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Traditional salt making among the Muklom community, Changlang District, Arunachal Pradesh

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Salt is a very common ingredient in every kitchen worldwide. It is a ubiquitous commodity readily available in every household. This was not the case in earlier times. Earlier, salt was one of the most valuable products in the hilly areas of Arunachal Pradesh, due to its scarcity. The Muklom (a sub-tribe under the Tangsa tribe) of Changlang district in Arunachal Pradesh is one of the few tribal communities known to have traditionally produced salt from the naturally available brine springs. This paper is an attempt to explore and document the traditional practice of salt-making in the community. Standard laboratory assessments have been made to determine the physicochemical properties of the locally made salt and its elemental composition.

Keywords: Brine springs, Changlang district, Muklom, Traditional salt making

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Sodium Chloride (NaCl), or more commonly, salt or table salt, is a household item. It is a very commonly used condiment and food preservative. Rock salt and sea salt are some common sources of salt. Though it may be a very common and cheap item today, in earlier times, salt was a precious commodity. In fact, during the early Roman period, the army was paid with salt. The soldier's monthly allowance was known as 'Salarium', where *'Sal'* is the Latin word for salt. The French word 'Salaire' also derives from the Latin 'Sal' and, finally, from the English word 'Salary'. Tribal communities around the world have developed many skillsets and knowledge that enable them to adjust to their surroundings. This knowledge and skill sets can be regarded as the outcome of ages of interaction between the communities and the natural environment. Salt was a precious commodity for the people of the hill areas of Arunachal Pradesh. To meet their need for salt, the tribal people adopted various approaches, where the Apatanis of Ziro are known to produce a plant-based alkaline salt substitute locally called *Tapyo*[1]. The western part of the state, namely the Tawang and West Kameng area, traditionally called *Monyul*, used to acquire salt from traders of the Tibetan highlands in exchange for food grains and other items[2]. The people in Changlang and Tirap are known to produce salt with the help of natural brine springs available in the area. Scholars have reported traditional practices of salt-making from brine springs in various regions of the world, such as the Benue through region of Nigeria, Romania, and also nearby states of Manipur, Assam, and Nagaland[3-6].

Salt is known to occur in many parts of the Himalayan Mountain belt. Salt-producing areas of North East India are located in the eastern part of the region in the Naga-Patkai hills and on the southern bank of the Brahmaputra. The main salt-producing area was known as Mohong. The Tutsa, Noctes, and Tangsas were the salt-producing communities in Arunachal Pradesh. Dimasa and Semsas are some other communities in the North Eastern region of India, known for producing salt[7]. During the reign of the Ahom rulers, there was a designated contingent of recruits from different tribal communities specifically tasked with salt production.

These people were known as *Lonpungias* or *Lonpuriyas*, which roughly translates to salt-makers. The *Lonpuriyas* consisted of various groups known as *Khel* that included the *Longpotiyas*, *Longsowals*, *Dhadumiyas*, *Chirupuriyas*, *Jogodumiyas* and *Longtingiyas*[7]. Scholars are of the view that, as there is an absence of any salt-bearing formations in this region and there is the presence of clear brine, it is

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presumably the ancient Tethys Sea's trapped water after the Himalayan upheaval[7].

The Tangsas are a tribal community residing in the southeastern part of Arunachal Pradesh, particularly in the Changlang district. The Mukloms are one of the sub tribes under the Tangsa tribe. They have been known to produce salt locally for ages and are still practicing it. The salt, or *Sim*, in Muklom is consumed and fed to water buffaloes. Besides, it was also a popular item for barter. The importance of salt can be highlighted by the fact that there have been several conflicts between various tribal communities living close to each other over the possession of natural brine springs and the production of salt. There are accounts of conflict between the Ahoms and the tribes of Tirap valley over possession of salt wells. Ahoms, with their military might, took control over the salt-producing areas of Borhat and Mohong (presently in Tirap District), but could not penetrate to Tutsa and Tangsa areas due to geographical barriers. During the British period, the Tutsas and Tangsas were allowed to produce and sell salt in the markets of Assam, but a tax of 20% on sale was levied by the Britishers[8]. There were armed conflicts between the Muklom chief and the chief of the Havis which is again a sub tribe within the Tangsa tribe. The conflict over the possession of the brine spring turned into bloodshed and enmity between the tribes, which was later resolved.

Salt production was an important economic activity in the tribal areas of Tirap and Changlang, and this salt was sold in the plains of Assam and Myanmar. It is a tedious and time-consuming process. Rungthung in Chingsa village, Simthung in Saching village, and Chiklong-Mahong Sim in Makantong village are some of the brine springs in Changlang District today.

Materials and Methods

This study has been carried out at Chingsa village (Fig. 1), which is one of the last few villages in

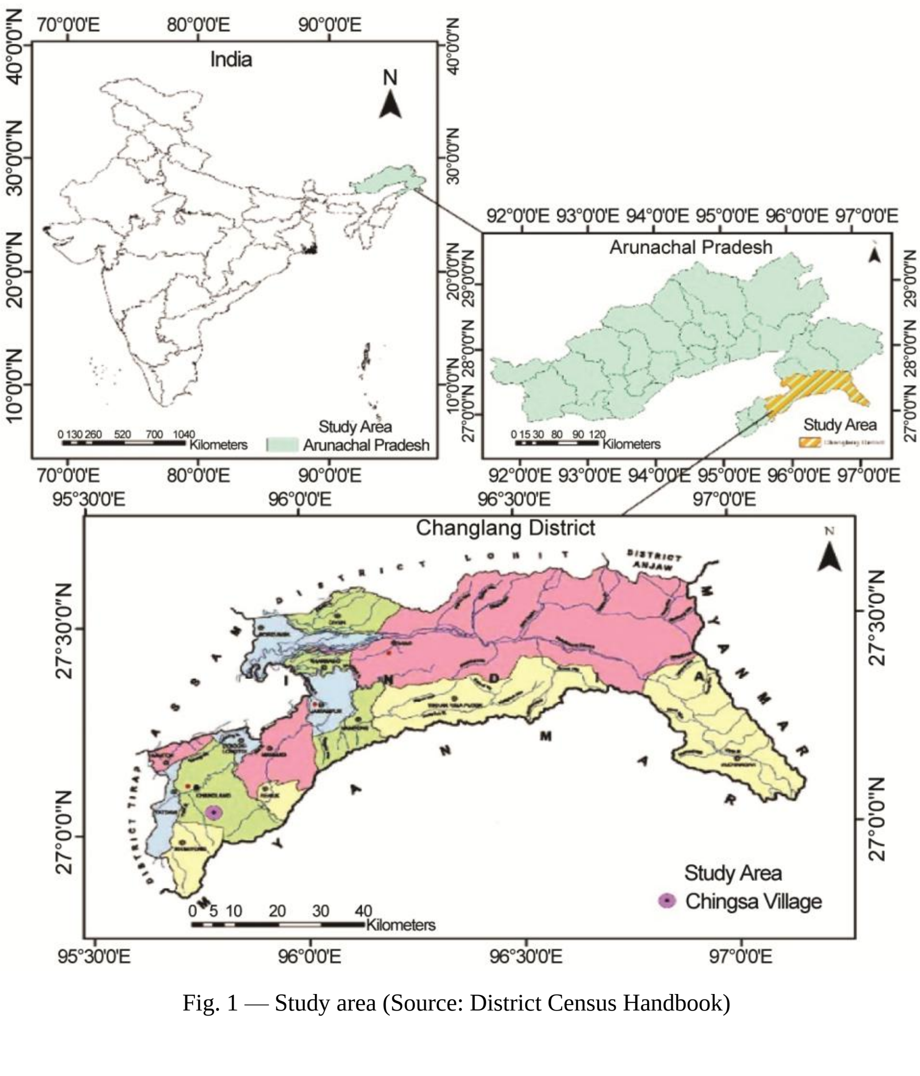


Fig. 1 — Study area (Source: District Census Handbook)

Changlang district that still practice traditional salt making. It is situated at a distance of about 16 kilometres from the district headquarters in Changlang. The Mukloms predominantly inhabit Chingsa village, and according to the 2011 census, there are about thirteen households in the village with a total population of about eighty-two. The villagers primarily depend on agriculture for their livelihood, and slash and burn or jhum cultivation is the main agricultural activity. The brine springs are located at an hour's uphill trek on foot, with no motorable road. In terms of the geo-environmental setup of the area, the village lies on a hill within an altitude range of about 500 to 1000 meters above mean sea level, which is part of the Patkai hills. In terms of geomorphology, the area can be expressed as moderately dissected structural hills and valleys. The lithology of the area features Shale, Siltstone, Greywacke Rhythmite, and Sandstones belonging to the Disang Formation, dating back to the Palaeocene-Eocene epoch. The brine springs are found in the Disang Shale and sandstone of the Barail Group of the Tertiary Assam Arakan Basin[7]. In terms of climate, the undulating hills and valleys make it vary from place to place within the district. The low-lying areas experience a hot and humid type of weather during the summer months of June to August, while in the hilly areas, the weather conditions remain moderate and pleasant. December to January is the coldest period, when the average temperature ranges between 22ºC to 13ºC, while August is the warmest month with an average temperature of about 30ºC. Changlang District is known for harboring economically viable deposits of coal and petroleum[8].

This study is primarily based on firsthand information collected from a field survey carried out in March 2023. Personal interviews with the local salt producers, village elders, and observations have been the source of primary information. Twelve key informants, including active practitioners of salt making and village elders, were interviewed after obtaining their verbal consent and explaining the purpose of the interview and the entire study. Photographs and videos were taken using a mobile camera for documentation purposes with due consent from the villagers. A sample of locally made salt was also collected using an airtight polypropylenepouch and subjected to standard laboratory assessment to identify the content or composition of the salt. Salt samples have been tested for various elemental compositions at the Sophisticated Analytical Instrumentation Centre (SAIC) at Tezpur University, Tezpur, Assam. Samples have been subjected to EDS (Energy Dispersive X-ray Spectroscopy) to determine the constituent elements.

Results and Discussion

Process in salt-making

The traditional process of salt making is known as *Sim-Tak.* It is a time-consuming and tiresome affair. The process involves various stages (Fig. 2), which are discussed below-

1. In the first stage, water is collected from the small well-like structure with an underground source of natural brine water.
2. In the second stage, the collected water is put in a wide pan and placed over a makeshift stove made by digging into the surface. Fire is set using wood, and the water is boiled for hours at a high temperature. As soon as water starts evaporating away, more water is added to the container up to 20-25 times. This process is continued until the water starts thickening, and after hours of boiling, what is left in the container is a thick brown and salty slurry (Fig. 3b).
3. In the third phase, the thickened slurry is set aside for some time, and then it is poured onto casts made by splitting open bamboo tubes (Fig. 3c). These split bamboo tubes are left to cool down in open air, and after a few hours, the liquid solidifies, and what is left are bars of dark brown smoky salt bars (Fig. 4a).

The whole process consumes a lot of time and manual labor. The process produces two products, namely *Sim-Khung* or salt bars (Fig. 4a) and another product, *Sim-Baan* or powder salt (Fig. 4c). Besides these two products, another type of salt is produced by burning the bamboo tubes used for settling the

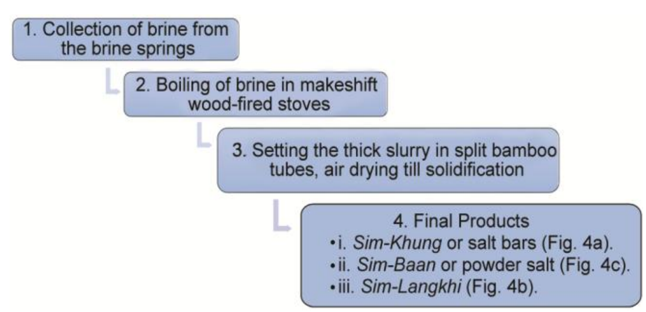


Fig. 2 — Flowchart depicting the process of traditional salt making

brine slurry, and the ashes are tightly stuffed into bamboo tubes. This process produces another type of salt called *Sim-Langkhi* (Fig. 4b). It is slightly bitter, and one can also feel the grains of charcoal.

Usually, the production of salt is done in groups of family and friends of 10 to 15 members. Rain-free days in December, January, February, and March are preferred periods for salt production. Villagers avoid salt-making activities during full moon days as they believe the origin of salt is from a woman, and this phase of time is when women have their periods. The powder salt *Sim-baan* is sometimes sold to fellow villagers at 40 to 50 rupees for a pouch weighing around 500 g. In comparison, the salt bars *Sim-Khung* can fetch up to 1000 rupees for large-sized pieces. Sometimes salt is also directly exchanged for some other commodities, such as grains. This system of exchange, or barter, was more common during earlier days, and very often salt was exchanged for food items like grains, vegetables, or dried tapioca flakes, locally known as *bangkheysuk*. Historically, salt has always been an important item for barter or used as a medium of exchange. The Fanti people of the southern half of Ghana used salt as a medium of exchange until the introduction of coins by Europeans. They used to travel with only a small bag of salt to pay for their food and lodging in the earlier days[9]. Salt was an important commodity that was exchanged between the Tibetans and the tribal communities of Nyishi, Apatani, Tagin, Puroik, and Nah of the erstwhile undivided District of Subansiri in Arunachal Pradesh, India[10].

Consumption and continuity

Personal interviews with villagers revealed that they prefer locally made salt over ready-made salt available in the market. Villagers choose to use locally-made salt for their daily consumption and only use ready-made salt when local salt is unavailable. Villagers believe this salt has medicinal properties and can cure throat discomfort as well as goiter, locally known as *Bo-wuung*. Besides its potential health benefits, as perceived by the villagers, they are still using this salt because of their sentiments associated with the locally made salt, as they regard the salt-making process as an age-old traditional knowledge and an item that their forefathers have used for a very long time.

In recent times, with better road facilities and accessibility to the market and readymade products, the traditional practice of salt making has witnessed a decline. During the field visit, it was found that during the winter of 2022, villagers went for salt making after almost a year. Mr Minghom Tangha, an elderly man in his 70s and a few others are the only people left in the village who are experts in the process of

Fig. 3 — (a) Collection of brine, (b) Boiling of brine in makeshift wood-fired stoves, (c) Setting the thick brine slurry in splitbamboo tubes, The process involved in traditional salt-making

Fig. 4 — Final products, (a) *Sim-Khung* or salt bars, (b) *Sim-Langkhi*, (c) *Sim-Baan* or powder salt, (Source: Field study)

salt making. It was under his supervision that the last salt-making was done. Only six households participated during that expedition. The people from the village, generally the youngsters, are migrating to the nearby town of Changlang for education, employment, and other facilities, and with this, the traditional practice of salt making is declining like many other traditional practices because of modernisation.

Physicochemical properties

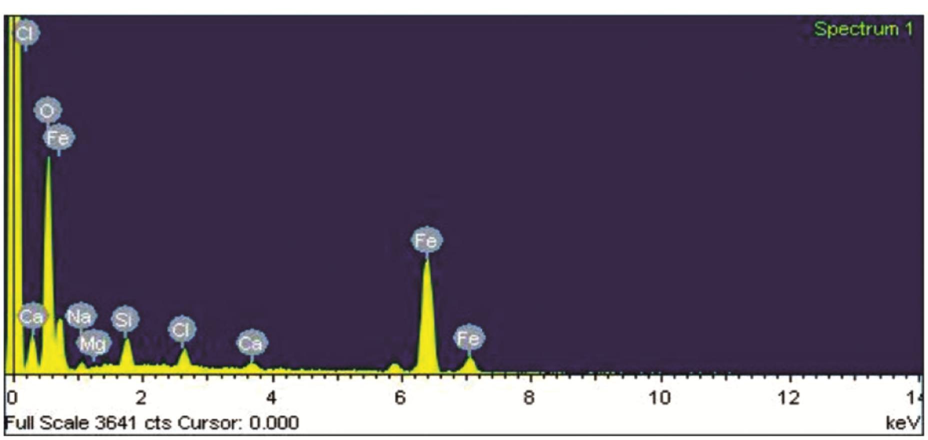
In terms of physical features, the salt samples feel grittier than the regular fine-grain packaged salt available in the market. In terms of colour and odour, it is greyish to brown, and it has a smoky odour. The *Sim Khung* or salt bars are fragile and can be easily broken into finer pieces, while *Sim-Langkhi* (Fig. 4b) is more resilient to breakage and requires comparatively more pressure and strength to break into grains.Salt samples have been tested at the Sophisticated Analytical Instrumentation Centre (SAIC) at Tezpur University, Tezpur, Assam, to determine various elemental compositions. Samples have been subjected to EDS (Energy Dispersive X-ray Spectroscopy). The elements observed in the sample (in wt. %) are Na 1.87, Mg 0.23, Si 3.56, Cl 2.12, Ca 0.79, and Fe 41.48 (Fig. 5). The EDS spectrum (Fig. 5) shows major peaks for oxygen and iron. The figure clearly indicates the presence of iron oxides. Quantification results are shown in the accompanying table in weight % and atomic %. The EDS analysis indicates a low amount of Na and Cl content in the sample as compared to about 42 and 40 wt. % for Na and 35 and 38 wt. % in rock salt and sea Salt, respectively[11]. Other than that, an unusually high amount of iron (Fe) has been observed that exceeds the maximum limit of BIS, which is 50 mg/kg or less (Table 1). The most probable explanations for the elevated Fe content are contamination from iron vessels used in boiling the brine or naturally high Fe content in the brine itself. Other than Fe, some other trace elements such as Mg (0.23 wt. %), Ca (0.79 wt.%) have been found to be in concentrations that exceed the maximum limits set by BIS (Table 1). The sample also shows a high concentration of oxygen; in fact, it is the highest element, accounting for about 49.95 wt. %. Generally, this concentration is very low to almost negligible in vacuum-evaporated or processed table salts. The high concentration of oxygen and iron indicates that the sample contained elevated amounts of iron oxides rather than pure salt.

This locally produced salt is not subjected to any refining process and therefore tends to contain some impurities. Measuring the observed Cl in samples (2.12 wt. %) as NaCl, using gravimetric conversion, we get about 3.49 wt. %, which is exceptionally low as per the BIS standards of at least 95.8 wt. % for table salt. The salt is also free from any additives such as anti-caking agents. Sodium and potassium ferrocyanide are some commonly used anti-caking agents in table salt. Some studies suggest that an

Table 1 — Concentration of elements in sample and maximum limit as per BIS

Element	Content in sample	Limits (BIS)
O	49.95 wt. %	NA
Na	1.87 wt. %	-
Mg	0.23 wt. %	$\leq$ 0.10 wt. %
Si	3.56 wt. %	NA
Cl	2.12 wt. %	(as NaCl 95.8 wt.%, *Min.*)
Ca	0.79 wt. %	$\leq$ 0.15 wt. %
Fe	414800 mg/kg	$\leq$50 mg/kg

Source: Bureau of Indian Standards



Element	Weight%	Atomic%
O K	49.95	75.01
Na K	1.87	1.95
Mg K	0.23	0.23
Si K	3.56	3.05
Cl K	2.12	1.44
Ca K	0.79	0.48
Fe K	41.48	17.85
Totals	100.00	

Fig. 5 — EDS spectrum and elemental quantification of salt samples (Source: Sophisticated Analytical Instrumentation Centre (SAIC), Tezpur)

excess of these elements could harm human health[12,13]. Sodium, potassium, and calcium ferrocyanides (E 535–538) are approved food additives in the European Union at 20 mg/kg for salt and salt alternatives. European Food Safety Authority's (EFS) Panel on Food Additives and Nutrient Sources Added to Food (ANS) suggested an acceptable daily intake for sodium, potassium, and calcium ferrocyanide of 0.03 mg/kg body weight per day, expressed as ferrocyanide ion. Within this permissible limit, ferrocyanides (E 535-538) are of no safety concern[14]. The exceptionally elevated iron content in the salt samples (about 414800 mg/kg) poses significant health concerns. Prolonged consumption of this salt with very high iron content might lead to excessive iron accumulation in the system. Excess iron build-up, or iron overload, is a situation where Transferrin saturation (TSAT), an important biomarker of iron availability, exceeds 40%, while TSAT at less than 20% represents iron deficiency. A TSAT at 60% to 70% indicates the formation of free iron, which particularly damages hepatic parenchymal cells. Iron overload can trigger damage at molecular and cellular levels, which can result in organ dysfunction in the long run[15]. Some major health issues related to the toxic effects of iron overload include heart failure, arrhythmias, and liver fibrosis, which may develop into cirrhosis or, in the worst-case scenario, hepatocellular carcinoma[16]. Development of diabetes mellitus, hypothyroidism and hypogonadism in young individuals is associated with the adverse effects of iron overload on the endocrine organs[17].

Magnesium and calcium are two other minerals that are found to be in concentrations exceeding the limits set by BIS in table salt. The recommended daily allowance or RDA, as suggested by the Indian Council of Medical Research (ICMR) and the National Institute of Nutrition (NIN) for magnesium, varies based on age, sex and stage of life. RDA for adult males is set at 440 mg/day and for females 370 mg/day. For pregnant and lactating women 440 and 400 mg/day, respectively and for children under the age of 15 years, the RDA ranges from 90 to 340 mg/day. The tolerable upper intake level of Mg cannot be based on natural food substances, as Mg ingested as natural food substances does not show any sign of adverse effects. Adverse effects of excess magnesium are, however, observed in pharmacological use or intake of Mg. Metabolic alkalosis, dehydration, paralytic ileus and cardiac arrest in rare conditions are some health issues associated with hypermagnesemia[18].

The RDA for Ca as recommended by ICMR-NIN also varies across age groups and physiological or reproductive stages, particularly in females (Table 2). Similarly, the tolerable upper limit of Ca as per ICMR-NIN recommendations varies across age groups and physiological and reproductive stages in women (Table 3). In terms of the tolerable upper limit

Table 2 — Recommended daily intake of Calcium as per ICMR-NIN

Category	Age and reproductive stage	RDA (mg/day)
1. Adults (Male and Female)	(above 18 years of age)	1000
2. Female	Pregnant	1000
	Lactating and post-menopausal women	1200
3. Children	1 to 3	500
	4 to 6	550
	7 to 9	650
	10 to 12	850
	13 to 18	1000

Source: ICMR-NIN Expert Group on Nutrient Requirement for Indians, Recommended Dietary Allowances (RDA) and Estimated Average Requirements (EAR) - 2020

Table 3 — Tolerable upper limit of Calcium as per ICMR-NIN

Category	Age and reproductive stage	Tolerable upper limit (mg/day)
1. Adults (Male and Female)	(above 18 years of age)	2500
2. Female	Pregnant and Lactating women	2500
3. Children	1 to 3	1500
	4 to 9	2500
	9 to 18	3000

Source**:** ICMR-NIN Expert Group on Nutrient Requirement for Indians, Recommended Dietary Allowances (RDA) and Estimated Average Requirements (EAR) - 2020.

of Ca, the expert committee ICMR suggests a lack of established studies that associate Ca supplementation with adverse health impacts. Oxalate-rich plant-based diets increase the risk of nephrolithiasis or kidney stones. Moreover, high Ca intake may lead to disturbances in the absorption of iron and zinc, which aggravate the deficiency of these minerals[18].

Conclusion

Salt has always been an important commodity that is widely used. Since salt is not ubiquitous, it has also been an important trade item, especially in the Himalayan region, where there are accounts of how salt was bartered for other necessities such as food grains. The traditional salt-making of the Mukloms in Changlang District is a very unique traditional practice. Though this practice is somehow still surviving, there is an undeniable possibility that this practice may go extinct. The emigration of the villagers to nearby towns for better opportunities and accessibility to the market and ready-made salt has a notable effect on this traditional practice. Presently, there are only a few elderly individuals in the village who have expertise in the process of salt making or *Sim-Tak.* It can be said that the dwindling existence of this practice is surviving more or less due to the sentiments of the people associated with the traditional practice of salt making as an age-old practice that has been carried on by their forefathers.

There are many lesser-known and undocumented traditional practices in Arunachal Pradesh, like the one discussed in this paper. These traditional practices showcase the vast traditional knowledge accumulated by the tribal people over centuries of interaction with their natural environment. Scientific studies and documentation of these practices are the need of the hour, through which we can ensure awareness and their survival. There is a need for scientific evaluation of the potential health impacts of long-term consumption of this traditionally made salt, which is found to have an elevated concentration of iron and some other elements. A comprehensive hydrogeochemical and microbial study, along side community-level management, must be considered; this requires the scientific community and the local inhabitants to work in collaboration. Furthermore, the elevated concentrations of impurities and probable contamination during the processing must be considered for evaluation to minimise potential health risks. While undertaking these operations, the ecological aspects must be considered as well, as it involves interaction with forest resources.

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Author Contribution

PN conceived the idea, carried out field surveys and interviews, and drafted the manuscript. TRS has been the guide, and under her supervision, the entire work has been done. RC contributed in terms of assisting with the drafting of the manuscript and literature review.

Conflict of Interest

The authors declare that there are no competing interests or conflicts of interest of any kind.

Prior Informed Consent

Verbal and written consent have been obtained from the key informants.

Use of Artificial Intelligence (AI)

Grammarly has been used while drafting the manuscript to improve language clarity and grammar checking. The authors have reviewed the content and made the required edits after using the tool and take full responsibility for the content published.

Data Availability

The data supporting the study, generated by laboratory analysis of samples collected from the field, are already presented in the tables and figures in the article.

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