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Development of Malaysian Ethnobotanical Online Database

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Abstract: The existing Malaysian ethnobotanical database is not sufficiently comprehensive and may hinder sharing of ethnobotanical knowledge. The lack of interest and documentation especially in digitalizing prior knowledge is a worrying trend since Malaysia possess high ethnicity and abundance of biodiversity. It is crucial to preserve and digitalize the comprehensive ethnobotanical database as it gives benefits worldwide. This study aimed to identify online database features and data type for an ethnobotanical database, to collect and populate existing database via secondary data and to test the acceptance of the database by users by testing whether the database fulfil the requirements of a good ethnobotanical database. Rapid Prototyping method has been used in this study involving User Requirement Analysis and data acceptance test to construct and create the best ethnobotanical database. Malaysian Ethnobotanical Online Database (MYETHBO) is the database created by using the Omeka Classic management system with Darwin Core standard. There are 1,074 plants information are collected online and mostly referred GlobinMed and GBIF. In this study, 30 plant species has been setup as exemplar pages. This study successfully developed a comprehensive ethnobotanical database (MYETHBO) by being able to identify the database features and data type needed via the Rapid Prototyping method, collect and populate existing data via secondary data and test the acceptance of the database by distributing the questionnaire to lecturers. MYETHBO will be beneficial to researchers, students and public people to gain knowledge of ethnobotany. It is available at https://cercom.uthm.edu.my/myethbo/.

Keywords: Ethnobotanical, database, malaysia, traditional knowledge, plants

1. Introduction

Ethnobotanical is one of the traditional knowledge consisting of natural sciences, including aspects of medicine, culture, agriculture, religion and household knowledge[1]. Thus, ethnobotany represents the evaluation of plant-human relationships in all phases and the effect of the plant environment on human society [2]. This traditional knowledge is commonly less appreciated by many especially the youngsters due to lack of interest, limited digital documentation and availability on the benefits of ethnobotany in daily use [3].

Malaysia is one of the developing countries with various technologies such as the Internet of Things (IoT) that are interrelated with computing devices, digital machines and systems over the internet and cloud computing. Various government and non-government organizations have made an effort to track the status and statistics of Malaysian ethnobotanical plants and publish them on the internet as a searchable website [4]. However, their database is not comprehensive and unsuitable for public sharing which may possess outdated information and lack many features of current biodiversity data standards [4].

The richness of biodiversity in Malaysia is unparalleled, creating a possibility to develop the best databases about ethnobotanical and related biodiversity databases. Malaysia's extraordinary richness of biodiversity creates a threat to wildlife, especially illegal activities such as deforestation and soil erosion [5]. Thus, it is crucial to develop a

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comprehensive ethnobotanical database due to prevent the traditional knowledge of ethnobotany from eroding, create better database management, create a guideline for other developers and ensure the sustainability of ethnobotanical knowledge for future generations or research.

The objectives of this study are to identify online database features and data types for an ethnobotanical database, collect and populate existing database via secondary data and test the acceptance of the database by users to figure out whether the database fulfil the requirements of a good ethnobotanical database. The scope of the study was focused on data quality by surveying existing standards such as Taxonomic Databases Working Group or now called as Biodiversity Information Standards (TDWG) (www.tdwg.org) and Scratchpad referring to databases already available online. Ethnobotanical databases were examined and features were identified by analysing the existing databases of plant species. TDWG standards have been used for the database as it offers a wide and most effective biodiversity information exchange about organisms globally. This study will create an easily accessed database, give a better understanding, give exposure to the public, beneficial to researchers and provide the best guideline for other developers to create a comprehensive ethnobotanical database.

2. Methodology

This study was developed by using Rapid Prototype methodology which contains ethnobotany information by collecting in existing plant databases. The rapid prototype model is one of the development methods that allow rapid construction and improvement of the database. According to [6], this method helps to reveal misunderstandings between developers and users by having direct feedback from the users to the developers themselves to meet their desired features in ethnobotany information such as geolocation, interactive interface and others.

2.1 Survey of Existing Database

User Requirement Analysis (URA) is any task involved in understanding the conditions and needs of users in project or product development [4]. In this project, analysis was conducted through surveys to discover the needs and requirements of websites based on users' opinions. By using User Requirement Analysis (URA), this study gained the data and features needed to survey the existing ethnobotanical database. Identification features are needed for developing a comprehensive ethnobotanical online database.

All features were analysed and clarified their functions on a database itself. The data type of the database was referred to as Biodiversity Information Standard (TDWG) to make sure the sharing of biological information is effective to the users. GlobinMed, GBIF and Scratchpad are example of existing databases that used the TDWG standard for data sharing. Therefore, this study used prior existing databases as references and guidelines to create an ethnobotanical database. 20 existing databases were reviewed and data content was browsed to survey on the data type of each database offered through a critical literature reviewed on journal and articles. The databases were gained from journal citations and keywords.

2.2 Secondary Data Collection

The secondary data collection was obtained via secondary sources which are the existing ethnobotanical databases. The existing database found for this study were compared to each other and highlighted the most features among all the databases available such as scientific name, common name, characteristics, morphology, chemical compound, medicinal use and bibliography. This study used the plant list of Medicinal Herbs & Plants Monograph [6] as reference. There are about 1,074 plant species of Medicinal Herbs & Plants Monograph but only 30 species were filtered out for this study as exemplar pages in the database based on alphabetical of the completed information for each species and 30 species are quite enough for exemplar pages for this study.

2.3 Database Construction and Population

The ethnobotanical database was publicly available to ensure all users can convey the information. This study was using the Omeka Classic engine to construct and populate the ethnobotanical database since Omeka is an open-source content managements system to maintain sites content, publish any digital information sharing and build a digital exhibit. Omeka Classic also allows the developer to create websites to share the data collections digitalized and exhibits via the Internet resources.

2.4 Database Acceptance Test

The whole database was evaluated in two stages: the Alpha and the Beta test. Alpha testing entails the developer evaluating the database. Later, Beta testing begins after the operating system has been approved. Users frequently do a Beta test to ensure if the database is functioning well and meet the study's requirements. The user was given a User Acceptance Test (UAT) in the form of a questionnaire (Google Form) as final verification that the system met the goals and to figure out either the database are accessible and acceptable to public or not. Appendix A shows the questions for the user acceptance test.

3. Results and Discussion

Table 1 is the survey on the 20 existing databases and their content or features. The features are vital components and content before constructing and developing a database for ethnobotany.

Table 1 - Survey on existing databases and their content

Online Databases	Database Content	
Global Information Hub On Integrated Medicine (GlobinMed) https://www.globinmed.com/medicinal_herbs_category/medicinal-herbs-plants-monograph/ [7]	• Photos • Definition • Synonyms • Scientific name • Common name	• Characteristics • Morphology • Chemical compound • Traditional uses • Medicinal uses
Malaysia Biodiversity Information System (MyBIS) https://www.mybis.gov.my/one/ [8]	• Photos • Scientific name	• Common name • Bibliography
Malaysian Agriculture Repository (Malaysian AGRIS) http://www.agris.upm.edu.my:8080/dspace/ [9]	• Definition • Synonyms • Scientific name • Common name	• Morphology • Chemical compound • Medicinal uses
USM Plant Database https://www.amdi.usm.my/31-plantdatabase [10]	• Photos • Synonyms • Scientific name • Common name	• Morphology • Traditional uses • Bibliography •
Forestry Department of Peninsular Malaysia https://www.forestry.gov.my/en/tumbuhan-ubatan [11]	• Photos • Definition • Scientific name	• Common name • Traditional uses
Malaysia Convention on International Trade in Endangered Species of Trees (MyCITES) https://mycites.frim.gov.my/en/ [12]	• Photos • Definition • Synonyms • Scientific name	• Common name • Characteristics • Morphology •
Global Biodiversity Information Facility (GBIF) https://www.gbif.org/species [13]	• Photos • Scientific name • Common name	• Geolocation • Bibliography •
Nparks Flora & Fauna Web https://www.nparks.gov.sg/florafaunaweb [14]	• Photos • Synonyms • Scientific name • Common name	• Morphology • Traditional uses • Medicinal uses •
iNaturalist https://www.inaturalist.org/ [15]	• Photos • Definition • Synonyms • Scientific name • Common name	• Morphology • Chemical compound • Medicinal uses • Bibliography • Characteristics
Dr Duke's Phytochemical & Ethnobotanical https://phytochem.nal.usda.gov/phytochem/search [16]	• Scientific name • Common name	• Chemical compound • Traditional uses
Native American Ethnobotany DB http://naeb.brit.org/ [17]	• Scientific name	• Medicinal uses

	• Common name • Traditional uses	• Bibliography •
Korean Traditional Knowledge Portal https://www.koreantk.com/ [18]	• Scientific name • Common name • Chemical compound	• Traditional uses • Medicinal uses •
Integrated Taxonomic Information System (ITIS) https://www.itis.gov/ [19]	• Synonyms • Scientific name • Common name	• Photos • Synonyms
Plants of the World Online (POWO) http://powo.science.kew.org/ [20]	• Scientific name • Common name	• Characteristics • Bibliography
National Center for Biotechnology Information (NCBI) https://www.ncbi.nlm.nih.gov/ [21]	• Photos • Scientific name • Common name	• Chemical compound • Medicinal uses
Encyclopedia of Life (EOL) https://eol.org/ [22]	• Definition • Scientific name • Common name • Characteristics • Morphology	• Chemical compound • Medicinal uses • Bibliography •
Catalogue of Life (COL) https://www.catalogueoflife.org/ [23]	• Definition • Scientific name	• Common name • Bibliography
World Flora Online (WFO) http://worldfloraonline.org/ [24]	• Synonyms • Scientific name	• Common name • Bibliography
West African Plants http://www.westafricanplants.senckenberg.de/root/index.php [25]	• Photos • Scientific name	
Rimbun Dahan http://rimbundahan.org/environment/plant-list/ [26]	• Photos • Scientific name • Common name • Characteristics • Morphology • Traditional uses	

3.1 Database Features and Data Type

The database features are vital components and content before constructing and developing a database for ethnobotany. Identification of features needed for a comprehensive ethnobotanical online database as stated in Table 2. It was listed out by comparing the 20 existing ethnobotanical databases. Features of geolocation (Geographic Information System) was added in this study to enable the user to visualize the distributions of the species, especially in Malaysia.

Table 2 - Identified features for a comprehensive ethnobotanical online database

Required features	Optional features
• Photos • Scientific name • Common name • Synonyms	• Definition • Characteristics • Morphology • Related document / specimen /

• Taxonomy/ classification • Traditional uses • Medicinal uses • Plant part used • Chemical compound • Geolocation • Bibliography / citation	article

Darwin Core standard is one of the TDWG data type standard for the exchange of biodiversity data that has been designed to facilitate biodiversity informatics. Specifically, this study used the Darwin Core standard to create consistent terms being used in combination with the normative term names and definitions with the non-normative comments [27]. Data in MYETHBO was sorted according to Darwin Core which was established with standardized data type for easier data search, retrieval, sharing and integration [27] as it provides a stable standard reference for sharing information on biodiversity. Table 3 shows the data type name in MYETHBO according to their functionalities and suitable data types.

Table 3 - Data type name and functionalities in MYETHBO

Data type name	Functionalities	Example Elements
Text	A resource consisting mainly of words for reading.	• Text
Moving Image	A series of visuals that represents an impression of motion.	• Transcription • Duration • Compression • Producer • Director
Still Image	A static visual representation.	• Original Format • Physical Dimensions
Website	A resource comprising of a web page.	• Local URL
Hyperlink	A link or reference.	• URL
Person	An individual.	• Bibliography
Dataset	Data encoded in a defined structure.	
Physical Object	An inanimate, three-dimensional object and substance.	
Service	A system that provides one or other functions.	
Software	A computer program in source or a compiled form.	

3.2 Secondary Data Collection

A total of 1,074 plants species was successfully collected from existing database but only 30 species were filtered out as exemplar pages for this study. Table 4 shows the list of 30 species for exemplar pages.

Table 4 - List of 30 species of exemplar pages in the database [7]

No	Scientific Name	Common Name
1.	*Abelmoschus moschatus*	Kapas Hantu, Kapas Hutan, Musk Mallow, Musk Okra
2.	*Abutilon indicum*	Bunga Kisar, Kembang Lohor, Monkey Bush
3.	*Acalypha indica*	Chika Mas, Kucing Galak, Tjeka Mas, Indian Acalypha
4.	*Acanthus ebracteatus*	Beruju, Jeruju, Sea Holly, Gerige
5.	*Achyranthes aspera*	Ara Songsang, Nyarang Sunsang, Colic Weed
6.	*Acrostichum aureum*	Piai raya, Piai lasa, Larat, Pebisi, Swamp fern
7.	*Adenanthera pavonina*	Saga tumpul, Coralwood , Bean tree, Peacock tree

8.	*Adenostemma viscosum*	Rumput pasir, Dung weed
9.	*Ageratum conyzoides*	Daun Misai Kuching, Rumput Jalang, Blueweed
10.	*Aglaia odorata*	Chulan, Mock Lemon, Mock Lime
11.	*Albizia myriophylla*	Tebu Gajah, Akar Manis
12.	*Aleurites moluccanus*	Kemiri, Buah Keras, Indian Walnut, Lumbang Tree
13.	*Allamanda cathartica*	Akar Chempaka Hutan, Allamanda, Buttercup,
14.	*Allium cepa*	Bawang Merah, Onion, Shallot Onion
15.	*Alocasia macrorrhizos*	Birah Negeri,Keladi Sebaring,Giant Taro,Giant Alocasia
16.	*Aloe vera*	Lidah Buaya, Indian Aloe, True Aloe
17.	*Alpinia galanga*	Lengkuas, Puar, Languas, Java Galangal, Galanga
18.	*Alstonia scholaris*	Pulai, Milkwood, Devil Tree, Dita Bark, Indian Pulai
19.	*Alternanthera sessilis*	Keremak, Pudoh, Sessile Joyweed, Water Amaranth
20.	*Alyxia reinwardtii*	Mempelasari, Pulasari, Alyxia Cinnamon, Forbes Alyxia
21.	*Amaranthus spinosus*	Bayam duri, Bayam hutan, Spiny Amaranth, Spiny Pigweed
22.	*Ammi visnaga*	Bishop's weed, Pick-tooth, Spanish Carrot, Toothpick
23.	*Amomum uliginosum*	Puar Hijau, Puar Gajah, Tepus Mera
24.	*Arctium lappa*	Great Burdock, Edible Burdock, Beggar's Buttons
25.	*Ardisia crenata*	Mata Ayam, Mata Pelandok, Coralberry, Spiceberry
26.	*Arenga pinnata*	Enau,, Kabong, Berkat, Sugar Palm, Toddi Palm
27.	*Artemisia afra*	Als, Wild Als, Wild Wormwood, African Wormwood
28.	*Artemisia vulgaris*	Cina baru, Hiya, Midge Plant, Moxa,Felon-herb, Mugwort
29.	*Asarum canadense*	Canada Snakeroot, Canadian Snakeroot Oil
30.	*Asclepias curassavica*	Bunga Mas, Bunga Tunjong, Swallow Wort, Red Milkweed

Based on Table 5, an exemplar page shows the data on the species of *Alpinia galanga.*

Table 5 - Information related to plant species

Content of database	Function	Information of plants
Species information	1. Scientific name (unique ID for each species)	*Alpinia galanga* [7]
	2. Common name (unique for each species)	Lengkuas, Puar, Lengkuas Biasa, Lengkuas Benar, Lawas, Mengkanang, Galangal, Spice Ginger, Languas, Java Galangal, Galanga and Greater Galangal [7]
	3. Taxonomy (Phylum, Class, Order, Family, Genus, Species)	**Phylum:** Tracheophyta **Class:** Liliopsida **Order:** Zingiberales **Family:** Zingiberaceae **Genus:** *Alpinia* **Species:** *Alpinia galanga*

	4. Photos (show depth and detail of the species)	
	5. Characteristics (detailed description about the species)	A perennial herb that can grow up to 3.5 m tall and possesses a creeping rhizome which the plant grows from rhizome under the ground [7].
	6. Chemical compound	Kampheride, alpinin, galangin, methyl cinnamate, cincole, 1'-acetoxychavicol acetate, 1'-hydroxychavicol acetate, galantin-3-methyl ether, a-terpineol, 4-hydroxybenzaldehyde, trans-coniferyl diacetate, trans-courmaryl diacetate, α-bergamotene, β-bisabolene, borneol, borneol acetate, butanol acetate, camphene, carveol I, carveol II, chavicol acetate, citronellol acetate and many more [7].
	7. Plant part used	Leaves and rhizomes [7]
	8. Traditional uses	• Used as a spice for flavouring foods [14]. • Used as the ingredient in some herbal preparations [14]. • The poultice of the rhizomes was mixed with vinegar to treat eczema [7]. • The leaves are used as a part of ingredients in an afterbirth herbal bath [7].
	9. Medicinal uses	• The rhizomes have antibacterial and digestive stimulant properties. The decoctions are usually used to treat flatulence, dyspepsia, vomiting and stomach bloating [7][14].
	10. List of country	• Thailand and Southeast Asia [7]
	11. Geolocation	• 3.1, 101.6 [13]
Researcher	Provide profile page for the researcher who developed Database	
Gallery	Provides gallery view of uploaded images	
Bibliography	All literatures that involved in a database with direct linking of Google Scholar	

3.3 Data Population in MYETHBO

This study created MYETHBO by using Omeka Classic with Dublin Core standard data type for the content and features. Omeka Classic is a content management system (CMS) and software programme that allows users to create, edit, collaborate on, publish and store digital material with customization templates of the interface. Next, it allows web publishing for sharing digital content and enable developers to create online exhibits. It also is very easy to use as it

provides no hand-coding in the website development process [28]. Therefore, it is the best way for anyone to develop a database without any programming language.

The web database was built entitled Malaysian Ethnobotanical Online Database (MYETHBO). The website of MYETHBO can be surfed at: https://cercom.uthm.edu.my/myethbo/. The logo created is based on the green leaves of the herb plant. The interface of MYETHBO consists of the logo, the name of the database, search box and five pages of menu tab: About, Exhibits, Kingdom, Items and Map. Figure 1 shows the MYETHBO interface and Table 6 shows the description of the main menu of MYETHBO.

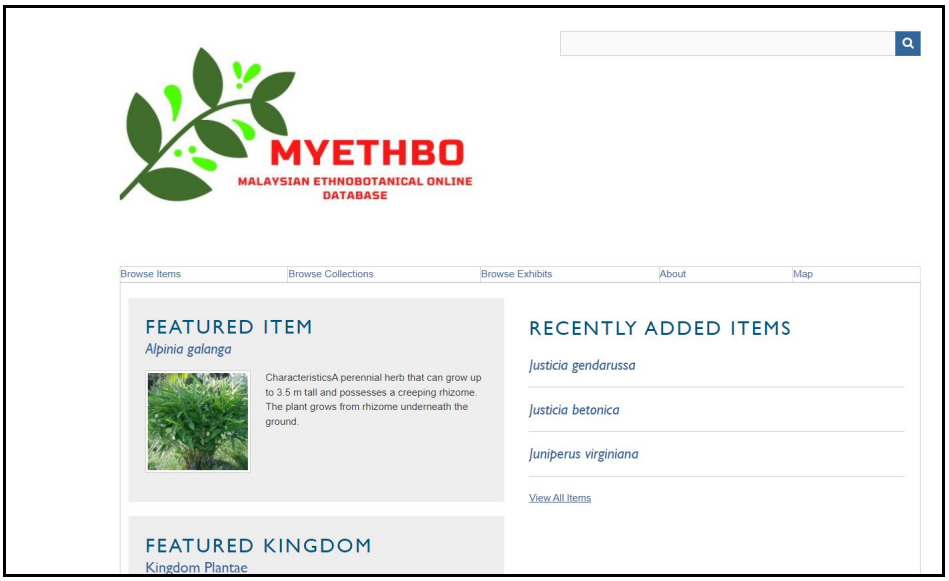


Fig. 1 - The dashboard of MYETHBO

Table 6 - Description of the main menu of MYETHBO

Menu	Description
About	Explanation on MYETHBO function that contributes to a centralized ethnobotany database through a collection of standardized metadata. MYETHBO aims to provide a sustainable biodiversity research ecosystem that is facilitated by data sharing with a centralized chain from collecting, verifying, and disseminating ethnobotanical data in UTHM.
Exhibits	Allow developer or admin to add any exhibition species or item.
Kingdoms	The collection of Kingdom Plantae
Items	Consists of 1,074 plant species data
Map	Distribution map of plant species in Malaysia

The main tab menu of MYETHBO is created to enable users to freely surf and easier for users to interact with the webpage and the elements according to preferred fields of About, Exhibits, Kingdom, Items and Map. Figure 2 shows the exemplar pages of *Alpinia galanga* on MYETHBO and Figure 3 illustrate the coordinate of *Alpinia galanga* on the map.

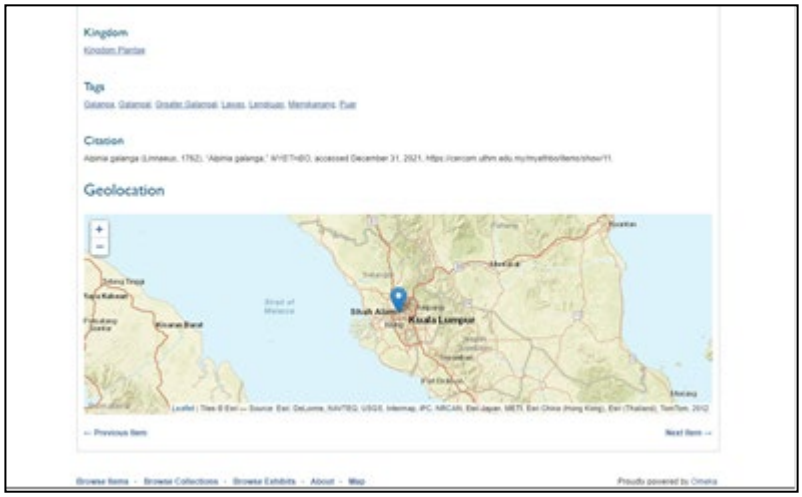


Fig.2 - The exemplar pages of Alpinia galanga on MYETHBO

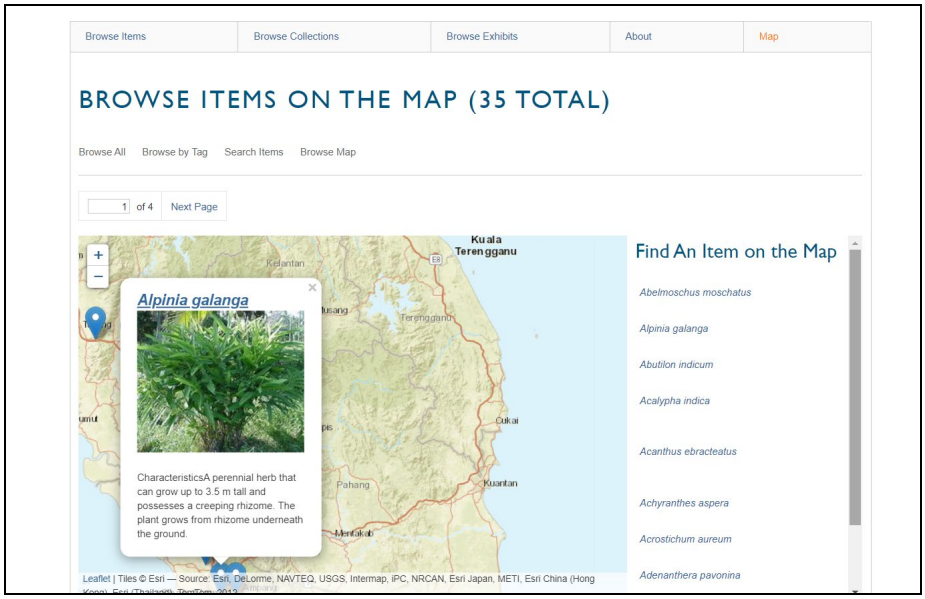


Fig. 3 - The coordinate of *Alpinia galanga* on the map

The database management of MYETHBO is held by Omeka Classic since it allows to add, amend and delete data as well as create new content types and submit data. It provides efficiency in managing an enormous amount of data and the database can add new data without any complexity. To maintain database security, Omeka Classic offers the function of user management. Table 7 shows the type and role of users in managing web content.

Table 7 - Role of users in managing web content

Type of Users	Role
Super Users	Super Users have full access to manage all the data and other users • They are the only users with access to the top navigations' tabs for Plugins, Appearance, Users and Setting
Admin Users	Admin users cannot access the tabs for managing plugins, appearance, users or site settings. Admin Users can: • Add, edit, tag, and delete items, both their own and created by other users. • Make items, collections, exhibits and other content public or not public. • Make items, collections, exhibits, and other content features or not featured. • Add, edit, and delete Item Types. • Add, edit, and delete files. • Interact with plugins installed and activated by a Super User. • Add, edit, and delete tags
Contributors Users	Contributor users have control over their content but cannot make their content public to view. Contributor users can: • Add, edit, tag, and delete items that they created. • Cannot make their items public. • Create their exhibits from public items.
Researcher Users	Researchers can log in to the admin side of an Omeka site and see the content but cannot add, edit, delete and tag any items.

Table 7 states there are four types of users and their roles in managing MYETHBO web content. The types of users are Super Users, Admin Users, Contributor Users and Researcher Users which all of them have different types of interaction and roles in the system. Therefore, it can be concluded the most influenced person in the database is Super Users as it has full access to manage all data including access to the top navigation tabs for Plugins, Appearance, Users and Setting.

3.3 Testing Process

User acceptance testing was done by presenting the web database to the potential user of this study through Google Form. A questionnaire in form of Google Form was successfully distributed to lecturers, students of Universiti Tun Hussein Onn Malaysia (UTHM) and public people. The respondents consist of 61 persons. The majority of respondents understand the concept of traditional knowledge of ethnobotany. For the second question, 51% of respondents find the logo of MYETHBO is attractive. This question was to identify whether the logo can give engagement to the users as they click the website link. Most of the respondent (60.7%) realized that ethnobotany knowledge become eroding nowadays especially the youngsters. The next questions, about 81.7% of respondents thought a comprehensive ethnobotanical database is useful because it makes it easier to search when identifying plants, gives benefits for research purposes as having many data in one big database can save a lot of time, consists of the morphology of the plant and preserve the traditional knowledge of ethnobotany.

For section System Application, the users stated the database is insufficient in information such as article related, specific ethnic for each plant and International Union for Conservation of Nature's Red List of Threatened Species (IUCN) status and distribution in Malaysia. 66.7% of the respondents found MYETHBO is easy to use and 30% of respondents are not sure either MYETHBO is easy to use or not. Meanwhile, small percentage of 3.3% respondents find it is hard to use MYETHBO. It is because of the lack of a short tutorial for new users for using the website. 45.6% of users found MYETHBO is less effective due to the deficiency of information mentioned. Thus, it can be concluded that MYETHBO was accepted by most of the respondents as one of the comprehensive ethnobotanical databases.

4. Conclusion

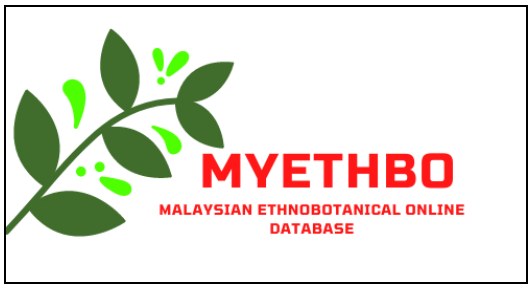
This study succeeds in developing a comprehensive ethnobotanical database (MYETHBO) by identifying the database features and data type needed via the Rapid Prototyping method, collecting and populating existing data via secondary data and testing the acceptance of the database by distributing the questionnaire to potential users. MYETHBO will be beneficial to the researchers, students and public people to gain knowledge of ethnobotany. It is hoped MYETHBO will be a medium for ethnobotany knowledge gain for students, researchers and public people. It is important to have continuously improved MYETHBO to ensure the database meet the users' requirements and demand in ethnobotany database for future use by adding more interactive design, a short tutorial for new users, allowing the user to edit some contents such as plant image and method of preparation and categorized the database with various features.

Acknowledgement

We would like to express greatest gratitude to Universiti Tun Hussein Onn Malaysia for funding this project and all users that contribute in testing the database.

Appendix A: User Acceptance Test questionnaire

1. Do you find this logo of MYETHBO is attractive?



A. Yes

B. Maybe

C. No

2. Do you know what is ethnobotany?

A. Yes

B. Maybe

C. No

3. Do you realize that ethnobotany knowledge become eroding nowadays especially the youngsters?

A. Yes

B. Maybe

C. No

4. We are building a comprehensive Ethnobotanical Database to tabulate plant species in Malaysia. Do you think it will be useful?

A. Yes

B. Maybe

C. No

5. Based on MYETHBO, do you think the information in the database is sufficient?

A. Yes

B. Maybe

C. No

Required features	Optional features
• Photos • Scientific name • Common name • Synonyms • Taxonomy/ classification • Traditional uses • Medicinal uses • Plant part used • Chemical compound • Geolocation • Bibliography / citation	• Definition • Characteristics • Morphology • Related document / specimen / article

6. Based on table above, is there any other field(s)/ feature(s) needed to add in MYETHBO? Please state the field if your answer is YES.

_____

7. Is MYETHBO easy to use?

A. Yes
B. Maybe
C. No

8. How was the effectiveness of MYETHBO?

A. Yes
B. Maybe
C. No

9. Is there any recommendation to improve the database in the future?

_____

Your cooperation and respond are highly appreciated. Thankyou. Have a nice day ahead.

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