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Research

Traditional Ecological Knowledge of Wild Tubers Used by The *Orang Asli* Bateq Tribe on The East Coast of Peninsular Malaysia

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ABSTRACT

Indigenous tribes and rural communities around the world are known to rely on various plant parts for their livelihood and nutrition, most notably for food. This research aimed to examine and document the traditional ecological knowledge (TEK) of wild tuber food plants used by the *Orang Asli Bateq* tribe of Peninsular Malaysia. The findings of this study are critical to scientifically identify and document food sources from the forest that contribute to the tribe's livelihood and, possibly, future food security. In the *Bateq* villages, information was gathered via semi-structured surveys, field trips, group discussions, and key informant interviews. The results show that TEK influenced the use of wild tubers inherited from their ancestors. The *Bateq* ate at least 11 different types of wild tubers, including *Dioscorea orbiculata*, *Dioscorea prainiana*, and *Dioscorea hispida*. Most of these wild tubers are from the Dioscoreaceae plant family and must be properly processed before being consumed. The elements related to the traditional knowledge of the wild tubers are the harvesting skills and the practice in the utilization of the plant. The survey also suggests that the selection to use plant tubers is prompted by its delicious taste and nutritional value while being natural and unpolluted food. In terms of plant sustainability, the majority of the Bateq will follow certain conservation techniques to maintain the plants' availability. Understanding what underlies TEK and the tribe's practices in using wild plant resources will preserve the natural legacy of forest resources and biodiversity, and possibly contribute to future food security.

Key words: Food security, indigenous tribe, livelihood, sustainability, traditional knowledge, wild yam

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INTRODUCTION

In Malaysia, under the provision of the *Orang Asli* Act (1954, Revised 1974) (Act 134), a person is considered *Orang Asli* if one of their parents is a member of an *Orang Asli* ethnic group and lives according to the laws, beliefs, and customs of that group. As of 2019, the Indigenous Peoples of Malaysia were estimated to account for around 14% of the 33.45 million national population, which is about 210,611 people. There are 18 *Orang Asli* subgroups within three main groups of *Orang Asli* tribes in Malaysia, which are Negrito or Semang, Senoi, and Aboriginal-Malay or Proto-Malay. *Orang Asli* populations account for only about 0.7% of the Peninsular Malaysia total population (IWGIA, 2023). The *Bateq* is an *Orang Asli* subgroup categorized as Negrito, the earliest and smallest group represents about 3% of the *Orang Asli* total population (Fatanah *et al*. 2012). The distribution of Negrito *Orang Asli* is also isolated and scattered, but mainly distributed in the Northern and middle part of Peninsular Malaysia concentrated in the highlands of Kelantan and Terengganu.

The *Bateq* tribe inhabit a remote area of north Pahang, west Terengganu, and south Kelantan (Mohd Salim

et al. 2021) and are acknowledged as egalitarian hunters and gatherers, living a nomadic lifestyle in the forest and have no connection with the sea at all (Endicott & Endicott 2008). As hunters and gatherers, the *Bateq* move in a small group. When a movement happens due to natural disaster, hunting, or death, they usually move with their own conjugal family. Generally, the *Bateq* collect their food from the forest for consumption and sometimes for earning. Forest resources like wild tubers are a form of the main carbohydrate for the nomadic *Bateq*. The *Bateq* tribe uses various wild food plants and natural resources from the forest in daily life by engaging in activities such as hunting, collecting, and gathering those resources (Mohd Salim *et al*. 2021). These subsistence activities are also central symbols of cultural and gender identity (Lye, 2021). Their dependence on forest resources in many aspects is very much guided by their traditional ecological knowledge (TEK) inherited from their ancestors (Kardooni *et al*., 2014). The *Orang Asli* are considered a great source of information on the forest flora, fauna, and ecosystem (Abdullah *et al*., 2021). Thus, they hold vital information in their TEK on the enormous valuable forest resources that can benefit human wellbeing.

TEK is defined as a network of knowledge, beliefs, spirituality, and traditions that aim to maintain and connect indigenous communities with their heritage, culture, and place. It is transferred through traditions, ritual practices, and other activities directly and indirectly among kin communities (LaRochelle & Berkes, 2003). A recent review on the impact of TEK towards indigenous peoples indicates that TEK plays a role in improving the indigenous quality of life, offering secure and supplemented food, not only for their consumption and earning but is also crucial for food security during hard times (Mohd Salim *et al*., 2023). TEK of wild edible and medicinal plants plays a significant role in a community's capacity to remain resilient through the conservation of food resources for future generations. However, the degradation of TEK could happen as TEK is often conveyed via indigenous languages, and the loss of language diversity directly affects the loss of knowledge diversity (Maffi, 2005).

Distinct cultures of each tribe or group of an indigenous community may imply the uniqueness of TEK despite only representing 6% of the world population (World Bank, 2022). Therefore, there is a dire need to document and conserve valuable TEK of an indigenous community, which is not only important to their community but also holds an optimum value for human future well-being, such as providing key information for a source of potential new medicinal and edible plants. This research and its findings provide the general descriptions of wild tuber species utilized by the indigenous *Bateq* tribes in Kelantan and Terengganu with their TEK practices in harvesting and consuming those plant resources. This study is not only important to document wild tuber food sources and relevant TEK among the *Bateq* tribe, but could also provide alternatives or new resources for future foods.

MATERIALS AND METHODS

Study site

The study was conducted in May 2022 in the indigenous community settlement in Kuala Koh, Gua Musang, Kelantan, located between 4.8735°N to 4.8757°N and 102.4512°E to 102.4634°E, and in Kampung Sungai Berua, Hulu Terengganu (Figure 1). The *Bateq* tribe lives within the greater Taman Negara or National Park, which spans three states: Pahang, Kelantan, and Terengganu. By road, Kuala Koh is roughly 290 km from Kuala Terengganu and Sungai Berua is located near the largest manmade lake in Southeast Asia, Lake Kenyir, about 54 km from Kuala Terengganu, the state capital of Terengganu.

Data collection

Official permission to conduct this study was obtained from the *Orang Asli* Development Department (JAKOA) in September 2019. The TEK survey was conducted in the *Bateq* settlement in Kuala Koh, Gua Musang, Kelantan, Kampung Sungai Berua, Hulu Terengganu, Terengganu (Figure 1). Data collection was conducted from May to August 2022 and has been approved accordingly and in compliance with the ethical standard by the Institute of Tropical Biodiversity and Sustainable Development (Bio-D Tropika), Universiti Malaysia Terengganu which acts as the founding Institution for this study. The research study entitled "Unveiling the Traditional Ecological Knowledge (TEK) Practice of Bateq and Semoq Beri tribes for the utilization of plant parts (Ubi, tubers, seeds) as food source" was reviewed by the ethical committee of the Institute of Tropical Biodiversity and Sustainable Development, Universiti Malaysia Terengganu.

A survey was conducted with the cooperation of a JAKOA officer and the *Bateq* tribe head or Tok Batin. The information was collected through face-to-face interviews using semi-structured questionnaires, field visits, group discussions, and key informant interviews. A total of 45 informants, aged between 12 and 85, were involved as respondents. Based on previous studies, key informants play an important role in traditional knowledge surveys and data collection. Thus, 12 key informants were selected using the purposive sampling technique to select those knowledgeable about the wild tubers. The key informants were informed that their personal information would be protected and all the data gathered would be solely used for the study. These informants were selected after preliminary

interviews that identified individuals as knowledgeable about wild tubers. They were briefed on the purpose of the research and asked whether they knew the wild tubers.

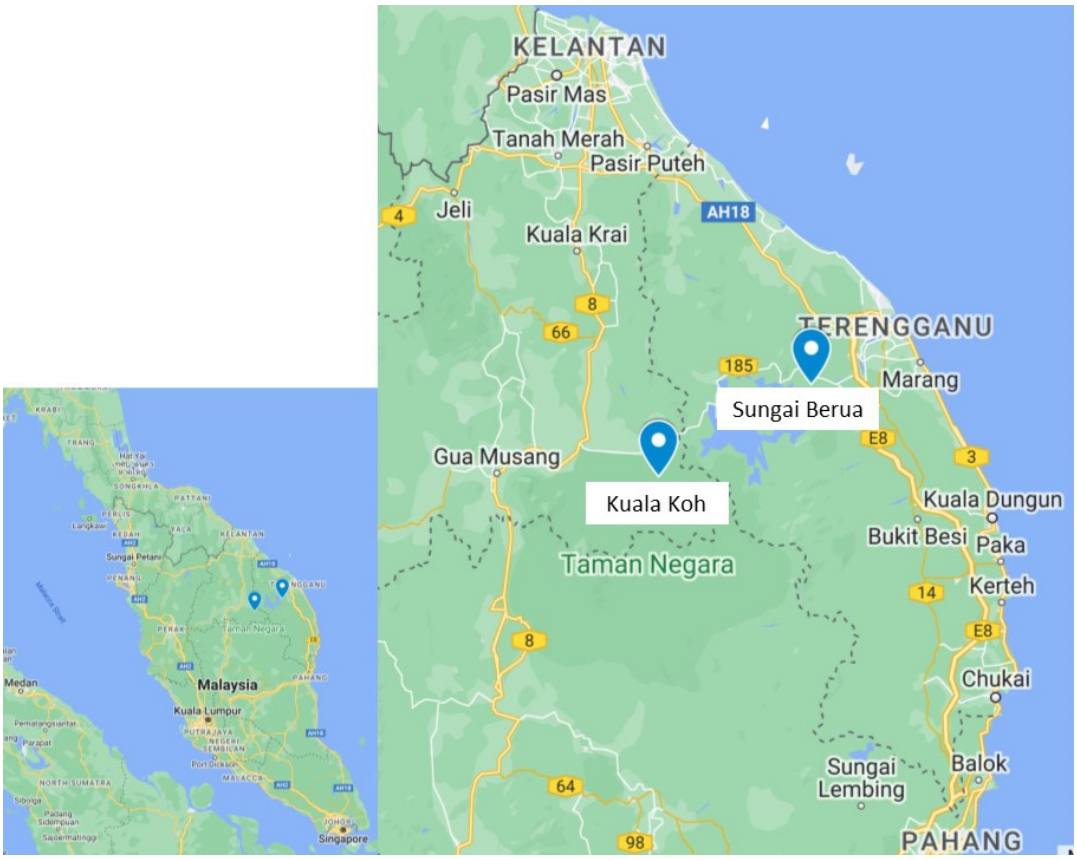

Fig. 1. Map of Peninsular Malaysia with a blue marker for the study sites of TEK survey in Kuala Koh, Gua Musang, Kelantan and Kampung Sungai Berua, Hulu Terengganu, Terengganu. Source: Google Maps (2023)

The purposive sampling technique was then applied since it is a type of non-probability sampling technique that is most effective when one needs to study a certain cultural domain with experts. The key informants included knowledgeable people from all age groups and were selected with the help of society leaders and developmental government agencies. Most of the informants were foragers; thus, they were ideal informants for achieving the research objectives, namely determining the traditional ecological knowledge of the wild tubers. The selected informants were interviewed using semi-structured interviews focusing on the (i) species of wild tubers, (ii) why they chose the plant, (iii) the method of preparation or processing the plant, (iv) how they came to know the plant and (v) practice of harvesting and consuming the plant. Interviews were conducted through verbal communication in Malay language, with a translator's help to ensure there was no miscommunication.

Wild tuber species identification

The plants mentioned by the informants were collected with the help of the field research assistant during fieldwork. The wild tuber plants were photographed, and if possible, identified for the scientific name in the field, otherwise, herbarium voucher specimens were taken and prepared for further botanical name confirmation with a botanist from the Forest Research Institute of Malaysia (FRIM), Kepong, Selangor.

Data analysis and calculation of Frequency of Citation (FC)

Survey data were analyzed using SPSS version 23. The data was quantified according to Tardio and Pardo de Santayana (2008). The collected ethnobotanical data were quantitatively analyzed and FC was calculated as follows:

$$FC = \text{number of citations} / \text{total number of citations of all recorded species} \times 100$$

RESULTS AND DISCUSSION

Demographic Information

The majority of the informants were female (57.7%) (Table 1). Based on these figures, it is fair to suggest that females are more knowledgeable about the wild tubers compared to males. This is supported by Endicott & Endicott (2012) who observed that women took primary responsibility for gathering tubers. They also documented that the success rate for gathering tubers was 93% for men and 95% for women, and women gathered 2.3 times as often as men and produced 66% by weight of all the tubers. Digging for tubers is a common activity for *Orang Asli* women, and they usually set out on short gathering trips with their children. The other reason that females are more knowledgeable about the wild tubers is that they usually took charge of cooking, while the husbands or men went hunting for animal-based food.

A notable trend in the demographics of the survey was the age of the informants, whereby the majority, 79.8%, were above 41 years old (Table 1). This was due to the younger generation of the community (30 years & below) admitting that they had little knowledge about the wild tubers. Most informants stated that they had passed the knowledge of the wild tubers to their children and the younger generation. The knowledge is passed on orally or by demonstrating it when they gather during the digging and processing of wild tubers.

The utilization of wild tubers among the *Bateq* tribe

During the study, a total of 13 species of wild tubers were identified as the most sought-after food among wild tubers (Table 2). The plant tubers were reportedly collected from various locations, including moderately sloping to hilly terrain, lowland areas, and riverbanks. The plants are available throughout the year, with the maximum return rates occurring in May and October. The collecting of plant tubers also has a seasonal pattern, as Orang Asli does not harvest wild tubers during the fruiting season.

Table 1. Demographic Description of Informants (N=45) of the *Bateq* tribe in Kuala Koh, Gua Musang, Kelantan and Sungai Berua, Hulu Terengganu, Terengganu

Factor	Frequency	Percentage (%)
	Gender	
Male	19	42.2
Female	26	57.7
	Age groups	
Below 20	5	11.1
21 – 30	4	8.8
31 – 40	6	13.3
41 – 50	7	15.5
51 – 60	12	26.6
61 and above	11	24.4
	Work status	
Employed	3	2.2
Unemployed	38	84.4
Self-employed	4	2.2
	Pass the knowledge	
Yes	40	88.8
No	5	11.1

Most of the wild tubers recorded in this study are from the plant family Dioscoreaceae. A study in Simial Biosphere Reserve in Orisha, India also recorded 10 species of Dioscoreaceae utilized by the local communities (Kumar *et al*., 2017). Wild tubers, or yam, are a monocotyledon plant, mostly of *Dioscorea* genus (Burkhill, 1966). In terms of morphology, all *Dioscorea* species are climbers that twine their way up the stem. The orientation of stem twining in *Dioscorea* species is a distinguishing trait for species-level identification within this genus (Burkhill, 1966). On shallow soil, tubers of *Dioscorea* species are known to be fibrous and predominantly unbranched. The majority of the tubers are located in the soil's uppermost layer, although some can be found living as much as 1 m in depth (Behera, 2009; Kumar *et al*., 2017). However, this study found that some of the wild tubers eaten by the *Bateq* tribe were dug out from soil up to 2 meters in depth (Figure 2). A specially modified handmade tool made from long slender iron with a thin and sharp chisel-like end was used to dig the tubers from the soil.

Fig. 2. Harvesting and preparing Ubi or wild plant tubers by the Bateq in Kuala Koh, Kelantan. Ubi Woh (a), (b), Ubi Cengul (c), (d) and Ubi Takop (e) and (f). (Photo images source: Mohd Salim *et al*. 2011).

Fig. 3. Photograph images of several wild tubers harvested by the *Bateq* tribe in Kuala Koh, Kelantan. Ubi Pasir (a), Ubi Gadong (*Dioscorea hispida*)(b), Ubi Ciak (*Dioscorea esculenta)* (c) and Ubi Kasu' (*Dioscorea* sp.) (d).

The list of wild tubers harvested and used by the *Bateq* at the study site is presented in Table 2. The characteristics of the wild tubers, including their taste, habitat, growth form, and processing before eating vary according to species. The local and traditional knowledge for identifying, harvesting, and safely eating wild tubers is indeed important for the *Bateq* communities, particularly to avoid the incidence of food poisoning (Mohd Salim *et al*., 2011).

The study suggests that indigenous people often rely on locally sourced plants for diverse uses and livelihood. Before rice was popularised as a staple food, wild plant tubers were typically thought to have been the primary source of carbohydrates (Endicott & Bellwood, 1991). The practice of foraging and eating wild tubers among the *Bateq* is considerably important, as indicated by the collected data. The tubers are the organ that stores carbohydrates, and they have been reported to be a good source of key nutritional components such as proteins, lipids, vitamins, minerals, and starch (Arinathan *et al*., 2009, Mohan & Kalidass, 2010). The characteristic of food quality in the tuber includes a nutritional and physical-functional composition that is significant in human nutrition (Otegbayo *et al*., 2010). The harvesting of the wild tubers by the *Bateq* in this study provides evidence and support for consuming wild food resources as a common source of nutrients and energy.

The taste of Ubi ranges from sweet to bitter and deserves further investigation. This could be attributed to the fact that the tuber and other parts of *Dioscorea* species possess different types of bioactive compounds (Kumar *et al*., 2017). Among those important bioactive compounds is Diosgenine which is a kind of sapogenin used in the synthesis of steroidal drugs, structurally similar to cholesterol. Harvesting wild tubers from nearby forest habitats can relate the connection of the *Bateq* with nature, whereby their livelihood activities are based on collecting and hunting and not on intensive use of land. Most of the growth forms of harvested wild tubers are climbers that grow along the streams and riverside. The harvesting of wild tubers is also based on daily needs and the *Bateq* are known to share their wild tubers harvested with relatives and neighbors (Mohd Salim *et al*., 2011).

The preparation method and frequency of citation

The preparation method to consume wild tubers by the *Bateq* tribe is reasonably simple and practical to be adopted at the collection site. The most common technique used to reduce the bitterness of the wild tubers is either by roasting it directly over a fire, boiling it in a cooking pot, or cooking it inside

bamboo (Table 3). The other method of detoxification is also by cutting the tubers into very thin sliced pieces and soaking them in running water, especially for Ubi Gadong (*D. hispida*). The majority of the wild tubers that the *Bateq* consume are known to have an unpleasant flavor or texture when eaten fresh. TEK on the wild tubers is important in foraging and preparing them before those tubers can be safely consumed as food. Despite having nutritional value, those tubers also contain anti-nutritional elements and secondary metabolites which give a bitter flavor and decrease palatability. The major toxic content in *Dioscorea* tubers is dioscorine, an alkaloid that is present in most of the *Dioscorea* (Lu *et al*., 2012). If this compound is not removed, dioscorine triggers fatal paralysis of the nervous system (Reddy, 2015). Thus, preparing the tubers based on existing knowledge and traditional skills is vital to make them edible. This study reveals that the motivation for utilizing the wild tubers by the *Bateq* is because it is nutritious, easy to cook, tastes delicious, and is naturally unpolluted. Additionally, eating wild tubers is partly supported by their traditional knowledge that the tubers are nutritional. Starch and energy in tubers are also known to have medicinal properties due to the presence of diverse secondary metabolites (Kumar *et al*., 2017), and *Dioscorea* species are also ranked as the world's fourth most important crop after potatoes, cassava, and sweet potatoes (Lev & Shriver, 1998).

The top four wild tubers in terms of frequency of citation by the *Bateq* were Ubi Takop (*Dioscorea orbiculata*), Ubi Rem (*Dioscorea prainiana*), Ubi Kasu' (*Dioscorea* sp.) and Ubi Gadong (*Dioscorea hispida*) (Table 3). *Dioscorea orbiculata* was highlighted by the respondents as tasty and succulent, either roasted or boiled. Tubers of Ubi Rem (*Dioscorea prainiana*) and Ubi Kasu' (*Dioscorea* sp.) could be harvested in large quantities in a matter of minutes as these species grow close to the surface and could weigh 10 to 20 kilograms. From the interview, the respondents confirmed that these two species of tubers are more sought after compared to other tuber species. They would rather stop working on anything else just to go and dig these tubers if they came across it. The respondents also confirmed that the taste of Ubi Gadong (*Dioscorea hispida*) motivates them to forage for it despite it is well known that this tuber contains toxic alkaloid as reported earlier (Burkill, 1966; Lye 2021) and need to undergo at least one full day of detoxication process (Estiaseh *et al*., 2022). For a long time, Ubi Gadong was also regarded as a useful food resource for the rural Malays during the famine (Burkill 1966).

Traditional knowledge of harvesting the wild tuber plants

The *Bateq* can choose the most suitable location for digging by noticing the presence of climbing woody stems, leaves, and flowers in the forest. This helps them locate the best spot. The intertwining of the climbing pieces is one of the most significant indications that tubers can be found there. Sometimes they keep these locations in mind for a year or two and visit the sites only when they think the tubers would be ready to harvest. They would also look for dry, dead leaves on the trees and then examine the ground for a portion of the vine that would point them in the direction of the tubers. Lye (2021) reported a similar observation that *Bateq* does not move randomly through the forest but follows a well-defined network of trails and other pathways incorporated with rivers and streams, particularly when gathering forest foods.

Young *Bateq* gained most of their knowledge about harvesting tuber plants through experience and practice. A trained tuber plant harvester may be able to determine the plant's growth cycle based on using their senses of sight, touch, taste, and, for some prominent species, smell. Instead of receiving spoken instructions directly, young *Bateq* learned to identify the growth and morphology of plant tubers by closely observing and imitating their parents. The findings of this study provide evidence supporting claims by other studies that traditional ethnobotanical knowledge and the use of plants for a variety of reasons have been passed down verbally and vertically from generation to generation (Nimachou *et al*., 2011; Garnatje *et al*., 2017). On the other hand, ethnobotanists have played an essential role in unraveling and documenting these plant-human relationships, as well as unlocking knowledge through various types of interviews and surveys (Chauhan *et al*., 2018).

Traditional practice in maintaining the sustainability of a plant

The wild tuber's head is frequently replanted by the *Bateq* by performing some gentle digging and then placing it back into the soil. To avoid injuring the plant's stalk, they never cut the stems and never excavate the spot close to the stem's base. The *Bateq* will spare some tubers that are not necessarily used, and after a period, they gradually develop a habit of returning to the spot where they had dug before. This shows that in using the wild tuber, the *Bateq* follows a quite casual conservation technique. This traditional faith and belief indirectly help the conservation of forest resources. This is supported by the fact that the practice of maintaining an equilibrium in the ecosystem, biosphere, and life cycle is a result of indigenous tribe's long experiences gained from previous generations, and has thus become valuable ecological knowledge and skills (Nimachow *et al*., 2011). Furthermore, recognizing the interaction between the environment and culture also can help people get a deeper understanding of the land's resources and support the function of the ecosystems (Limbu, 2013).

Table 2. The list of the wild tubers used by the *Bateq* tribe in Kuala Koh, Gua Musang, Kelantan and Sungai Berua, Hulu Terengganu, Terengganu

No.	Common name (in *Bateq* dialect)	Scientific Name	Family	Characteristics	The growth form of the plant
1.	Ubi Takop	*Dioscorea orbiculata*	Discoreaceae	Good flavor, and a long and thin tuber. The largest source of tuber and dependable famine food. Usually grows on lowlands away from streams	Climber
2.	Ubi Rem	*Dioscorea prainiana*	Dioscoreaceae	The enormous tuber can grow up to 18 kilograms. Grows on one spot near the surface and does not spread in every direction.	Climber
3.	Ubi Gadong	*Dioscorea hispida*	Dioscoreaceae	The good flavor when properly prepared. It can be poisonous due to containing the toxic alkaloid Dioscorine. The processing time requires at least one or two days. Widely cultivated and planted by other local communities beside Orang Asli.	Climber
4.	Ubi Kebark	*Dioscorea* sp.	Dioscoreaceae	Pungent smell. Usually, eaten with meat or other vegetables. It gives an intoxicating effect on the person who eats it. Grows in hilly or secondary areas of the forest.	Climber
5.	Ubi Pasir	*Dioscorea alata*	Dioscoreaceae	Important starchy plant. Usually found on sandy plains by the riverside	Climber
6.	Ubi Woh	*Dioscorea* sp.	Dioscoreaceae	Good flavor. Thorny stem. Hard to obtain. Produces many buds that drop close together, so the vine is usually seen in clusters.	Climber
7.	Ubi Hakay	*Amorphophallus campanulatus*	Araceae	Elephant-foot yam grow near Malay dwellings. Irritant due to the presence of calcium oxalate. It can be consumed after washing and being cooked well. Usually boiled in water to remove the juice.	Non-woody shrub
8.	Ubi Kasu’	*Dioscorea* sp.	Dioscoreaceae	Good flavor. Grows near riverbanks.	Climber
9.	Ubi Hau	*Dioscorea* sp.	Dioscoreaceae	Grows in the lowland and hilly areas, the root has small fur.	Climber
10.	Ubi Ciyak /Ubi Tuba	*Dioscorea esculenta*	Dioscoreaceae	Poisonous raw. Tastes bitter if inadequately cooked. Thorny, grows in the lowland area near the river. Fish poison can be extracted from the tuber.	Climber
11.	Ubi Tampak	*Gnetum tenuifolium*	Gnetaceae	If eaten a lot may get nauseous. A woody tuber that develops near the surface in a tiny bunch off the vine. Growing on level or slightly sloping land.	Climber/ shrub
12.	Ubi Cengul	*Dioscorea pyrifolia*	Dioscoreaceae	Good flavor. The stem is woody and spiny towards the base. Commonly found in the lowlands.	Climber
13	Ubi Carga’	*Dioscorea* sp.	Dioscoreaceae	Long and big tuber develops on the surface of limestone cliffs.	Climber

Table 3. The preparation method for wild tubers and frequency of citation (FC) mentioned in the survey of the *Bateq* tribe in Kuala Koh, Gua Musang, Kelantan and Sungai Berua, Hulu Terengganu, Terengganu

No.	Local Name	Scientific Name	Preparation method	FC (%)
1.	Ubi Takop	*Dioscorea orbiculata*	Roasted or boiled with skin	100
2.	Ubi Rem	*Dioscorea prainiana*	Roasted	100
3.	Ubi Gadong	*Dioscorea hispida*	Due to its alkaloid content, it must be carefully processed before it can be consumed. Typically, it is finely sliced into thin strips. Placed inside a sack and left in water for a few days until the toxin has leached out. Then, it is usually cooked inside bamboo.	100
4.	Ubi Kebark	*Dioscorea* sp.	Roasted or boiled. An inadequate cooking time will result in an intoxicating effect	48.8
5.	Ubi Pasir / Ubi Cengel	*Dioscorea alata*	Roasted or boiled. An inadequate cooking time will result in an irritating effect	73.3
6.	Ubi Woh	*Dioscorea* sp.	Roasted	68.8
7.	Ubi Hakay	*Amorphophallus campanulatus*	Cooked in bamboo, boiled in water	84.4
8.	Ubi Kasu’	*Dioscorea* sp.	Roasted	100
9.	Ubi Hau	*Dioscorea* sp.	Roasted	44.4
10.	Ubi Ciyak / Ubi Tuba	*Dioscorea esculenta*	Roasted or boiled, inadequate cooking time will make it remain bitter	51.1
11.	Ubi Tampak	*Gnetum tenuifolium*	It can be eaten raw without any irritating effect, but usually it is roasted	26.6
12.	Ubi Cengul	*Dioscorea pyrifolia*	Roasted	48.8
13.	Ubi Carga’	*Dioscorea sp.*	Roasted	73.3

CONCLUSION

The *Bateq* tribe safely utilizes wild tubers with the guidance from TEK passed down by their ancestors. Knowledge related to the utilization of wild plant resources is decreasing in the younger generations among the indigenous people. As most of the wild tubers are unknown to the larger public, this study is important in providing information on useful edible wild tubers. Understanding the TEK of indigenous tribes could contribute to future food security and the preservation of the natural heritage of plant biodiversity. The ability and understanding of best practices for harvesting and consuming wild plants and other resources sustainably will play a role in strengthening community management of the valuable resource. On the other hand, the patterns of collection and consumption must be compatible with the ability of wild plant resources to regenerate on their own.

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ETHICAL STATEMENT

This research was approved by the Universiti Malaysia Terengganu (UMT) Research Ethical Committee dated 1st April 2022.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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