Traditional usage of underutilized aquatic plants found in the Imphal valley of Manipur

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Abstract

The paper focuses on the traditional usage of aquatic plants found in the wetland areas of the Imphal valley of Manipur. From the survey, 30 aquatic plants have been collected use for the management of various health conditions. Most of the collected plants consume as daily food items, some used for specific remedial purposes in the treatment of certain types of ailments and diseases like cough, fever, ulcer, piles, diarrhea, jaundice, skin diseases, rheumatic pain, diabetes, hypertension, urinary troubles, body pain, respiratory problems, urinary problems, cardiovascular diseases, etc. Accordingly, different parts of the plant are used as a single item or by mixing with other ingredients in various forms of fresh or raw, culinary, or as a tonic or dry or powder form to treat the diseases. The aquatic plants also incorporate in the preparation of various traditional dishes. 70% of collected wetland plants are marketable provides a means of livelihood and source of income for the poor and needy people. Therefore, proper documentation and preservation of traditional knowledge are essential that may provide useful for future generations through research in pharmaceuticals and drug discovery.

Introduction

Wetlands are 'wealthlands' or 'biological supermarkets' because of the extensive food chain and rich biodiversity that they support (Moirangleima 2007). They are one of the most biologically productive ecosystems on Earth and provide numerous services to human civilization (Ghermandi et al. 2011). Wetlands are lands transitional between terrestrial and aquatic systems (Cowardin et al. 2005) and consist of lakes, rivers, bogs marshes. It is the areas of land that remain waterlogged for a substantial period of the year. Wetlands in India comprise less than 5% of the total geographical region, and they are the most productive biomes that support one-fifth of the total biodiversity (SACONH, 2004), (Jain et al., 2011). The Indian landscape is prominent for 4290 large lakes and numerous small water bodies (Kumar and Dhankhar 2015), (Jain et al. 2011). Northeast India falls under Indo-Burma global hotspot, and the area harbors a maximum number of wetlands (Venkataraman and Sivaperuman 2018). Wetlands of northeast India have a rich diversity of habitats consists of lakes, reservoirs, bells, rivers, ponds, etc., and one of the most productive life-supporting systems having immense socio-economic and ecological importance to the people of the region(Convention 1990), (Chandra *et al*., n.d.). The Loktak Lake (Manipur), Deepor Beel (Assam), Rudrasagar (Tripura), Palak, and Tamdil (Mizoram) are a few of the freshwater wetlands of the region known for their resources (Chandra et al. 2018), (Chatterjee et al. 2006). Manipur is a state that consists of several lakes, marshes, swamps, canals (24,804 ha), rivers and streams (13,888 ha), and low-lying wetlands (9,219 ha) that cover a total area of 47,911 ha. Among the 13 lakes (wetlands) found in Manipur, Loktak lake (42,672 ha) is the biggest and is one of the Ramsar sites of global significance (Ministry of Environment and Forests 2010) (Jain and Singh 2014). The maximum number of lakes is in Imphal and Thoubal districts. However, there are also several smaller lakes known as Kom (pits). In different areas of Manipur, there are around 134 waterlogged marshy and swampy wetlands. These areas are low-lying, situated either in the peripheral areas or the vicinity of the lakes. The maximum number of areas covered with water are recorded in the Imphal valley (69), followed

by Thoubal (40) and Bishnupur districts (21). There are two artificial reservoirs, one each in Senapati and Tamenglong districts (Centre and Environment 2017), (ENVIS, 2015). More than 30 ethnic communities with a total population of about 23 lakhs, mainly dependent upon their cumulative knowledge and surrounding resources for their day-to-day healthcare, inhabit different parts of the state (Jain and Singh 2014). In addition to providing food and medicine, maintain the livelihood and income of an extensive segment of people living around them (Jain et al. 2011). Wetland is also very rich in medicinal plants that help in curing various ailments and diseases. Since time immemorial, the application of traditional medicine not only helps in conserving their traditional knowledge but also helps in the management of health and diseases. From this, we can say that the practice of ethnomedicine plays a vehicle for understanding indigenous societies and their relationship with nature. The rapid declined in usage, ignorance, changes in climate, environment, and advancement in pharmaceutical medicines have posed a threat to their practices. Hence, proper documentation of aboriginal knowledge is of utmost importance that we can achieve through ethnobotanical studies in the conservation and management of biological resources. The documentation of aquatic plants will facilitate future research on the safety and efficacy of different ailments. In addition, insufficient data are available specifically on ethnobotanical reports of aquatic plants in Manipur. And it is also revealed that aquatic plants have a higher concentration of bioactive compounds because of their ability to adjust in intense environmental conditions like alkaline, or acidic water, high or low temperature, high pressure, and inadequate substrate in the water (Baharum, Beng, and Mokhtar 2010), (Vijayan et al. 2012). It will facilitate the discovery of new sources of drugs and promote the sustainable use of aquatic plants. Therefore, considering these points, the present study is focused on the traditional usage of aquatic plants found in the Imphal valley of Manipur.

Materials And Methods

Study Area

Manipur is an isolated hill grit state lying in the extreme northeastern corner of India along the indo-Myanmar border. The geographical area consists of about 22,327 square kilometers (8,621 sq mi) (Jain *et al.* 2011) and has a population density of 2,855,794 as per the 2011 census. Around 90 percent of the state consists of hilly regions; the remaining are by the lacustrine plains of the Central Valley (Singh and Moirangleima 2009). The present study area consists of wetlands areas situated in the Central or Imphal valley of Manipur (93°42' to 94°11' E and 24°41' to 25°06' N). It is an intermundane basin around 70 km long (north to south) and 30-35 km wide (east to west), oval-shaped with an unequal outline covered by hills. The valley is a high flood plain with an altitude of around 760 m above mean sea level. Several streams and rivers arising from the hills are the main physiological features of the valley and many shallow wetlands and marshes in the interfluvial areas. The Imphal River is the most significant perennial river flowing in the Central Valley of Manipur and its tributaries (Iril, Thoubal, Khuga, Sekmai, Chakpi, etc.). Other small rivers (Nambul, Nambol, Kongba, Merakhong, etc.) dried out throughout the lean period (Moirangleima 2007), (Singh and Moirangleima 2009).

The lacustrine plains of the Central Valley were the site of an ancient lake which was afterward filled up and uplifted to its current position, the remnant of which is the Loktak lake which occupies the south-east corner of the valley is the Loktak Lake (Singh, 1982). Several lakes are encircling on both sides of the Imphal River. The biggest river Loktak has stayed on the right side of the Imphal River; on the left side lays the Ikoppat/Kharungpat, Waithoupat, Khoidumpat, Lamjaopat, and Pumlenpat. Most of these lakes become contiguous throughout the rainy season (May to August), on the other hand, merged under a massive sheet of water during the dry season. All the smaller lakes Ikoppat/Kharungpat, Waithoupat, Utrapat, Poiroupat, Sanapat, Loushipat, and Ushoipokpipat are extremely aged eutrophic and seasonal marshy land areas (Moirangleima 2007).

Methods

The collection of data for the study has been done based on both primary and secondary sources. The data was accumulated through the primary sources by surveying all the wetlands and a comprehensive survey of Loktak and Pumlen lakes situated in the Central Valley of Manipur. To understand various utilization of the lakes features was collected through questionnaire interviews. The information regarding traditional usage was gathered through an extensive survey (2018-2019), semi-structured interviews, and focus group discussions. A total of 200 individuals (30-70 yrs) were questioned together with village chiefs, priests, senior leaders, local healers (*Maibas* and *Maibis)* identified with the assistance of local administrators and community leaders. Field visits involved direct contact with the community and also visiting *the Ema* market (local market), the nearest and hugest market in Manipur. At around 10–15 women vendors in *the Ema* market were catechized regarding the local name of the plants, uses, source, and medicinal properties. A few numbers of herbal practitioners/healers (*n*=10) also visited. During the discussion, information was assembled based on vernacular names, plant parts used, mode of preparation, administration, and measured doses and documented elaborately for the medication of particular ailments. To obtain accurate data secondary sources of data from the published works on the aquatic plants of Manipur have also been consulted. Plant specimens secured after regular field trips to the wetlands of Manipur were identified as to their scientific names and families with the help of experts and using standard literature and floras (Jain, 2007), (Jain, 1968), (Singh et al., 2003), (Sinha, 1987), (Sinha, 1996). All the literature concerning the wetlands of the state has been interrelated. Efforts have been given to recover accurate data by touring several times for validation. Out of the 30 collected aquatic plants ten plants were estimated of their mineral content, such as calcium, magnesium, iron, and zinc, using standard methods (Rangana SC. 1979). The ten samples were washed thoroughly under running tap water to make them free from dust and then dried in a shady area at room temperature (25°C) with regular turning. Dried plant parts were then chopped and ground to a coarse powder using an electronic grinder for laboratory analysis (who, 2003).

Considering community perception regarding plants use and taste, availability, and conservation status were aggregate for different aquatic plants using a random sampling method. The community interpretation (n = 30) was ranked on a range of 1 to 4 from least to highly preferred category. For assessing ‘Use’ and ‘Taste’ status the ranking was done with the community members as 4-most

preferred, 3-commonly preferred, 2-preferred but not so common, and 1-occasionally used. For 'Availability' status the species was ranked based on field observations of the authors, market availability trend, and interaction with collectors and user groups as 4-extensively available, 3-commonly available, 2-available but not so common, 1-rare. For 'Conservation' status, the scale ranked as 4-for the species whose conservation is highly needed, 3-conservation urgently needed, 2-conservation required but not so urgent, and 1-not required at present. Such ranking of the species found favor to understand community perception on the use of the species(Sundriyal and Sundriyal 2003).

DATA ANALYSIS

The mineral content of the ten aquatic plants is presented as average mean values (± SD). The data collected on community ranking of aquatic plants for their use, taste, availability, and conservation status was qualitative, which ranked on a scale of 1 to 4 to convert it to quantitative form. The information was ethnographically analyzed based on community discernment, belief, and thoughts about aquatic plant resources so that the management and protection movements can be addressed in near future.

Results

The observations made and collected on traditional usage are presented (Table no.1) with botanical names of the plants arranged in alphabetical order followed by their families in parentheses and local names in the Manipuri language. Out of 30 aquatic plants accumulated from the wetland areas of the central valley of Manipur state, of which 21 plants adopted in the traditional delicacies such as *ootti, eronba, singju*, etc. All the aquatic plant species had a common name that explains the prevalent use of these species in the traditional system.

Most commonly consumed aquatic plants are *Alocasia cuculata, Cyperus haspan, Enhydra fluctuans, Eryngium foetidum, Euryale ferox, Hedychium coronarium, Houttuynia cordata, Ipomea aquatic, Nelumbo nucifera, Neptunia oleraceae, Oenanthe javanica, Polygonum barbatum, Polygonum posumba, Sagittaria sagittifolia, Trapa natans,* and *Zizania latifolia.* Diverse communities used different modes to consume these aquatic plants. Consumption in the form of raw was the most preferred mode to use these plants and incorporated in the most commonly eaten traditional preparation viz. *ootti, eronba, singju*, etc. The '*Singju*' was prepared by aquatic plants along with fermented fish, chili, and other plants; *eronba* was made by boiling plant parts and smashing it with potatoes, chili, and fermented fish before consuming; while the only local dish, '*ootti'* was prepared by boiling vegetables with a pinch of sodium bicarbonate (Table 2). At least one item of these traditional delicacies incorporates in an everyday meal becomes an indispensable constituent of the local diets, which explained the significance of these aquatic plants in the local food system.

A total of ten aquatic plants estimated for the mineral content has been presented in Table 3. Maximum and minimum content of iron was recorded in *Jussiaea repens* and *Zizania latifolia*; for magnesium in *Trapan natas* and *Zizania latifolia*; for calcium in *Trapan natas* and *Zizania latifolia*; and for zinc in *Ipomea aquatica* and *Eleocharis dulcis*, respectively (Table 3).

Community matrix ranking of use status, taste preference, availability status, and conservation of 30 aquatic plants found in the wetland areas of the central valley of Manipur is presented in Table 4 and Figure 3A to 3D. From the use of species, 7 aquatic plant species were most preferred while 9 other commonly preferred (Table 4 Figure 3A). The most frequently used plant was *Alocasia cuculata, Eryngium foetidum, Euryale ferox, Hedychium coronarium, Houttuynia cordata, Neptunia oleraceae,* and *Oenanthe javanica.* Taste-wise 12 plants were highly preferred while another 4 plants were commonly preferred (Figure 3B). Availability status of the plant showed just one plant as extensive available and another 12 plants as commonly available (Figure 3C). *Alocasia cuculata, Euryale ferox, Hedychium coronarium, Nelumbo nucifera, Neptunia oleraceae,* and *Zizania latifolia* was extremely demanding due to their extensive utilize, intense collection, and market demand (Figure 3D). Considering the four ranking parameters, the most desired aquatic plant was *Alocasia cuculata, Euryale ferox, Hedychium coronarium , Houttuynia cordata , Nelumbo nucifera, Neptunia oleracea,* and *Zizania latifolia* (Table 4). Fascinating work that farmers have started cultivation of *Alocasia cuculata*, *Eryngium foetidum, Euryale ferox*, *Houttuynia cordata, Ipomea aquatic, Neptunia oleracea, Nelumbo nucifera*, *Oenanthe javanica, Polygonum barbatum*, and *Polygonum posumba,* at the household level.

Discussion

From the present study, 30 species belong to 24 families have been identified. The collected aquatic plants used in the healing of various diseases and ailments viz. cough, fever, headache, wounds, ulcer, piles, diarrhea, dysentery, jaundice, eye and skin diseases, rheumatic pain, diabetes, hypertension, urinary troubles, muscular and body pain, respiratory problems, urinary problems, cardiovascular diseases, bleeding, constipation, fracture of bones, gonorrhea, smallpox, measles, snakebite, etc. They use either orally/internally or externally. Orally in the form of tonic or concoction or as culinary, especially the fresh leaf or part of the plant used for curing of ailments such as stomach ache, headache, chronic ulcer, gastritis, etc. And externally in the form of ointment or pastes or balm for the cases of cuts, burn, sprang, fracture, septic, etc. The most frequent practice used for therapeutic purposes was to make paste, decoction, or powder, or to boil or eat raw. From the survey, it was discovered that most of the diseases viz. indigestion, dysentery, and intestinal infections (14 species); skin diseases (13 species); gout, muscular and rheumatic sprains (12 species); blood pressure and circulation problems (12 species); cough and fever (10 species); urinary troubles (9 species); diabetes (9 species); boils, burns, and wounds (7 species); earache and insect bites (6 species); stomach ulcers (6 species); jaundice (5 species); cuts and injuries (4 species); piles (4 species); paralysis (3 species); intestinal worms, leucoderma; food poisoning and cancer (1 each species) were treated with locally available aquatic plants. Among the plant parts used for medicinal purposes, leaves are the most commonly used (26%), followed by young shoots (20%), rhizome (14%), and least by flower, tuber, stem consists of only 3% as shown in fig no 2.

Local people consume rice as a staple item with green leafy vegetables and salad. The communities used diverse modes to devour these aquatic species. Their diet exclusively depends on the fresh green vegetables they eat. Consumption in the form of raw was the most preferred mode to utilize the aquatic plants and incorporated in the most commonly eaten traditional preparation such as *ooti, eronba, singju*,

etc. *Singju* is the most prominent conventional food made by combining aquatic plants with fermented fish, chili, and other plants. E*ronba* is prepared by boiling plant parts and smashing them with potatoes, chili, and fermented fish; while *ooti* is prepared by boiling vegetables with a pinch of sodium bicarbonate (Table 2). At least one item in each feast was a crucial component of the local diets, which explained the significance of aquatic plants in the local system. *Polygonum barbatum* (yelang), *Ipomea Aquatica* (Komlamni), *Oenanthe javanica* (Komprek), *Neptunia oleracea* (Ekaithabi), *Eurgale fero* (Thangjing), *Trapa natans* (Heikak), *Marsilea minuta* (Ising ensang), *Nelumbo nucifera* (Thambou), *Nymphaea alba* (Tharo) are some of the aquatic plants used as remedial purposes but incorporated in the preparation of various traditional dishes such as *Eronba, Singju, Kangsoi, Chamthong, Paknam, Ooti*, etc.

The most common ten aquatic plant species estimated for different mineral content has been presented in Table 3. The maximum and minimum content of iron was recorded in *Jussiaea repens* and *Nelumbo nucifera*; for magnesium in *Trapan natas* and *Eleocharis dulcis*; for calcium in *Trapan natas* and *Eleocharis dulcis*; and for zinc in *Ipomea aquatica* and *Eleocharis dulcis*, respectively. From Fig. 1, we can conclude that 70% of the plants are marketable, and the remaining 30% are non-marketable. Besides, most of the aquatic plants grow wild and are available in abundance. Consequently, people generously collect them and provides a means of livelihood and source of income specifically for the poor and landless people. Among aquatic plants, *Cyperus haspan*, *Euryale Ferox*, *Ipomoea*, *Nelumbo nucifera, Neptunia oleraceae, Oenanthe javanica*, *Polygonum barbatum, Trapa natans*, *Sagittaria sagittifolia*, *Zizania latifolia*, etc. are some of the common vegetables sold in the market of Manipur. And *Sagittaria sagittifolia*, *Nelumbo nucifera, Neptunia oleraceae, Zizania latifolia*, *Cyperus haspan* are some delicacies and expensive conventional foods available in Manipur. Most of the rural population was drawn into the business that primarily comprises womenfolk. *Neptunia oleracea, Sagittaria sagittifolia*, and *Zizania latifolia* are some of the most demanding aquatic species regardless of their inadequate availability which could lead to their constricted scope of distribution and accessibility during the growing season only. Some of the species viz. *Euryale ferox, Colocasia esculenta, Oenanthe javanica, Nelumbo nucifera, Polygonum barbatum, Hedychium coronarium*, and *Sagittaria sagittifolia* are also a way of generating incomes among the rural people. Above all, most of these plants are consumed uncooked with the belief that they obtain direct nutritional and medicinal benefit and thus incorporated in various conventional dishes viz. *Eronba, Kangsoi, Chamfut, Ooti, Kangsu, Singju, Chagem-Pomba*, etc.

Several wetlands are drying due to climatic conditions and transform into other landforms such as paddy fields, human settlements, a land modification for developmental, and indirectly by rainfall shift. It is suggested that a sturdily participatory approach is necessary for the sustainable management of wetland areas. To accomplish the said objective, the community needs to be well-thought-out for adopting sustainable harvest protocols for all the aquatic and wetland plants, and necessary training can be imparted for them. Additionally, appropriate value chain development for selling and value-addition for aquatic plants can bring good revenue to the communities. Thereby helps in soaring their income from them by improving keeping quality and developing by-products is very much necessary as the majority of the species have low self-life. Furthermore, aquatic plants can be grown in the fields by applying appropriate agro-techniques that will facilitate in management and conserving of aquatic plants in

wetland areas. Therefore, prominence on identification, documentation, assessment of the patterns, validation of nutritional quality is crucial. In addition, the conservation of wetlands is becoming a globally discussed issue. Therefore, proper documentation and preservation of wetland plants help ensure sustainable, self-reliant socio-economic development of wetland areas by strengthening community linkages and acknowledging the aesthetic beauty of the place through ecotourism, etc. And, sustainable harvesting of aquatic plants can be approved to get long-term perspectives.

Conclusion

Interactions between researchers and locals people have not only brought understanding between local people and researchers but also their orally handling down traditional practices for the management of various disease ailments. Documentation and preservation of the traditional knowledge are challenges, still can be preserved for future pharmaceuticals and drug discovery with constant efforts on ethnobotanical surveys and analysis of the plants used by various ethnic communities. Therefore, a joint holistic approach between the researchers, NGOs, and locals peoples is necessary for the conservation and protection of such valuable treasure to enlarge the population of the threatened wetland plants in their natural habitat.

Declarations

CONFLICT OF INTEREST

Authors have no conflict of interest.

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AUTHORS' CONTRIBUTIONS

O.A.D and M.B.S conceived and conceptualized the research idea, designed the experiments, interpreted the results and prepared the manuscript. O.A.D carried out purposive sampling for aquatic plants with relation to community dependence for subsistence and organised interview schedules. O.A.D and M.B.S carried out mineral analysis of commonly used aquatic species. S.S.N helps in identifying the aquatic plants and participated in design and coordination of the study. All authors read and approved the final manuscript.

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Tables

Please see the supplementary files section to view the tables.

Figures

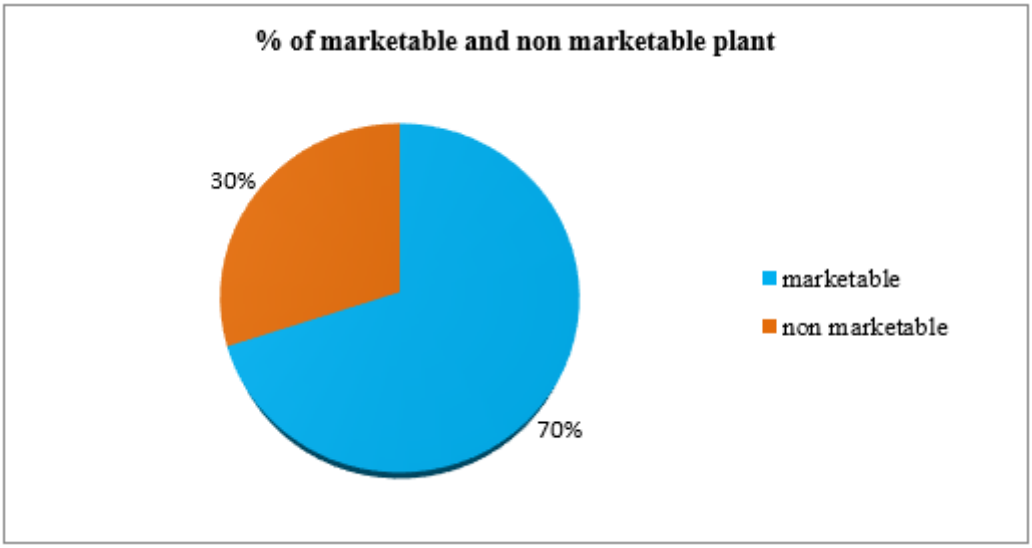

Figure 1

Graphical representation of marketable and non-marketable of aquatic plants

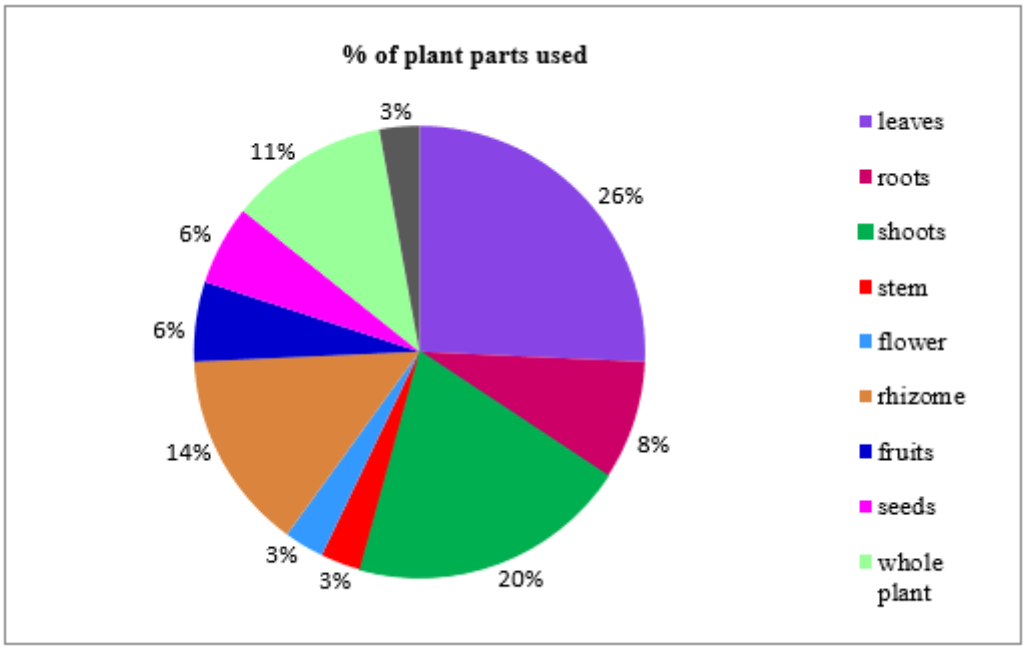

Figure 2

Graphical presentation of plant parts used

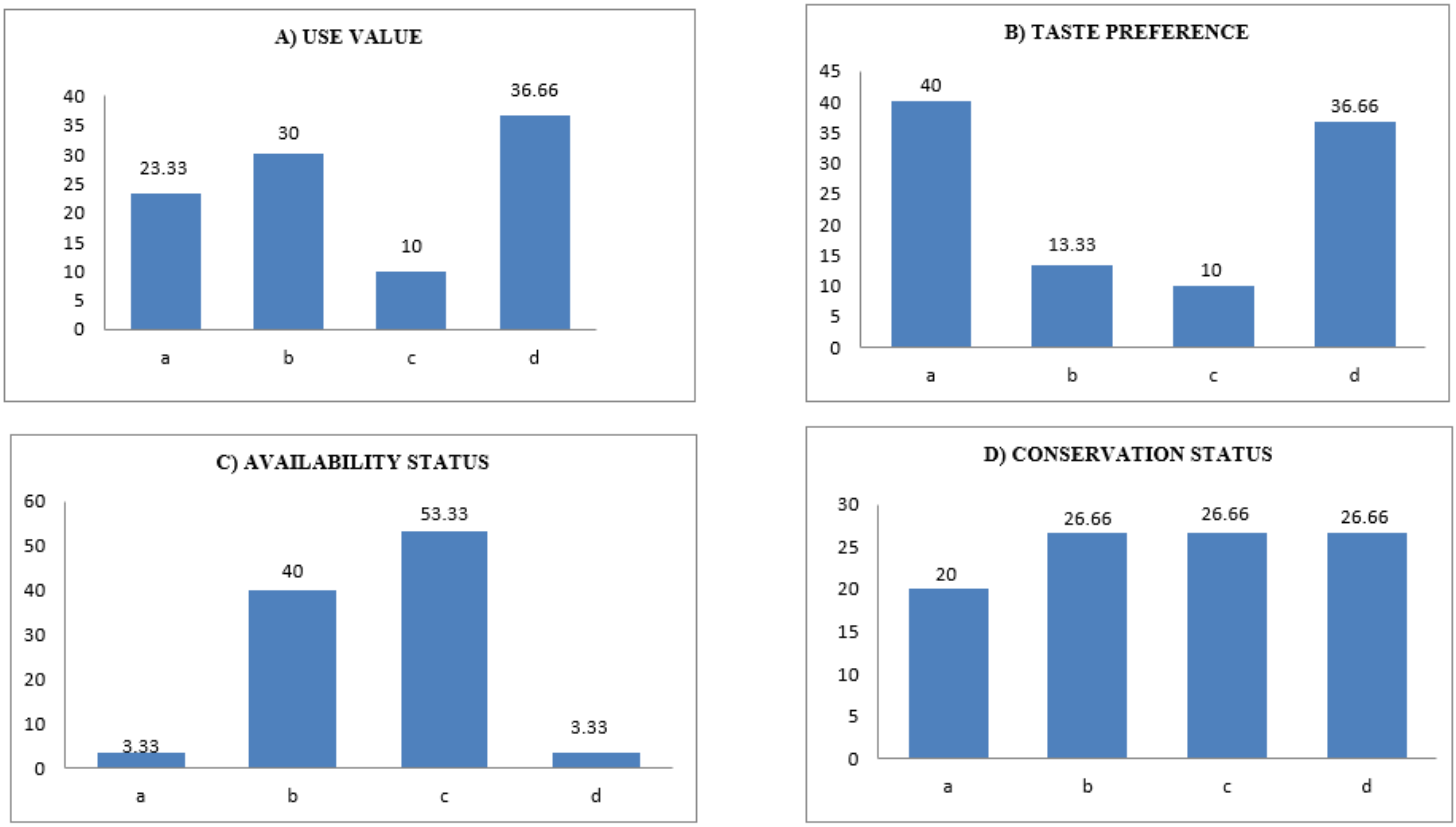

Figure 3

Bar diagram showing percent Use value (A), Taste preference (B), Availability status (C) and Conservation status (D) of aquatic plants in Manipur, India (ranking for 'Use' and 'Taste' status comprised as: (a) occasionally used, (b) preferred but not so common, (c) commonly preferred, and (d) most preferred; for 'Availability' status: (a)- rare, (b) available but not so common, (c) commonly available, and (d) extensively available; and for 'Conservation' status: (a) no conservation required at present, (b) conservation required but not so urgent, (c) conservation urgently required, and (d) conservation highly required).

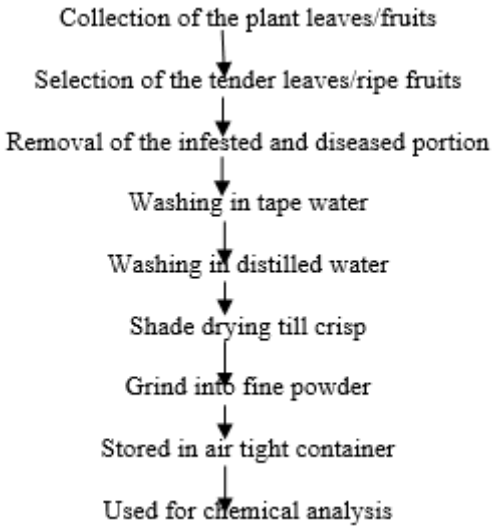

Figure 4

Flow diagram for preparation of samples (who, 2003)

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