties of the leaves are most famous for their cleansing properties in humans (Soedibjo 1992).

Besides that, breeders also use betel leaves as cough medicine and influenza for livestock. Preparing it as follows: pick 21 pieces of betel leaf (Figure 8. B) and place it, then add one tablespoon of lump sugar, add ½ liter of water and boil them. The boiled water with the betel leaf is drunk on cattle.

The interviews and observations found that 15 plants can be used as animal feed and medicines. Breeders use plant materials to increase livestock growth, reproductive capacity, and treatment for livestock with health problems. Plants are used singly or in the form of a mixture of herbs.

REFERENCES

Adnyana IK, Elin Yulinah, Joseph IS, Neng FK., Muhamad I. 2004. Efek ekstrak daun jambu biji daging buah putih dan jambu biji daging buah merah sebagai antidiare. Acta Pharmaceutica Indonesia 29 (1): 19-27. [Indonesian]

Amina S, Tezar R, Miflihani Y. 2015. Kandungan nutrisi dan sifat fungsional tanaman kelor (*Moringa oleifera)*. Buletin Pertanian Perkotaan 5 (2): 35-44. [Indonesian]

Amzu E. 2014. Kampung konservasi kelor: upaya mendukung gerakan nasional sadar gizi dan mengatasi malnutrisi di Indonesia. Risalah Kebijakan Pertanian Lingkungan 1 (2): 86-91. DOI: 10.20957/jkebijakan.v1i2.10298. [Indonesian]

Badan Meteorologi Klimatologi dan Geofisika Klimat Sicincin. 2019. Data Curah hujan di daerah Sumatera Barat. BMKG, Jakarta. [Indonesian]

Badan Pusat Statistik Sumbar. 2018. Sumatera Barat dalam Angka: Data populasi ternak di Sumatera Barat-2018, BPS Provinsi Sumatera Barat, Padang. [Indonesian]

Barlina R. 2007. Peluang pemanfaatan buah pinang untuk pangan. Buletin Palma 33: 96-105. [Indonesian]

Ghofur M, Sugihartono M, Arfah J. 2016. Uji efektifitas ekstrak kunyit (*Curcuma domestical*) terhadap daya tetas telur ikan gurami (*Osphronemus gouramy* Lac.). Jurnal Ilmiah Universitas Batanghari Jambi 16 (10): 68-76. [Indonesian]

Heyne K. 1987. Tumbuhan Berguna Indonesia jilid 1. Yay Sarana Wana Jaya, Jakarta. [Indonesian]

Kristina NN, Syahid SF, 2007. Penggunaan Tanaman Kelapa (*Cocos nucifera*), Pinang (*Areca catechu*) dan Aren (*Arenga pinnata*) sebagai Tanaman Obat. Balittro, Bogor. [Indonesian]

Mardiana. L, 2012. Daun Ajaib Tumpas Penyakit. Penebar Swadaya, Jakarta. [Indonesian]

Mursito B, Heru P. 2011. Tanaman Hias Berkhasiat Obat. Penebar Swadaya, Jakarta. [Indonesian]

Puspitasari M, Tara VW, Tri DW, Jaya MM, Nur IPN.2016. Aktivitas antioksidan suplemen herbal daun sirsak (*Annona muricata* L.) dan kulit manggis (*Garcinia mangostana* L.): Kajian pustaka. Jurnal Pangan dan Agroindustri 4 (1): 283-290. [Indonesian]

Rafikasari D. 2019. Kunyit membantu mengobati depresi, Koran Sindonews. https://lifestyle.sindonews.com /read/1444217/155/ kunyit-membantu-mengobati-depresi-1569822730. [20 Januari 2020]. [Indonesian]

Soedibjo M. 1992. Manfaat sirih dalam perawatan kesehatan dan kecantikan. Warta Tumbuhan Obat Indonesia 1 (1). [Indonesian]

Said.A, 2001. Khasiat dan Manfaat Kunyit. PT. Sinar Wadja Lestari, Jakarta. [Indonesian]

Winarto WP. 2005. Khasiat dan Manfaat Kunyit. Agromedia Pustaka, Jakarta. [Indonesian]

ASIAN JOURNAL OF ETHNOBIOLOGY
Volume 3, Number 1, May 2020 E-ISSN: 2580-4537
Pages: 30-38 DOI: 10.13057/asianjethnobiol/y030105

The North Borneo Iranun's community's ethnomedicine knowledge on marsh clam (*Geloina expansa*)

DIANA DEMIYAH MOHD HAMDAN[1,4,♥], JALIHAH MD. SHAH[2,4], FAIZAH GUMPULAN[1], JURRY FOO[2,4], KHAMISAH AWANG LUKMAN[3,4]

[1]Environmental Science Programme, Faculty of Science and Natural Resources, Universiti Malaysia Sabah. Jalan UMS, 88400 Kota Kinabalu, Sabah, Malaysia. Tel. +60-19-6581340, ♥email: diana.demiyah@ums.edu.my
[2]Faculty of Social Science and Humanities, University Malaysia Sabah. Jalan UMS, 88400 Kota Kinabalu, Sabah, Malaysia
[3]Faculty of Medicine and Health Sciences, University Malaysia Sabah. Jalan UMS, 88400 Kota Kinabalu, Sabah, Malaysia
[4]UMS SIMSEA Research Group, University Malaysia Sabah. Jalan UMS, 88400 Kota Kinabalu, Sabah, Malaysia

Manuscript received: 19 April 2020. Revision accepted: 25 May 2020.

Abstract. *Hamdan DDM, Shah JMD, Gumpulan F, Foo J, Lukman KA. 2020. The North Borneo Iranun's community's ethnomedicine knowledge on marsh clam (*Geloina expansa*). Asian J Ethnobiol 3: 30-38.* North Borneo is rich with natural resources that have boundless potential for pharmaceutical product discovery, leading to socio-economic development in rural areas as suppliers. Even though rich with cultural heritage and comprises of hundred sub-ethnic groups, detailed documentation of ethnomedicinal knowledge in North Borneo from different ethnic groups is still limited and could disappear in no time. The ethnomedicinal knowledge of marsh clam (*Geloina expansa*) use in the Iranun community (respondents no.=28) living in Kampung Rampayan Ulu, Kota Belud in North Borneo were investigated, and also the concentration of iron, zinc, and copper in different parts of marsh clam tissues were determined. In postnatal care of the Iranun community, many believe that marsh clam soup help boost nursing mother milk supply. Marsh clam is rich in iron micronutrients, followed by zinc and copper. The mantle organ has a higher iron concentration than other tissues. The traditional knowledge to heal blood clotting and bruises are the topical application of marsh clam mantle organs onto the wound areas. Although participants have the ethnomedicinal ability of marsh clam, they have poor knowledge of the nutritional benefits of this clam. Lifelong learning the use of marsh clam is necessary from local health care.

Keywords: Galactagogue, indigenous knowledge, Iranun, maritime community, transdisciplinary

Abbreviations: ICP-OES: Inductively Coupled Plasma Optical Emission Spectroscopy; MFR 1985: Malaysia Food Regulation 1985

INTRODUCTION

In recent years, there has been an increase of awareness on the importance of the preservation of indigenous knowledge, especially for ethnic groups that did not have their development of writing system until other societies who have writing system transferred this writing system to them (Kheng 1996; Embong et al. 2016; Mandal 2016). Some traditional oral stories have also been confirmed as a narrative that helps scientists understand past natural world catastrophic e and history. The history of North Borneo was recorded from outside people who have a relationship with them. The writing system was adopted late on this island, and only aristocrats had early learning access. Indian cultures once heavily influenced the old Malay World culture before Islam establishment in the Nusantara region was once territories of Hindu empires such as the Srivijaya Empire and Majapahit Empire that had brought along the Sanskrit writings with them (Al Qurtuby 2013, Jalil et al. 2019). The Jawi literature development was modified from Arabic letters when some parts of the Malay World community had converted to Islam religion brought by Arab and Indian traders before Roman letters were still used. There is also a suggestion that some groups of people in tropical regions might have written records in the past, but it was done on perishable items that perished after hundreds of years (Keene 2019). This could be one of the factors why only a few well-preserved records from the old Malay world by locals are available. The political power and religious change throughout the Malay world timeline had caused record preservation to be neglected. However, apart from the writing system, the diverse motif depiction by different ethnic groups in Borneo also has a tale to decipher. The flora and fauna motifs used in the design are usually natural product resources that have the utmost importance in the life of their people and bring many benefits to their users. One of the importance of oral tradition preservations is the traditional ethnomedicine knowledge that can cure illness in the synthesis of medical drug production (Poh et al., 2018).

The technology to extract a substance from natural products is well-refined; specific substances from natural products can be generated from a resource for a clinical study to aid specific ailment (Peng et al. 2017; Hsieh et al. 2018). In contrast, the traditional medicine preparation of natural products will retain all its natural substance composition when the patient is treated. Nowadays, an innovation of pharmaceutical products has been developed that can instantly be used during medical procedures by topical application rather than standard traditional methods

of ingestion such as consumption of snakehead and sea cucumber to enhance wound healing (Poh et al. 2018; Sahid et al. 2018). However, it will take time to test all flora and fauna globally to find the right cure for different disease symptoms. Thus, pharmaceutical drug synthesis literature is based on natural products like common herbs. The uses have been well-recorded from ancient times and are actually traditional medicine (Montaben 2017). In some societies, natural products identified to have medicinal value are from the perception based on taste, smell, and visual (Narchi 2017). The documentation of traditional medicinal natural products is commonly are plant-based (Olawa and Demayo 2015; Rozaimie et al. 2019), whereas there is little documentation on animal use in traditional ethnomedicine knowledge, especially in North Borneo. North Borneo is rich with terrestrial and marine animal diversity that even now, there is often news of recently discovered species. Different ethnic groups in North Borneo could have other traditional ethnomedicine knowledge due to the local natural product resource availability (Rozaimie et al., 2019). Generally, in Borneo, ethnic groups are categorized as either inland people or maritime people.

A large population of North Borneo lives in the coastal areas. One of the ethnic groups in North Borneo, which is a part of maritime society, is the Iranun ethnic group; which is a great historical enemy of the western countries that were trading in the sea trade route of Southeast Asia region and had branded them in their view as pirates (Warren 2002). There were no local words for what the westerners defined as pirates during that century. The colonial power gave birth to the local term of piracy, '*lanun*,''n fear of Iranun's great maneuvering skill in the sea. The Iranun ethnic group had a close political relationship with the Sultanate of Sulu before the colonial came to the Southeast Asia region. Most of what is recorded in the literature concerning the Iranun ethnic group is about their history in the sea trade and political connections (Sajok 2018).

Furthermore, there is a growing concern about the decline of Iranun native speakers and the possibility of losing some of their cultural heritage in dire need of preservation (Smith 2003: Pugh-Kitingan 2010: Amat and Abd Samad 2019). There are limited documentations of Iranun ethnic group ethnomedicine knowledge in North Borneo. Some Iranun ethnic group villages are near mangrove forests with a wide distribution of natural products such as marsh clam (*Geloina expansa*). Marsh clam is a common food source of coastal people, and we investigate if there are other uses of marsh clam in Iranun's ethnomedicine knowledge.

MATERIALS AND METHODS

Study area

Kota Belud district in Sabah state, Malaysia, is a cultural hub (Amat and Abd Samad 2019) where many different ethnic groups live harmoniously in this district, such as the Dusun-Kadazan Bajau-Sama and Iranun ethnic groups. Iranun ethnic group is one of the minorities in Sabah that originated from the Southern island of the Philippines. Iranun is generally categorized as maritime communities because of their widespread reputation as a very skillful seafarer during their strong involvement in sea trade in the Southeast Asia region exceptionally (Warren 2002). The Iranun ethnic group settlement in the coastal areas of North Borneo is mainly located in Kota Belud district, Marudu Bay of Kudat district, and Darvel Bay in Lahad Datu district (Sajok 2018). One of the historic settlements of the Iranun ethnic group is located in Kota Belud district, North Borneo. The Iranun ethnic group villages are usually near coastal areas because they were very involved economically and politically in the maritime sea trade (Sajok 2018). One of the Iranun villages in Kota Belud district is Kampung Rampayan Ulu, an area sheltered by mangrove forests (6º31'13º N, 116º31'00º E). It takes about an hour's drive to Kampung Rampayan Ulu from the capital city of Sabah state, Kota Kinabalu.

Perception and knowledge on marsh clam survey

During the first site visit, semi-structured interviews were conducted to gather preliminary data for constructing a structured questionnaire. A questionnaire that was previously used in different locations and ethnic groups (Hamdan et al. 2019) was adapted according to the suitability of the study site with some addition and modification of multiple-choice questions based on preliminary data. The questionnaire language medium was the Sabah state Malay language dialect, but some words were changed to follow the study site-local most common term used with the help of the locals. The questionnaire was divided into different parts. The first part was to record the socio-demographic and socio-economics of the survey participants in Kampung Rampayan Ulu. Then respondents were given choice selection about their perception and knowledge of marsh clam (Geloina expansa) use as food and natural pharmaceutical resources. The survey was distributed randomly to villagers when *G. expansa* was collected from Kampung Rampayan Ulu. A local villager assisted researchers as a translator to avoid miscommunication during interviews and survey distribution. The total number of survey participants was 28.

Marsh clam heavy metal analysis

A total of 20 individuals adult *G. expansa* in the same size shell range were collected once a month in November 2016, January 2017, and February 2017. *G. expansa* samples were obtained from the same *G. expansa* cage farmer in Kampung Rampayan Ulu. Samples were brought to the laboratory in a cool box (4º C) and washed clean. The abductor muscle, foot, gill, gonad, and mantle organs were dissected from *G. expansa* tissues and dried at 80º C in the oven. Dried samples were ground into a powder, homogenized with 5 mL 65% nitric acid (HNO3), and left overnight. The next day 2 mL HNO_3 was added and heated at 80ºC for 4 hours until complete digestion. Cooled samples were filtered with 0.45 µm Whatman paper and diluted for heavy metal analysis by Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) (Perkin

Elmer Optima 5300DV). Blank solutions were also prepared with the same procedure for control.

RESULTS AND DISCUSSION

Socio-demographic profile

Iranun communities in Southeast Asia have been devoted Muslims for centuries. Some believe this is one of the reasons they had vigorously combated western enterprise during their prosperous sea trade era (Warren 2002). All the survey participants conducted in Kampung Rampayan Ulu, Kota Belud district, belong to the Iranun ethnic group Muslim in faith. The majority of the respondents were female (70.0%), and half were already married (Figure 1). Most of the women who had participated in this survey had at least completed secondary school and are working in the private sector. Only two women were homemakers with no income and no formal education because they were already retirement age. Four women who work in the fisheries sectors participated in this survey, and only one of them earned above the poverty line.

On the other hand, we only managed to have one male participant working in the fisheries sector and above 60 years old during the survey. The male fisherman's monthly income was below the poverty line (RM1215) for rural areas of Sabah. The self-employed three fishermen above 40 years old did not receive any formal education and earned below RM500 monthly income. None of the respondents who participated in this survey were involved in the agriculture industry.

In this modern time, only a few people in Kampung Rampayan Ulu are working at sea as their primary source of income. Moreover, fishers below 40 years old prefer to buy marsh clam as middlemen rather than hunt these natural resources themselves due to the hard work and environmental conditions that had to be endured. In contrast, the older fishermen generation prefers to harvest the marsh clam themselves because they are more accustomed to the mangrove conditions. A similar situation has happened in communities living adjacent to mangrove areas in the Kudat district, North Borneo; many prefer to buy these natural resources rather than venture into the mangrove area (Hamdan et al., 2019). The Rungus community's perception of the Kudat area on which gender is generally associated with marsh clam foraging in a mangrove in Rungus culture points out that it is a woman's work. Nevertheless, there has been an increasing number of males who forage marsh clam in some Rungus communities in recent years due to the demand for marsh clam supply. However, all survey participants from Kampung Rampayan Ulu agree that marsh clam foraging does not focus on any gender.

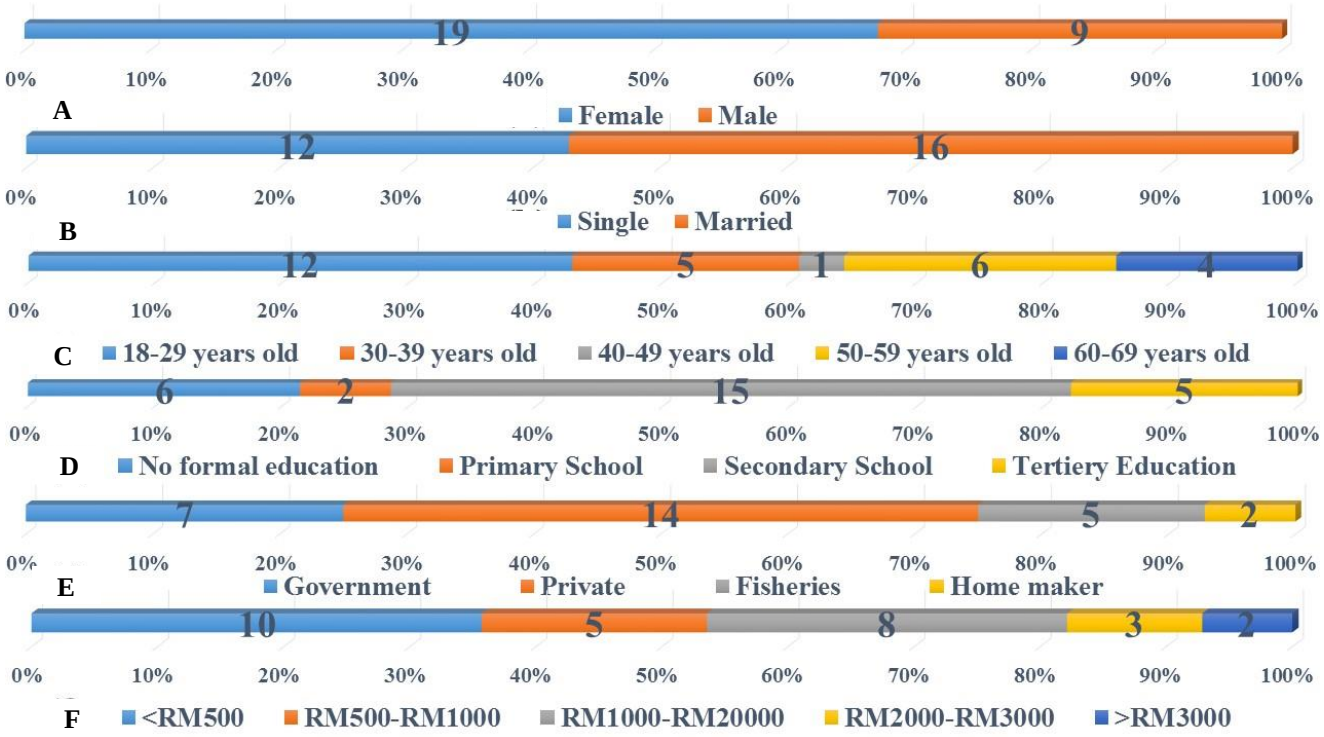


Figure 1. The sociodemographic and socio-economic profile of respondents (n=28) from Kampung Rampayan Ulu, Kota Belud district, North Borneo (n=28) who are Iranun Muslim in percentages of (A) gender, (B) marital status, (C) age, (D) education level (E) working sector, and (F) monthly income

Respondents employed in the government sector have more stability in their monthly earnings. They all have more than RM1000 above monthly income, and all had at least completed secondary school education (Figure 1). Moreover, only two representatives in this survey had revenues of more than RM3000 working in the government sector and are close to the retirement age. Like other parents in the world who want a better future for their child in life by getting a good education, Iranun parents begin to converse less with their children using their native language at home to help their children to grasp the national language that is mainly being used in the primary education (Smith 2003). The younger generation finds it difficult to master their native language because, at school, they need to have a deeper comprehension of the national language of Malaysia and the English language for better opportunities in furthering their study to tertiary education. This has raised concern about the decline of Iranun native speakers, which can cause this language to lose as many languages have been lost in recent years. Initiatives were taken to rectify this situation by providing Iranun language classes to a primary school with many Iranun students in the class. All the respondents living in Kampung Rampayan Ulu under 40 years old had completed their secondary school education except for one participant (Figure 1). The decline of native Iranun speakers is a concern as it can disrupt the oral tradition of passing down indigenous knowledge to the younger generation. Thus, the documentation of traditional indigenous knowledge is essential before it is lost forever.

Rural communities that solely rely on fishing as a source of livelihood face many insecurities and need to find different side income sources. The Sabah state government had developed rubber or oil palm plantation projects in collaboration with locals to alleviate poverty in rural coastal areas (Kodoh et al., 2016). This has shifted some of the main occupations of the locals who participated in this socio-economic development project from the sea to land because the primary source of stable income comes from the rubber or oil plantations. In contrast, a small number of Rungus communities in Marudu Bay have also begun to work more in the sea than land. The Rungus ethnic group has always been associated with the agriculture sector, and very little is known about their history connected to the sea. In recent years, an increasing number of Rungus communities have participated in aquaculture projects (Hamdan et al., 2019). Socio-economic has been one of the key drivers that change the dynamics of community development in this modern world (Mansur and Idris 2016). There is a lack of socio-demographic and socio-economic data for the Iranun community in North Borneo. Most of the literature emphasizes the cultural elements of this community (Amat and Abdul Samad 2019; Mulia 2010). Therefore it isn't easy to gauge how long this marine community has gradually shifted to more land orientated in their current lifestyle. This study can provide data for future studies on the Iranun community in North Borneo.

Mud clam locality as a food resource

Most of the survey participants are seafood lovers, and no one has any allergies to seafood consumption (Table 1). Only two respondents did not enjoy seafood and preferred to eat meat than seafood. Marsh clam is not a staple food in this maritime society. However, they prepare marsh clam as the main dish and consume them once or twice per month (Figure 2). Moderate clam consumption is recommended as bivalves are filter feeders which absorb nutrients from their habitats that can cause toxicity risk if the environment is contaminated with an excessive amount of minerals from the upstream activity caused by agriculture management and industrialization (Hamdan et al. 2016). Moreover, respondents do not have any tips to reduce toxicity risk from marsh clam consumption (Table 1). Marsh clam boil together with blood cockle perhaps can reduce contaminant risk were tips given by only two respondents.

The Iranun community in Kampung Rampayan Ulu is not a heavy marsh clam consumers. All respondents did not consume more than 10 clams per meal, making it at most 20 clams per month per person (Figure 2). On the other hand, the Rungus ethnic group, which is not known as a maritime society in the Kudat district, North Borneo, eats marsh clam more frequently and consumes more than the Iranun community in Kampung Rampayan Ulu (Hamdan et al. 2019). Marsh clam is becoming a popular cheap seafood snack by the roadside in North Borneo, especially in Salut, the outskirts of the capital city of Sabah state, Malaysia (Hamdan et al. 2016). These eateries offered grilled marsh clam where the entrepreneur grilled the marsh clam with charcoal on top of straight zinc slate and sometimes added some herbs on top of the clam flesh. Thus, grilling has increasingly become a popular cooking method for marsh clam in the Iranun community in Kampung Rampayan Ulu compared to the traditional way of preparing marsh clam by marinating. The locals describe it as '*hempap*' (Figure 2). Marsh clam can also be eaten as raw meat (Table 1), and this is also had been observed in other cultures such as the Rungus people of Kudat district, Malaysia (Hamdan et al. 2019).

Table 1. Survey participant (n=28) perceptions on the marine resources as a food source and their life experience with marsh clam as a food source

	Yes	**No**
Seafood lover	26 (93%)	2 (7%)
Prefer to eat seafood rather than poultry meat	26 (93%)	2 (7%)
Allergic to seafood.	0 (0%)	28 (100%)
Like to eat marsh clam.	26 (93%)	2 (7%)
Eat more marsh clam than fish.	0 (0%)	28 (100%)
Enjoy marsh clam as the main dish	20 (71%)	8 (8%)
Raw Marsh Clam ingest experience	16 (57%)	12 (43%)
Know any tips to reduce contaminant risk	2 (7%)	26 (93%)

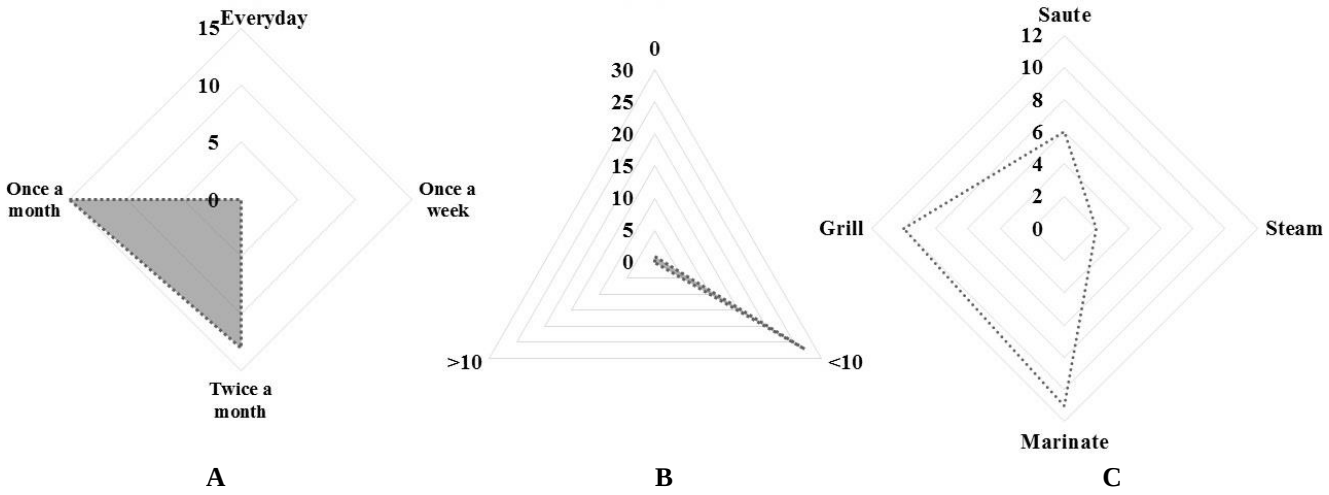


Figure 2. A. Frequency of how often do respondents have marsh clam for a meal. B. The no. of marsh clam that usually respondent eats per meal. C. The common way to prepare marsh clam as a dish that was chosen by the respondents (n=28)

A galactagogue to aid nursing mother

Bivalve is a natural food product rich in micronutrients like iron and zinc, essential for the human body system to function correctly. Iron is necessary for the early baby's development in a mother's womb. Thus, this increases expectant mothers' iron needs in their diet. Local food like marsh clam is a cheap protein source and contains many essential minerals good for health (Hsieh et al., 2018). *G. expansa* harvested in Kampung Rampayan Ulu contains a high concentration of iron followed by zinc and copper (Figure 3). The iron, zinc, and copper concentration in total tissues studied did not exceed the permissible limit of the Malaysia Food Regulation 1985 (MFR 1985). Thus marsh clam collected from Kampung Rampayan Ulu is safe to consume. Marsh clam is widely available for the locals to hunt in the mangrove forest anytime they want. All the respondents have informed that there is no specific season to harvest marsh clam in the mangrove forest and marsh clam is available all year round to catch.

Marsh clam can help supplement pregnant and breastfeeding mothers' diets who earn income below the poverty line than the over-reliance on conventional pharmaceutical supplements. Iron deficiency can cause anemia, and local people can avoid anemia by occasionally consuming clams in their diet. However, all respondents have poor knowledge of the nutritional value of marsh clam that can benefit them (Figure 4. A). Local health care needs to promote indigenous functioning food like marsh clams to the locals as part of their diet as this natural food resource is more fresh, attainable, and cheaper. This can also help promote the local's socio-economic development by eating locally-produced.

Furthermore, not many respondents thought that marsh clam was harvested near their village can pose any health risk (Figure 4. B). By ensuring that marsh clams do not pose any health risk, the fisheries department can regularly monitor the seafood products and inform locals of a red tide occurrence. The local Iranun community knows the impact of red tide on food safety.

Nowadays, all healthcare worldwide strongly encourages mothers to breastfeed their babies as soon as birth because the early nutrient content in breastmilk is beneficial to newborn babies. Borneo people are very supportive towards nursing mothers; At an early stage, family members will support finding ingredients of food resources that can boost milk supply, especially during the post-Partum period (Chang et al. 2015). The Rungus ethnic people in North Borneo are very family-oriented, and some still live in longhouses with extended families. For example, the family elders o,f the Rungus help prepare a soup of marsh clam boil with papaya to help increase breastmilk supply for nursing mothers (Hamdan et al. 2019). Iranun community also uses marsh clam to improve breast milk supply, but many are unsure of its effectiveness due to poor knowledge of the nutritional value of marsh clam (Figure 4). However, this ethnomedicine knowledge is not widely known in North Borneo. For instance, a field study conducted at Kampung Sebayan, Marudu Bay in North Borneo found that the maritime community of the Bajau-Sama ethnic group does not possess any traditional ethnomedicine knowledge on the use of marsh clam.

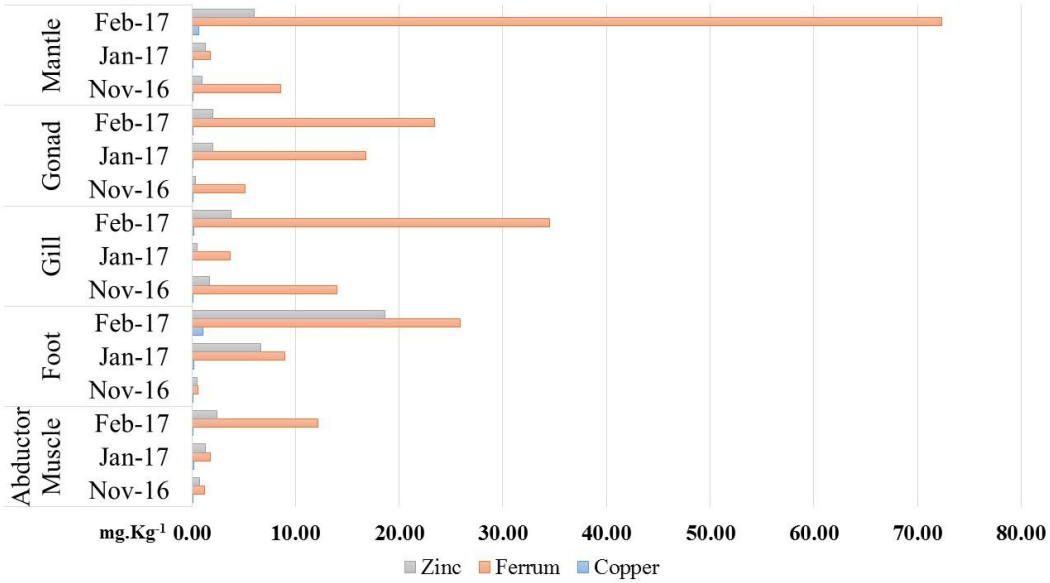


Figure 3 Distribution of zinc, Ferrum, and copper mean concentration (mg.kg^{-1}) in different organs of an individual adult *G. expansa* collected from Kampung Ulu Rampayan in other months.

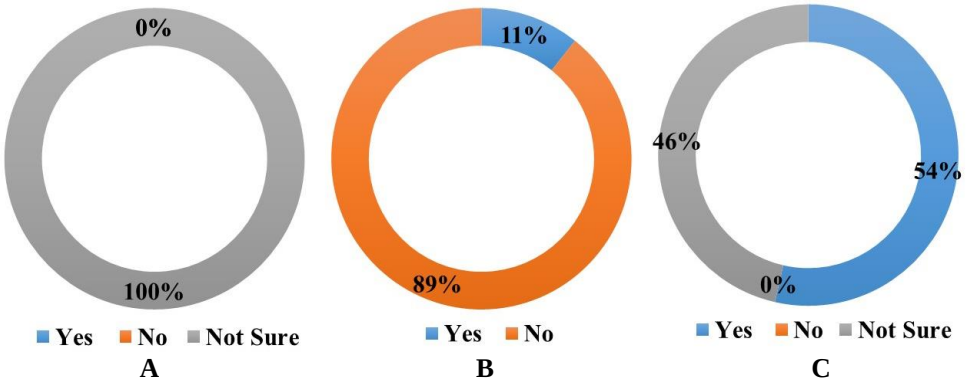


Figure 4. A. Percentages of respondents (n=28) know the benefit of the nutritional value of marsh clam (*Geloina expansa*). B. Respondent thinks that marsh clam can pose a risk. C. Respondents who hold beliefs that marsh clam boost nursing mother breastmilk supply

The importance of postpartum care for mothers who had just given birth to a newborn is common because people in the Southeast Asia region with different cultures and ethnic backgrounds hold the same belief. Traditional medicine during postpartum care is one of the indigenous knowledge that is best preserved among other traditional medicine (Olowa and Demayo 2015). Many different natural product sources are utilized for various needs in postpartum care (Rozaimie et al., 2019). Traditional knowledge of post-natal care is also essential in ensuring that nursing mothers have enough breastfeeding for newborn babies (Montaben 2017). Food resources that can increase breast milk supply for nursing mothers are also called galactagogue. Many traditional galactagogues used in Asia have been recorded, but most are from plant-based resources. There are limited documentations of animal-based galactagogue (Montaben 2017). The human body more readily absorbs substance extract from animals than plant-based. Like plants, Zinc requirements for early seedling growth development are also essential in the early baby's development and growth. Recently Zinc content in mother breastmilk is not sufficient for baby needs as mothers themselves need this mineral for their body function (Aumeistere et al. 2018). Thus, this causes little allocation left of Zinc to breast milk. The type of food in the mother's diet is essential to ensure that Zinc content in breast milk is sufficient, especially for baby growth. Marsh is rich in iron and one functional food rich with zinc micronutrients (Figure 2). A clinical study is recommended to ascertain the merits of marsh clam as nutraceutical food.

Traditional medicinal knowledge of marsh clam topical application

Anticoagulants such as heparin and warfarin are medications that decrease the blood's ability to clot. However, caution must be taken to control the use of anti-coagulants to minimize the risk of hemorrhagic complications. Heparin and other anti-coagulants substance compounds can also be extracted from natural products from marine animals like the bivalve (Ahmad et al. 2018). In these past decades, an increasing number of findings of different bivalve species have been identified as a beneficial functional food for wound healing and anti-coagulation (Cesaretti et al. 2004; Mirshahi et al. 2009). Extracting compounds from bivalve tissues administrated in clinical studies as a supplement had shown quicker recovery of wound areas than the sole reliance on conventional modern medical practice (Peng et al., 2017). Many different substances can be extracted from clam tissues, providing many pharmaceutical properties in treating various ailments. The survival rate of specimens with Alzheimer's disease and cardiovascular disease had increased when *Geloina eros* was included in its diet regime (Hsieh et al., 2018). Organic practice in the poultry industry is without administrating livestock with antibiotics. Bacterial diseases can spread very fast between animals in dense conditions. This is one of the main challenges that organic farmers with limited rearing space currently face. Other alternatives than antibiotics, animals can be given feed products based on supplemented organic materials as marsh clam that contain nutritional value and medicinal value content (Saili et al. 2019). Marsh clam can have a broader scope of the function in the future, not as a food resource but as natural pharmaceutical products that are useful for human medicine and the livestock industry. The diversification of marsh clam functions can also help increase the livelihood of coastal people who hunt this wild food and help sustain community-based-management *Geloina* sp. aquaculture development (Hamdan et al. 2019).

The Iranun community in Sabah is related to the Maranao communities living in the Illana Bay off the southwestern coast of the Mindanao islands, the Philippines, where they were come from (Amat and Abd Samad 2019). Ethnobotanical documentation on Maranao communities in Iranun people's original homeland had been published. This publication reported that one of the most common uses of this natural product is to heal cuts and wounds (Olawa and Demayo 2015). Due to their socioeconomic circumstances, many Maranao people still rely on this natural pharmaceutical product than modern medicine. This shows that indigenous knowledge provides the basis for grassroots decision-making (Senanayake 2006) for healthcare in their household. However, only plant-based natural products were listed in the publication. In traditional medicine, plant-based products could be used for healing wounds, but there are animals like molluscs to which marsh clam belongs, which are believed to have properties that can heal wounds recorded in other cultures (Ahmad et al. 2018).

Nevertheless, the ethnomedicine marsh clam usage for external application to heal blood clotting and the wound was not documented in the literature. Iranun villagers that live in Kota Belud mangrove areas have shared one of the medicinal uses that some still practice today to get rid of blood clotting or bruise on the body are by topical application of raw marsh clam (figure 5. A). The part used for the traditional treatment to heal blood clotting and the wound uses the mantle organ in marsh clam that looks like a layer usually covering other soft tissues in marsh clam. The mantle organ is usually closest to the clam inner hard shell side (Figure 5. B). Other organs are dissected, and only the mantle organ that looks like a thin layer is applied onto the injured areas.

Interestingly, the mantle had a higher concentration of iron (Fe) compared to other orgaJanuary 2017 (Figure 3). Iron is a mineral essential for maintaining a normal process in the blood system. A clinical study will be needed to elucidate how effective this traditional medical treatment is for wound healing is to bridge science and traditional knowledge together as an alternative for cheaper treatment for rural communities whose income is generally below the poverty line. Moreover, indigenous traditional knowledge and basic science need to be promoted so that this valuable information from oral tradition won't be lost in the future.

Another aquatic living use for traditional medicine that has many believers in its effectiveness to heal wounds from surgery is the snakehead (*Channa striatus*) fish. The snakehead fish is locally known as *ikan haruan* and is especially sought out for mothers who had just delivered a newborn baby that had to undergo a cesarean section to assist in a fast recovery. Products from snakehead fish compounds have been innovated for external application and clinical use, which have been proved practical rather than the traditional method by ingestion (Sahid et al. 2018). Sea cucumber (*Stichopus horrens*) is a marine animal for traditional medicine use of people in the Southeast Asian region because it is widely known for its wound healing properties. Not just snakehead but sea cucumber products are also being rapidly developed for external application in clinical use (Poh et al., 2018). The prospect of pharmaceutical products innovation from marsh clam extracts for convenient topical application will increase the demand for this natural product and prompt the fisheries department to support the development of sustainable community-based marsh clam aquafarming that can help alleviate poverty in rural areas (Hamdan et al., 2019). In addition, these pharmaceutical products are also a part of a product that has similar concepts with cosmetic products objective which one of them is to diminish scar visibility.

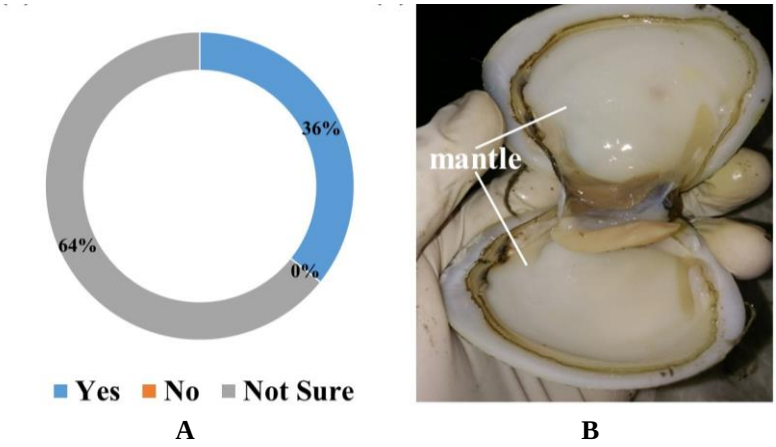


Figure 5. A. Percentages of respondents (n=28) who have heard about the traditional knowledge of Geloina expansa heal blood clotting or bruises and hold this belief. B. The anatomy of *G. expansa* mantle tissues after other organ tissues had been dissected out from the shell

Historically, Iranun ethnic groups are also land people. They also do subsistence farming and are known as people of the lake where they originated from near Lake Lanao in the Philippines. But due to catastrophic natural disasters and different political views, a few seafarer Iranun ethnic groups open up settlements and government in some coastal areas in North Borneo to strengthen their political power in the profitable sea trade route of the Southeast Asia region (Warren 2002). Western countries were prompted to be involved in local politics in this region as Iranun marine military force is a force to be reckoned with, and sometimes war would ensue at sea. Some casualties are common during war times. Therefore there will be a need for medicinal resources at hand to treat injuries. Unfortunately, there were very few records from the Southeast Asia region side apart from Western views during that time. It is left to the imagination of how the Iranun army treats these casualties. During that period, the production of synthetic medicine of these days is not available yet. Hence, it will surely be from natural resources at hand. The uniqueness of marsh clam compared to other marine life is that marsh clam can live several days without water, making it easy to transport anywhere because of the clam keeps water in its shell. Moreover, marsh clam has antibacterial properties (Argent and Ilano 2015). The marsh clam is widely distributed in the mangrove forests of North Borneo and will later be discovered by new settlers when they assimilate with the new environment.

Marsh clam (*Geloina* sp.) in North Borneo is locally known as '*lokan*.' The Rungus ethnic group has their word for '*lokan*,' or '*Tagum*' in the native Rungus language. Interestingly, during the survey was conducted in Kampung Rampayan Ulu, an inquiry of other local names for '*lokan*' in the Iranun community resulted in all the respondents saying they used the term '*lokan*' to refer to marsh clam. Nowadays, not only spoken language that was not successfully transferred to the younger generation orally (Smith 2003) also the skill or knowledge of minority ethnic groups is also rapidly disappearing. One fine example is the disappearance of gong-making in the Iranun community in the Kota Belud district, Sabah, Malaysia (Pugh-Kitingan 2010). They are once acclaimed as the local gong maker that helps provide gong to this region. The gong is an important musical instrument used in many traditional ceremonies of different ethnic groups, such as the Dusun-Kadazan and Bajau ethnic groups. The skill of gong-making ended in the Iranun community in the Kota Belud when the last gong-making practitioners died of old age without any preservation of gong-making production. Nowadays, the famous locally made gong in North Borneo is only available in the Kampung Sumangkap in the Kudat district, part of the eco-tourism initiative. However, the material used for gong making these days is not the same as previous use in the older version due to the production cost.

Some civilizations have written records of the traditional medicinal value of their fauna and flora in the region they live in, which could be passed on to generations (Ahmad et al., 2018). However, many ethnic groups in the Borneoic islands do not have written records. This information is passed down orally to the younger generation interested in preserving their cultural heritage. Preservation of oral tradition is important before the knowledge is lost. It allows future science research to integrate with indigenous knowledge for the benefit of all during this globalization. Marsh clam is one example of marine animal use in Iranun community traditional ethnomedicine knowledge at the moment that has high potential as pharmaceutical resources. North Borneo is one of the world's regions renowned for its rich marine life diversity. More investigations are required to document detailed other marine animal use in traditional ethnomedicine of the Iranun community in North Borneo for the benefit of all, especially to the next generation. Understanding the worth of this marine animal to humans, not just for food resources, can facilitate socio-economic development and alleviate poverty in rural coastal areas when the demand for this natural product increases.

ACKNOWLEDGEMENTS

The authors would like to express their deepest gratitude to the villagers of Kampung Ulu Rampayan for their cooperation. We received technical assistance from the Faculty of Science and Natural Resources laboratories, Universiti Malaysia Sabah. Universiti Malaysia Sabah partially supports this study under the research project code: SDN0075 (Skim Dana Nic).

REFERENCES

Ahmad TB, Liu L, Kotiw M, Benkendorff K. 2018. Review of anti-inflammatory, immune-modulatory, and wound healing properties of molluscs. J Ethnopharmacol 210: 156-178. DOI: 10.1016/j.jep.2017.08.008.

Al Qurtuby S. 2013. Southeast Asia: History, modernity, and religious change. AL ALBAB – Borneo J Relig Stud 2 (2): 145-167. DOI: 10.24260/alalbab.v2i2.33.

Amat A, Abd Samad L. 2019. Bridal dais of the Iranun community in the district of Kota Belud, Sabah. Melayu: Jurnal Antarabangsa Dunia Melayu 12 (2): 164-180.

Argente FAT, Ilano AS. 2015. Susceptibility of some pathogenic microbes to soft tissue extract of the mud clam, *Polymesoda expansa* (Bivalvia: Corbiculidae). The Experiment 30 (2): 1984-1990.

Aumeistere L, Ciprovica I, Zavadska D, Bavrins K, Borisova. 2018. Zinc content in breast milk and its association with maternal diet. Nutrients 10 (10): 1438. DOI: 10.3390/nu10101438.

Cesaretti M, Luppi E, Maccari F, Volpi N. 2004. Isolation and characterization of heparin with high anticoagulant activity from the clam Tapes phylippinarum: evidence for the presence of a high content of antithrombin III binding site. Glycobiology 14 (12): 1275-1284. DOI: 10.1093/glycob/cwh128.

Chang CT. Denney DF, Cheah WL. 2015. Perception of exclusive breastfeeding among Bidayuh mothers in Sarawak, Malaysia: a qualitative study. Malays J Nutr 21 (2): 263-268.

Embong AM, Jusoh JS, Hussein J, Mohammad R. 2016. Tracing the Malays in the Malay Land. Procedia – Soc Behav Sci 219: 235-240. DOI: 10.1016/j.sbspro.2016.05.011.

Hamdan DMH, Ngadnan N, Shah JM, Tair R. 2019. Marudu Bay community-based Geloina spp. aquaculture management: enhancing sustainable consumption, livelihood, and food security. Journal of Sustain Sci Manag 14 (5): 16-25.

Hamdan DMH, Tair R., Agong R, Adnan MH, Salleh AR. 2016. Effective communication and interdisciplinary research on the idea that size matter for safer lokan delicacies in Sabah. Jurnal Komunikasi Borneo 6 (2): 84-106.

Hsieh YL, Teng HJ, Yeh YH, Hsieh CH, Huang CY. 2018. The protective effects of clams on hypercholesterolemia in late-stage triple-transgenic Alzheimers diseased mice hearts. Marine Drugs 16 (8): 263. DOI: 10.3390/md16080263.

Jalil MNA, Amin WMAM, Alias M. 2019. The politico-cultural-religious milieu of southeast Asia: An examination of pre-Islamic structures of authority and syncretic practice. Kemanusiaan Asian J Human 26 (Supp. 1): 109-129. DOI: 10.21315/kajh2019.26.s1.6.

Keene BC. 2019. Toward a Global Middle Ages. The J. Paul Getty Museum, Los Angeles.

Kheng CB. 1996. Writing indigenous history in Malaysia: A survey on approaches and problems. Crossroad: Interdiscip J Southeast Asian Stud 10 (2): 33-81.

Kodoh J, Sinusun V, Liew KC, Maid M, Lintangah W, Mojiol AR. 2016. The contribution of rubber plantation to the socio-economic development: A case study on Kanibongan project-rubber smallholders community in Pitas, Sabah. Intl J Agric For Plantation 2: 207-211.

Mandal SK. 2016. Cultural geographies of the Malay world textual trajectories in the Indian Ocean. Philological Encounters 1: 370-395. DOI: 10.1163/24519197-00000013.

Mansur K, Idris S. 2016. Economic integration and cooperation in Borneo towards sustainable economic development: poverty eradication. Intl J Econ Empirical Res 4 (1): 52-65.

Mirshahi M, Mirshahi P, Negro S, Soria J, Sreekumar PK, Kotnala S, Therwath A, Chatterji A. 2009. Extract of Indian green mussel, *Perna viridis* (L.) shows inhibition of blood capillary formation in vitro. Pertanika J Trop Agric Sci 32 (1): 35-42.

Montaben M 2017. Maternal knowledge and use of galactagogues in Anden communities of Cusco, Peru. Ethnobiol Lett 8 (1): 81-89. DOI: 10.14237/ebl.8.1.2017.935.

Mulia DS. 2010. Adat dan Ritual Kematian Suku Kaum Iranun di Kota Belud. In: Mahali SN (ed.). Adat dan Ritual Kematian di Sabah. Penerbit Universiti Malaysia Sabah, Kota Kinabalu.

Narchi NE. 2017. Aposematism: An alternative hypothesis on how we discover medicinal organisms. J Ecol Anthropol 19 (1): 18-28. DOI: 10.5038/2162-4593.19.1.1208.

Olowa L, Demayo, CG. 2015. There are ethnobotanical uses of medicinal plants among the Muslim Maranaos in Iligan City, Mindanao, Philippines. Adv Environ Biol 9 (27): 204-215.

Poh YWA, Halim AS, Maat Saad AZ, Mohd Nor F, Wan Sulaiman WA. 2018. A prospective study is evaluating wound healing with sea cucumber gel compared with hydrogel in the treatment of skin graft donor sites. Compl Ther Med 41: 261-266. DOI: 10.1016/j.ctim.2018.10.006.

Peng YC, Fwu LY, Subse YM, Tien CC, Lee RP. 2017. Freshwater clam extract supplementation improves wound healing by decreasing the tumor necrosis factor α level in blood. J Sci Food Agric 97 (4): 1193-1199. DOI: 10.1002/jsfa.7849.

Pugh-Kitingan J. 2010. From Brunei? Preliminary inquiries about Iranun gong-making and metalwork at Tempasuk, Sabah, Malaysia. In: Billings L, Goudswaarde N (eds.). Piakandatu ami Dr Howard O. Mckaughan. Linguistic Society of the Philippines and SIL Philippines Manila.

Rozaimie A, Bolhassan, R. Johari A. 2019. Sarawak's Malay: The traditional ways of confinement care. Borneo J Soc Sci Human 4: 1-11.

Sahid NA, Hayati F, Rao CV, Ramely R, Sani I, Dzulkarnaen A, Zakaria Z, Hassan S, Zahari A, Ali AA. 2018. Snakehead consumption enhances wound healing? From tradition to modern clinical practice: A prospective randomized controlled trial. Evid-Based Compl Altern Med. 2018: 3032790. DOI: 10.1155/2018/3032790.

Saili T, Aka R, Auza FA, Salido WL, Sari AM, Napirah A. 2019. Supplemented with herbal probiotics and mud clams extract (*Polymesoda erosa*) in Kendari-South-East Sulawesi. Jurnal Peternakan Indonesia 21 (3): 327-336. DOI: 10.25077/jpi.21.3.327-336.2019. [Indonesian]

Sajok A. 2018. Perhambaan tradisional di Borneo Utara zaman Kesultanan Sulu & Brunei. Jurnal Sains Insani 2 (2): 20-28. DOI: 10.33102/sainsinsani.vol2no2.33.

Senanayake SGJN. 2006. Indigenous knowledge as a key to sustainable development. J Agric Sci (1): 87-94. DOI: 10.4038/jas.v2i1.8117.

Smith KJ. 2003. Minority language education in Malaysia: Four ethnic communities' experiences. Intl J Bilingual Educ Bilingualism 6 (1): 52-65. DOI: 10.1080/13670050308667772.

Warren JF. 2002. Iranun and Balangingi: Globalization, maritime raiding and the birth of ethnicity. New Day Publishers, Quezon City.