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'*Pila*' – the traditional alkaline food-additive of Apatani Tribe in Ziro valley of Arunachal Pradesh, India

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Abstract

The alkaline food-additive, called '*Pila*', extracted from the ashes of various plants is popularly prepared and consumed by the people of Apatani tribe living in the Ziro valley of Arunachal Pradesh (India). This paper focuses the plants which are used as resource for *Pila* extraction, their availability, uses, edibility and ethnobotanical values. It also highlights the process involved in its preparation and concerns attached to preparation consumption of *Pila*. Of the 29 plants from 15 families reported as *Pila*-plants 15 are wild and remaining 14 species are cultivated food-plants. Details of the method of Pila preparation and the future prospect of this popular food-additive and its marketability also has been discussed.

Key words: Apatani tribe; *Pila*; *Khar*; Alkaline food additive; Ziro; Arunachal Pradesh

INTRODUCTION

Arunachal Pradesh is the largest of the eight North-eastern States of India (FSI 2021). It is home to officially recognized 26 major tribes and 110 sub-tribes with their tremendous diversity of culture (Anonymous 2001; Kri 2010; Nimasow *et al.* 2011). Along with their cultural diversity comes the diversity of food habits. All these tribal communities of Arunachal Pradesh collect most of their food resources from their surrounding vegetation (Lungphi *et al.* 2018; Taram *et al.* 2018 2020). Some of these communities are specialised for the preparation of some unique drinks including '*Pkalap-khah*' by Tangsa in Changlang district (Lungphi *et al.* 2019) and a few types of '*Chhyang'* by Monpa of Tawang district (Chozom & Das 2023). '*Pikey*' and '*Pila*' are two such traditional dishes prepared by the Apatani tribe residing at Ziro valley in Lower Subansiri District of Arunachal Pradesh. These dishes are not only popular among the Apatani people but are also relished by other tribes of the State and also by the visitors. The prevalence of *Pikey* and *Pila* dishes in Arunachal Pradesh had been reported by various authors in recent times (Tiwari & Mahanta 2007; Wangpan & Tangjang 2021; Yamang & Singh 2021). While '*Pikey'* is one generally non-veg preparation with some plant materials, the *Pila* is one alkaline liquid prepared using different plants. This *Pila* is added to *Pikey* (and other prepared foodstuff) that impart the most agreeable aroma and taste to the preparation. It is to be noted here that the term '*Pilaa*' is also used for a non-veg dish prepared through roasting method. The alkaline liquid (*Pila*) is added on both *Pikey* as well as *Pilaa* dishes.

Pila is an alkaline aqueous filtrate obtained from ashes of several plants and plant-parts used as a food-additive. Similar such preparations are known by various names in Assam like '*Khaar*' or '*Kolakhaar*' or '*Kalakhaar*' or '*Khardwi*' or '*Dokhora khaar'* (Deka & Talukdar 2007; Hemanta *et al.* 2014; Kalita *et al.* 2016; Kalita *et al.* 2017; Limbu & Das 2018; Sarma *et al.* 2020; Talukdar & Deka, 2020; Mazumder *et al.* 2024). A similar product is prepared by the Rajbanshi community in Terai and Duars (Jalpaiguri and Coochbehar districts) areas of West Bengal (India) and is called '*Chhyaka'* (Roy & Das 2015). It is referred as '*Kshara*' in Ayurvedic literature (IAPC 2003). According to Sen and Roy (2020), traditional knowledge on *kshara* (*khar*) is popular mainly in Assam and Manipur of NE India. Most of the study on such alkaline food-

additive has been reported from Assam. Different scientific studies had been undertaken in Ziro Valley considering many ethnobotanical or ethnomedicinal aspects, sustainability of the ecosystem, agroforestry systems, edible and medicinal plants, cultural practices prevailing in the region, etc. (Kala 2005; Srivastava *et al.* 2010; Yakang *et al.* 2013; Panda *et al.* 2016; Singh & Asha 2017; Yanka *et al.* 2019; Chaudhuri & Chaudhuri 2022). However, till date, no much work has been done for recording the plant sources used in *Pila* preparation. A single local plant, *Lobyo tare (Cirsium eriophoroides*) had been reported earlier from Ziro for the same apart from mentioning commonly used banana peels and papaya trunk (Tiwari & Mahanta 2007). The study on plant resources used to prepare *Pila* is important because this alkaline food-additive has secured a spot for itself in every household of Apatani community though very little study has been done on this topic especially with reference to Ziro valley.

Map 1. Location map for the study sites [maps not to the scale]

METHODOLOGY

Field survey was carried out mainly in Hari and Biila villages of Ziro Valley in Lower Subansiri District of Arunachal Pradesh during the years 2022 – '23, in different seasons. Voucher specimens were processed into mounted Herbarium-sheets following Das (2021) and preserved in the Herbarium of the Department of Botany, Himalayan University, Itanagar, Arunachal Pradesh. Mandatory FPIC was taken from the informants before start of the interaction. Ethnobotanical data were collected through open-end personal interview method using their own Apatani language (Martin 1995). Plants were identified using local floras (Hooker 1872 – 1897; Hajra *et al.* 1996; Giri *et al.* 2008; Chowdhery *et al.* 2009), taxonomists available through professional interactions and by consulting and matching in the ARUN Herbarium of the Arunachal Pradesh Regional Circle of Botanical Survey of India. The updated scientific names and their family delimitation were determined mostly from https://powo.science.kew.org/

OBSERVATIONS AND RESULT

A total of 29 species of plants belonging to 15 families (Figure 1) have been recorded as the source materials for the preparation of alkaline food-additive, *Pila*, by the Apatani tribe. It includes only one Pteridophyte and no Gymnosperm. Asteraceae and Poaceae contributed highest number with five species from each, followed by Solanaceae with four species,

Polygonaceae with three species and Fabaceae with two species. Remaining families have contributed only one species each. Table 1 enlisted recorded 29 plants used for *Pila* preparation.

Table 1. List of plants used to prepare traditional alkaline food-additive, *Pila*, by the Apatani tribe of Ziro valley, Arunachal Pradesh

Scientific name [Family]; *Voucher specimen*	**Apatani name**	**Plant part used**	**Nativity**	**Availability**
Actinidia chinensis var. *deliciosa* (A.Chev.) A.Chev. *[*Actinidiaceae]; *HU-HA-003*	*Kiwi*	Branches, twigs	Exotic	Cultivated
Adenostemma lavenia (L.) Kuntze [Asteraceae]; *HU-HA-022*	*Subu-giiyang*	Aerial part	Native	Wild
Arundo donax L. [Poaceae]; *HU- HA-026*	*Pepu*	Aerial part	Native	Cultivated
Bidens pilosa L. [Asteraceae]; *HU-HA- 004*	*Tiikhiing-tiilying*	Aerial part	Native	Wild
Brassica juncea (L.) Czern. [Brassicaceae]; *HU-HA-024*	*Giiyang-hamang*	Aerial part	Exotic	Cultivated
Capsicum annuum L. [Solanaceae]; *HU-HA-005*	*Tero*	Aerial part	Exotic	Cultivated
Capsicum chinense Jacq. [Solanaceae]; *HU-HA-007*	*Tagin-tero*	Aerial part	Exotic	Cultivated
Capsicum frutescens L. [Solanaceae]; *HU-HA-006*	*Tero*	Aerial part	Exotic	Cultivated
Cirsium eriophoroides (Hook.f.) Petr. [Asteraceae]; *HU-HA-021*	*Lohyo-tiire*	Aerial part	Exotic	Wild
Crassocephalum crepidioides (Benth.) S.Moore [Asteraceae]; *HU HA 001]*	*Genda-hamang*	Aerial part	Native	Wild
Cucumis sativus *L. [*Cucurbitaceae]; HU-HA-028	*Taku*	Aerial part	Exotic	Cultivated
Dendrocalamus hamiltonii *Nees & Arn. ex Munro* [Poaceae]; *HU-HA-023*	*Yayi-bije*	Culm and sheaths	Native	Cultivated & wild
Eleusine coracana (L.) Gaertn. [Poaceae]; *HU-HA-002*	*Sarse*	Aerial part, husk	Exotic	Cultivated
Glycine max (L.) Merr. [Fabaceae]; *HU-HA-019*	*Potung-perung*	Aerial part	Exotic	Cultivated
Juncus himalensis Klotzsch [Juncaceae]; *HU-HA-018*	*Mima*	Aerial part	Native	Wild
Ligustrum confusum Decne. [Oleaceae] *HU-HA-010*	*Sankhang-melyang*	Branches, twigs	Native	Wild
Oenanthe javanica (Blume) DC. [Apiaceae]; *HU-HA-011]*	*Hugu-hamang*	Aerial part	Native	Wild
Persicaria hydropiper (L.) Delarbre [Polygonaceae]; *HU-HA-012*	*Ngiiyi-roring/ Iidii-tami*	Aerial part	Native	Wild
Persicaria nepalensis (Meisn.) H.Gross [Polygonaceae]; *HU-HA-014*	*Looli-tami*	Aerial part	Native	Wild
Persicaria thunbergii *(Siebold & Zucc.) H.Gross [*Polygonaceae]; HU-HA-013	*Ropuh tami*	Aerial part	Native	Wild
Phaseolus vulgaris *L. [*Fabaceae]; HU-HA-029	*Manii-perung, Ako-perung* varieties	Aerial part	Exotic	Cultivated
Phyllostachys mannii Gamble [Poaceae]; *HU-HA-025*	*Bije*	Culm and sheaths	Native	Cultivated
Pogostemon yatabeanus (Makino) Press [Lamiaceae]; *HU-HA-015*	*Hugu-Hiiah*	Aerial part	Native	Wild
Pontederia crassipes Mart. [Pontederiaceae]; *HU-HA-020*	*Nyipa-yaru tami*	Aerial part	Exotic	Wild

Scientific name [Family]; ***Voucher specimen***	Apatani name	Plant part used	Nativity	Availability
Pteridium revolutum (Blume) Nakai [Dennstaedtiaceae]; *HU HA016*	*Taree*	Aerial part	Native	Wild
Senecio graciliflorus DC. [Asteraceae]; *HU-HA-017*	*Pakho-habyo-hamang*	Aerial part	Native	Wild
Solanum aethiopicum L. [Solanaceae]; *HU HA009*	*Byako*	Stem, branches	Exotic	Cultivated
Strobilanthes helicta T.Anderson [Acanthaceae]; *HU-HA-027*	*Taging-hamang*	Aerial part	Native	Wild
Zea mays L. [Poaceae]; *HU-HA-008*	*Tanyi*	Cob, husk and aerial parts	Exotic	Cultivated

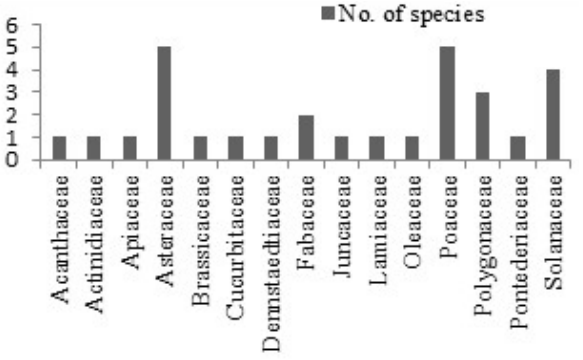

Figure 1. Number of plants reported from different plant families

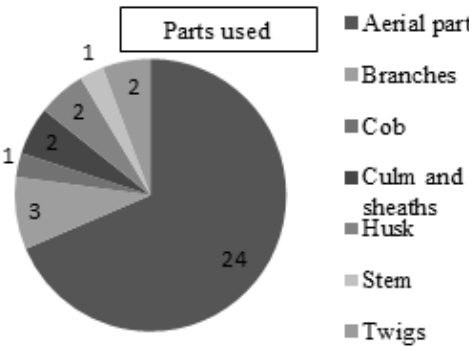

Figure 2. Plant parts prefer to use for *Pila* preparation

Plant-parts used: Generally aerial portion of different plants is used for *Pila* preparation (Figure 2). However, for some plants the one or more specific parts are used, like only stem and branches in case of *Solanum aethiopicum*; branches and twigs from *Ligustrum confusum and Actinidia deliciosa*; culm and sheaths of *Dendrocalamus hamiltonii* and *Phyllostachys mannii*. Cob of *Zea mays* and husks of *Eleusine coracana* are usually used during winter months due to unavailability of other desired plants. For *Pila* preparation single plant is used in some cases (*Zea mays*, *Eleusine coracana*, *Strobilanthes helicta, Solanum aethiopicum, Phyllostachys mannii, Glycine max, Pontederia crassipes*, *Dendrocalamus hamiltonii, Actinidia deliciosa, Arundo donax* etc.) but a mixture of two or more plants is the practice in most cases.

Occurrence and availability: Out of the recorded 29 Pila-plants, 15 species are wild and are commonly available in the local vegetation. From the cultivated plants, during present survey, as much as 14 species have been recorded as resource for producing *Pila* (Figure 3). Among the wild ones, *Pteridium revolutum* is a very common fern growing on floor of open forests. *Persicaria hydropiper* and *Persicaria thunbergii* are found growing in wet barren lands. It was observed that *Adenostemma lavenia* and *Oenanthe javanica* were found growing in the same fields of shady and swampy areas while *Juncus himalensis*, *Pogostemon yatabeanus* and *Senecio graciliflorus* were found growing at the vicinity of each other, in abandoned paddy fields and around forest areas. *Strobilanthes helicta* was collected from nearby forest areas. *Arundo donax* is commonly found growing along the stream-sides. *Crassocephalum crepidioides* is also found wild in open terrestrial herblands. *Persicaria nepalensis* is abundantly found in abandoned paddy fields. *Phyllostachys mannii* is cultivated *en masse* in bamboo grooves. But, *Dendrocalamus hamiltonii* is found in jungle areas and sometimes domesticated and growing in small bamboo-groove. Common vegetables like *Brassica campestris, Capsicum annuum,*

PLATE - I. Pila preparation: A - E. Collection of maize-cover bracts (A), remains of tender bamboo shoot (B), pericarp of beans (C), water-pepper i.e. *Persicaria hydropiper* (D), soyabean aerial parts(E); **F.** Drying of cucumber plants; **G.** Collection of Kiwi branches; **H.** Burning of plant materials to produce ash (*Piyu*); **I.** Traditional method of storing *Piyu* in bamboo baskets; **J.** Traditional bamboo funnel (*Piyu Khugyu*) for filtering *Piyu*; **K.** Extraction of *Pila* from *Piyu* using *Piyu Khugyu;* **L.** Traditional method of storing *Pila* in *Yayi siilii*; **M.** *Pila* on sale at a local market in plastic mineral water bottle; **N.** *Tapyo* pieces in a plastic sachet [*inset*: a piece of *Tapyo*]; **O.** *Prepared 'Pikey'* dish; **P.** *'Pilaa'* (prepared dish with homonymous with *Pila*)

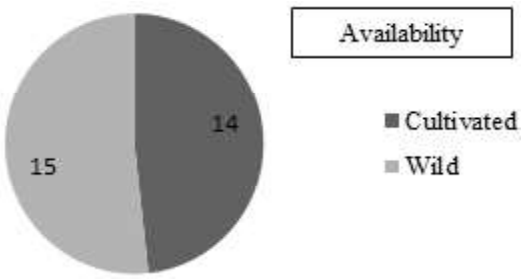

Figure 3. Availability of plants used as source of *Pila*

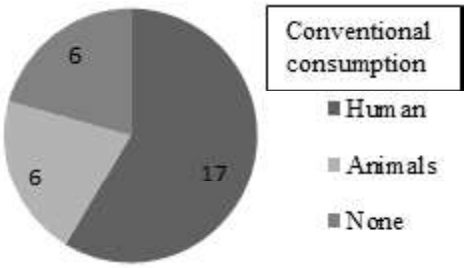

Figure 4. Conventional consumption pattern of plants used as *Pila* source

Capsicum chinense, *Capsicum frutescens, Cucumis sativus, Glycine max, Phaseolus vulgaris, Solanum aethiopicum* and *Zea mays* are cultivated on upland dry farms. *Eleusine coracana* is either cultivated on dry farmlands or on the separating bunds (*Agar*) of paddy fields. *Actinidia deliciosa* is popularly cultivated as a commercial crop in the region and has been a recent addition to the list.

***Edibility*:** As *Pila* is used in foods, so it comes to mind that the source plants are edible or not! In fact, all of them are not directly edible (Figure 4). Conventionally, 17 of the recorded species (*Actinidia deliciosa*, *Brassica campestris, Capsicum annuum, Capsicum chinense, Capsicum frutescens, Crassocephalum crepidioides, Cucumis sativus*, *Dendrocalamus hamiltonii, Eleusine coracana, Glycine max, Oenanthe javanica, Persicaria nepalensis, Phaseolus vulgaris, Phyllostachys mannii, Solanum aethiopicum, Strobilanthes helicta,* and *Zea mays*) are consumed by the people of Apatani tribe only; 6 of them are cattle-fodder (*Adenostemma Lavenia, Arundo donax, Ligustrum confusum, Persicaria hydropiper, Persicaria thunbergii, Senecio graciliflorus*) and the remaining six plants (*Bidens pilosa, Cirsium eriophoroides, Pontederia crassipes, Juncus himalensis, Pogostemon yatabeanus, Pteridium revolutum*) are neither consumed by Apatani people nor given to their domestic animals. *Adenostemma lavenia* is usually grazed by cattle and can be collected as source of fodder especially for native mithuns (*Bos frontalis*). Earlier, young tender leaves of *Persicaria hydropiper* and *Persicaria nepalensis* were harvested from the wild, cooked and fed to pigs (Yakang *et al.* 2013; Jha 2015). Tender leafy-shoots of *Persicaria nepalensis* are still consumed by human; however, their popularity has reduced significantly in recent years.

***Other ethnobotanical importance*:** Some of the recorded *Pila*-plants have some other ethnobotanical uses as well. *Arundo donax* is used for crafting traditional household mats called *Pepu*. The matured culms of *Dendrocalamus hamiltonii* and *Phyllostachys mannii* are widely used in construction, fencing and making numerous household items and agricultural tools as well as crafting local shrines/altars (*Agyan*). *Juncus himalensis* is used as natural rope/thread to tie small bundles of vegetables and paddy saplings. They are also used for making toys for children in rural areas. *Ligustrum confusum* is easy to propagate through stem cuttings and are popularly used in the valley to develop fence around dry crop-fields. *Crassocephalum crepidioides* and *Oenanthe javanica* are popularly consumed as wild vegetables, usually consumed raw with dishes prepared from *Pila* or prepared as salad with other common vegetables. However, few of these plants like *Bidens pilosa, Cirsium eriophoroides, Pontederia crassipes, Pteridium revolutum,* and *Senecio graciliflorus* had no other particular usage as per Apatani community is concerned. They are considered as unwanted weeds or plants of no use otherwise.

Process of *Pila* preparation:

Selection of plants: Fully matured plants are considered to be the best source of *Pila*. It is to be noted that dried up senesced plants are not used because they do not produce any taste. Therefore, healthy matured plants are always selected for the purpose. Currently cultivated ones are commonly used in comparison to those found in wild. It is due to the reason that

agrarian community is slowly declining in the region who can recognise those wild plants as they remain closer to the nature.

Earlier, people would specifically take out time to collect *Adenostemma lavenia*, *Bidens pilosa*, *Cirsium eriophoroides*, *Juncus himalensis, Oenanthe javanica*, *Pogostemon yatabeanus*, *Pteridium revolutum* and *Strobilanthes helicta* from the wild. It involved selecting an open space with fresh and healthy wild plants and monitoring them to keep away from the grazing cattle as those can damage the plants or drops dang on the plants. Special attention was also given so that such selected plots remain free from any kind of anthropogenic disturbances and maintained a hygienic condition throughout the process.

Collection and drying: There are some definite steps for the preparation of *Pila*. Clean and healthy matured plants are cut and openly dried under direct sun. Drying is done by hanging the plants in bundles or scattered about in a horizontal bamboo mat or bed supported by stumps. They may also be sundried above the fences of garden. Since cobs and husks are used in the absence of main plant body, they are usually dried above traditional fireplace (*Da-reke*). Cutting and drying of most plants are done during August-September when the plants are fully matured and will die after that. However, ferns are harvested and dried during June-July as they are found fresh and full grown at that time of the year. However, they proceed for the next step immediately after drying and do not store the dried plants.

***Burning plants to prepare ash*:** For burning the dried plants, a clean and dry area is selected or may be burnt inside a large iron pan at home. A fire is ignited with woods collected from timber yielding trees, preferably *Phoebe cooperiana*, *Magnolia champaca*, *Castanopsis tribuloides* etc. Dried plants are then put onto the fire for burning. During entire burning process very high flames are maintained so that the plants are fully burnt into ash. The ashes so formed are collected immediately after burning is completed. Sometimes ashes may be collected before it cools down and sometimes it is collected after cooling. The collected ash is now termed as '*Piyu*', which can be stored for long term in dry containers. Now-a-days people store *Piyu* packed in newspapers and then put inside polythene bags or in commercial rice sacks. Earlier, people were using traditional cane/bamboo basket called *Yagii* for the purpose. Some broad leaves, e.g. the leaves of *Phrynium pubinerve*, were put on the inside-wall of baskets to block the pores. Then *Piyu* would be poured inside and tightly packed with pressure. Little water was then sprinkled over the *Piyu* for stability. After this, it would be covered with such broad leaves for safe storage. Sometimes, one extra wooden plank is used to cover it properly.

***Filtering of Piyu*:** *Pila* is extracted from *Piyu* through filtering. *Piyu* is first packed tightly into a plastic container with many minute pores at the bottom. Small amount of water is slowly poured on its top, phase by phase. The filtrate is collected at the bottom of the container. The filtrate so obtained is termed '*Pila*.' In traditional set up, a bamboo funnel called *Piyu-Khugyu* is used instead of plastic containers. The extraction method remains same. The only thing to note while using *Piyu khugyu* is that it should be lined with packing leaves to block the side pores of the bamboo funnel. Now-a-days *Piyu khugyu*s are rarely seen/used in many households as plastic containers are much easily available and found easier to work.

***Storing Pila*:** Now, *Pila* can be stored in any plastic container. It can be stored for long time but its exact shelf-life is unknown. In olden days people would store *Pila* in bamboo flasks known as '*Yayi Siilii*' which would be tightly covered with maize husk or wooden lid.

***Circumstances and beliefs*:** Weather plays important role in this process of *Pila* preparation. Bright sunny days are selected for burning down the dried plants as any rain would hinder the overall process and ashes can be washed away. This process also encompasses some traditional beliefs. When the fire is set to put out it is believed that only younger unwed or aged persons should be allowed to do so. The reason being that in the olden days *Pila* preparation was

objectified as an art of those less fortunate people. Practising this during marriage period would mean bringing less prosperity to the family. Thus, they were refrained from preparing *Pila*. As small children were yet to start a family life and senior citizens had already completed their social life responsibilities, they were free from such imposition. Married persons also may put out the fire, but they are refrained from doing so if they have recently performed or taken part in '*Supung*' ritual. Such cultural restrictions are considered as part of respecting the divine. However, this belief system has been faded overtime, and as per current observation, anyone can prepare it according to one's need.

Uses of Pila: *Pila* is generally used as main food-additive in the preparation of Apatani local cuisines like *Pikey* and *Pilaa* (dish with similar name). As per the community, *Pila* is known to enhance the taste of dishes and also provide product stability and improved shelf-life. Usually, any boiled items would have very limited shelf-life but it is noted that boiled dishes in the form of *Pikey* would normally last for about 3 – 4 days without refrigeration and almost a week with refrigeration. *Tapyo* is also produced from *Pila*. It is also an important part of meal in festivities and rituals like *Murung*, *Myoko*, *Niipo Apin* and other local cultural events of Apatani community. The preparation of *Tapyo* had also been highlighted by Tiwari and Mahanta (2007; Panda *et al.* 2016). *Tapyo* is a modified solid form of *Pila* obtained through its dehydration. The consumption of *Pila* and *Tapyo* is a very old process, since the time immemorial and of course before the arrival of table salt in the valley. It is said that consumption of *Tapyo* from the very early times has protected the Apatani people from goitre disease.

DISCUSSION

Pila production can be considered also as a way of agriculture waste management. The whole process involves consumption of plants in various forms by either incorporating in diet or in other useful ways. The residue left after *Pila* extraction through filtration is spread out in fields to enhance the soil fertility. In olden days the women of Apatani community used *Pila* as shampoo to clean their hair. This practice resonates with reports from Assam where *Khaar* (*Pila*) is used for the same purpose apart from being used as prevention of cattle diseases and leech attacks (Deka & Talukdar 2007; Sarma *et al.* 2020).

Current status of *Pila*: From the collection of plant species during the present survey, it is noted that *Pila* can be extracted from many plants, most of which are consumed by humans. Those plants which are not edible and are used for other purposes or may simply be treated as weeds in fallow lands and forest areas can also be used for *Pila* preparation. Reports from different authors indicate that plants such as *Sesamum indicum, Brassica nigra, Cocos nucifera*, *Musa balbisiana*, *Musa paradisiaca*, *Musa chinensis, Musa acuminata* and *Pontederia crassipes* can also be used as basic source-materials for *Pila* (Deka & Talukdar 2007; Hemanta *et al.* 2014; Roy & Das 2015; Talukdar & Deka 2020; Sarma *et al.* 2020; Mazumder *et al.* 2024). Now-a-days Apatani community has also started using banana peels and branches of papaya (*Carica papaya*) plant as source of *Pila* through cross border knowledge exchange with other communities of Northeastern Region of India.

Most of the study related to *Pila* or *Khaar* or *Chhyaka* has been done in Assam and in nearby areas of West Bengal with different species of *Musa* and also with *Pontederia crassipes*. Various authors had reported on its bioactive properties such as antimicrobial and antioxidant activities, antacid property as well as wound healing ability, treating piles, common cold, abdominal lump, anorexia and different cattle diseases, etc. (Deka & Talukdar 2007; Kalita *et al.* 2015; Kalita *et al.* 2016; Narzary *et al.* 2016; Sarma *et al.* 2020; Sen & Roy 2020; Mazumder *et al.* 2024). In West Bengal Roy and Das (2015) recorded its preparation from the rhizome part of banana plant (*Musa acuminata, M. × paradisiaca, etc,).* While Schwalfenberg (2012) and

Sangma *et al.* (2019) are of the opinion that alkaline diets may reduce chances of chronic diseases in human, and other authors (Phukan *et al.* 2001; Limbu & Das 2018) has reported that high consumption of *Pila*/ *Khaar* can lead to oesophageal cancer and liver damage. Many people are also of the opinion that *Pila* consumption can lead to cancers and one of the prime reason for increasing cancer patients among the Apatani people (https://arunachal24.in/arunachal-comprehensive-research-work-to-be-undertaken-to-unearth-rising-prevalence-of-cancer-in-ap/). The repercussions of *Pila* consumption need proper research in such scenario with scientific supports. Research in this area is still lagging at least in the context of Arunachal Pradesh.

Elemental composition of *Khaar*/ *Pila* from Assam had been reported by some authors (Deka & Talukdar 2007; Neog & Deka 2013; Hemanta *et al.* 2014; Talukdar & Deka 2020; Mazumdar *et al.* 2024). Aluminium, sodium, vanadium, potassium carbonate, zinc, cadmium, arsenic, sodium, potassium, calcium, nickel and magnesium, chlorine, iron, cadmium, cobalt, chromium, copper, manganese, and traces of lead have been reported to be present in *Khaar*. Similar study can be done for *Pila* obtained from the various plants of Ziro Valley. Such study can give proper insight into detecting any harmful elemental composition in the filtrate. It can help in deciding the beneficial and harmful aspects of *Pila* consumption. *Pontederia crassipes* is known to absorb heavy metal pollutants from water (Boyd 1970; Mary-Lissy & Madhu 2011; Nazir et al. 2020) so, it will not be surprising, if the presence of those heavy metals is detected from the *Pila* produced using this exotic weed. As our environment keeps on polluting with each passing year, investigation of presence of harmful elements such as lead and mercury should be seriously taken care of as these elements tend to accumulate in human body over the time (Mahaffey 1990). Another important concern involves the chances of presence of micro-plastics in it as they are usually processed in plastic containers and marketed in reused mineral water plastic bottles.

Apart from its health implications, *Pila*/ *Khaar* have been reported as one important natural and sustainable source of potassium carbonate, and chlorides of calcium and magnesium (Deka & Talukdar 2007; Sarma *et al.* 2020). It indicates that the process of *Pila* preparation can pave way to natural and sustainable production of potassium, calcium and magnesium salts, which are required in various sectors of economy.

Conclusion: *Pila* can be prepared from most edible plants grown in kitchen gardens. In earlier days the wild ones were harvested from natural vegetation for its production. However now-a-days wild ones are not much popular because of time constrain and reducing number of expert *Pila*-makers. The rise in popularity of dishes prepared with this alkaline food-additive calls for research in health sector. Proper investigation of minerals and trace elements can be done to identify the key components of such ash-extract (*Pila*). Any possibilities arising out of its consumption can be studied. And, attempt should be made to mitigate any harmful effects caused by its consumption, may be through the selection at species level. The process of *Tapyo* preparation can also be studied in depth and its elemental composition can be recognised. A broad spectrum of scientific research is needed in this field for the betterment of its promotion in the market and also to understand if there is any health risk.

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