Report on Mapping and Profiling of selected *Menchu* (Medicinal Spring) under Dagana, Wangdue Phodrang and Punakha Dzongkhags

2025

Sorig Research and Innovation Division
National Centre for Traditional Medicine Services
Ministry of Health, Thimphu

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The information presented is based on field observations, geospatial mapping, laboratory analyses, literature reviews, and information collected from local communities during the study period. While every effort has been made to ensure the accuracy and reliability of the data, the findings represent conditions observed at the time of the survey and may change over time due to natural, environmental, or anthropogenic factors.

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Reviewer

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2. Kencho Wangdi, Chief program Officer, TMD, DHS, MoH

We remain deeply grateful to the Local Government Administration, Dzongkhag Public Health Officers, and the local community under Dagana, Wangduephodrang and Punakha Dzongkhag for their invaluable support and cooperation during the field survey of the Tshachu and Menchu.

We would also like to acknowledge WHO for the funding support without which the data collection, analysis and report would not have been completed. We remain humble and look forward to their continued support in the subsequent activities related to Tshachu and Menchu studies.

FOREWORD

Bhutan's rich endowment of the medicinal/mineral spring resources called (Menchu) has long supported alternative healing traditions, particularly through medicinal hydrotherapy. It is used in combination with herbal bath balneotherapy, which is widely practiced across the country and continues to show strong potential for advancing healthcare services and promoting eco-tourism development. Rooted in the principles of gSowa-Rigpa, the Bhutanese Traditional Medicine, these natural therapeutic resources represent an important intersection of traditional knowledge, public health, and sustainable economic opportunity.

Responding to this national priority as well as request from the communities, the Traditional Medicine Division under the Ministry of Health undertook a systematic study to document five Menchus under Dagana, Wangdue Phodrang and Punkha Dzongkhags. The initiative was carried out in collaboration with the Royal Centre for Disease Control and the Faculty of Traditional Medicine under Khesar Gyalpo University of Medical Sciences of Bhutan. The study included brief historical background, detailed physicochemical and microbiological profiling of the springs, complemented by findings from the traditional gSowa-Rigpa perspective. Such scientific characterization is essential for validating therapeutic claims and ensuring safe utilization. Understanding the physicochemical and microbial properties of these springs will strengthen evidence-based use for both therapeutic and recreational purposes by local communities and visitors.

This publication marks the second report issued by the Traditional Medicine Division on Tshachu and Menchu in the country. The findings are expected to support public health awareness on the safe use of these waters and guide the Ministry of Health in developing a health advisory package for their proper therapeutic and recreational use across ten locations in Dagana, Wangdue Phodrang, and Punakha Dzongkhags.

I hope this report will serve policymakers, health professionals, researchers, and planners in advancing evidence-based traditional wellness services while preserving Bhutan's unique healing heritage for future generations.

Specialist Head

National Centre for Traditional Medicine Services

EXECUTIVE SUMMARY

Unlike Tshachus (hot springs), Menchus (medicinal/mineral springs) are not widely known globally, but are well recognized in Bhutan for their therapeutic properties, including the treatment of musculoskeletal pain, dermatological disorders, and cardiovascular conditions. Some have historical and spiritual significance, blessed by saints or visited by royals, while others are newly recognized. It is widely found in diverse terrain forests, rocky slopes, and riverbanks. These springs contain medicinal minerals like Sindhura (mercury oxide) and Chongzhi (Calcium carbonate), as confirmed by Sowa Rigpa and laboratory tests. Their location and the therapeutic benefits vary due to varying contents of therapeutic components in the hot-spring facing a critical need of preservations for the cultural and medicinal values possessed.

A total of 5 Menchus were mapped out located across, Dagana, Punakha, and Wangdue Dzongkhags. Five water samples were collected from different sources and ponds for testing physical, microbial, and chemical properties. Across five Menchus, temperature ranged 11.6–17.9°C, pH remained near neutral, and conductivity/TDS varied moderately. Turbidity was generally low, except Baykey and Damethang Menchus, which recorded elevated levels.

The pH value is slightly alkaline (7.43) at Baykey Menchu and it also had the highest conductivity, suggesting high mineral content, while Damethang had the lowest. Turbidity was highest at Damethang, indicating suspended solids. Damethang Menchu (22.9 NTU) and Baykey Menchu (13.9 NTU) exceeded turbidity limits (5 NTU), posing risks of microbial contamination and reduced effectiveness of water disinfection.

The arsenic content in the Menchus ranges from 0.005 - 0.011mg/L which indicates that the public need to be cautioned for prolonged exposure and drinking. Lead, Cadmium, Molybdenum, Bismuth, Boron, Silver, Gold and Nickle were not detected (ND) selenium were below| 0.006 in all samples, iron is detected in Tsheringma Menchu(0.13mg/l). Bayken Menchu exceeded fluoride limits, and Omchu Menchu showed arsenic and aluminum concerns, posing risks like fluorosis and potential neurological effects. Otherwise all other mineral content levels are within WHO standard limits.

Microbial analysis showed variable contamination across Menchus. Omchu Menchu and Phenteykha had extremely high E. coli and coliform counts, while Baykey Menchu also indicated contamination. Other sites had low E. coli but high coliforms, suggesting possible fecal pollution. These results highlight the need for effective disinfection and source protection measures.

1. Introduction

Globally, hot springs are valued for various purposes, depending on their unique geothermal and natural resources, as well as historical and cultural factors that influence their development and use over time. According to the Global Wellness Institute's 2022 report, there were 31,290 thermal/mineral spring establishments across 130 countries, generating $65.7 billion in revenue at the pre-pandemic peak. Due to their reliance on tourism, the sector is projected to grow at 14.3% annually from 2022 to 2027 as it recovers from pandemic-related declines (McGroarty, 2024). Scientifically these hot springs are usually found in areas where Earth's crustal plates are moving apart or have recently done so, often linked to volcanic activity involving basalt. They can also occur in subduction zones, where one plate is pushed beneath another, causing the crust to melt and form volcanoes that produce andesitic lava (Xi & Scientific, 1975). The geothermal circulation process involves meteoritic water being heated deep underground at high temperatures. This heated water then flows out to the surface through the Main Central Thrust (MCT) zone, appearing as hot springs (Basnyat et al., 2020). In the 1800s, the effective treatment of hydrotherapy also known as balneotherapy emerged in Europe. Its popularity grew due to the chemical composition of the mineral waters, which contained bicarbonate, sulfate, sulfide, and chloride, as well as their molecular concentration and temperature classifications into hypothermal (20–30°C), thermal (30–40°C), and hyperthermal (>40°C) (Li et al., 2024).

In gSowa Rigpa, the term "Menchu" refers to medicinal water, which contains minerals dissolved from soil and rocks in natural water sources and streams. These waters are typically identified by their colour, smell and taste and are used to treat various ailments due to their unique therapeutic properties. When a person immerses their limbs or entire body in Menchu, it is believed to provide healing benefits. According to gSowa Rigpa literature, this practice can be correlated with non-invasive therapy for conditions such as myalgia and arthralgia (musculoskeletal pain). Hot springs are suitable for both ill and healthy individuals, with their benefits well-documented through oral traditions and personal experiences of those who have bathed in them. However, improper usage may pose health risks (Meyenima Thongwadhondhen, Malaya-kadrel).

A study conducted in Japan on guinea pigs demonstrated that bathing in a hot spring accelerates wound healing and enhances the heat retention effect compared with tap water bathing. In addition, the hot spring bath group had higher plasma concentrations of some amino acids associated with wound healing

(Inaka & Kimura, 2022). There is an emerging trend to validate the therapeutic applications of hot springs by examining utilization patterns and investigating their bioactive components. Japan and France are major contributors to this research, with studies focusing on the healing properties of mineral-rich waters in various locations (Li et al., 2024). Similarly, Bhutan is also leveraging its numerous geothermal hot springs and mineral springs, locally known as Tshachu and Menchu, respectively. These springs are widespread across the country and hold deep cultural and spiritual significance, as they are believed to have been blessed by Buddha and Bodhisattvas. For centuries, the Bhutanese have used these natural springs to treat various ailments particularly Menchus, which are renowned for relieving body pain, joint pain, and other conditions. Beyond their therapeutic benefits, these sites are popular for relaxation and recreation, attracting both locals and visitors seeking wellness and tranquility (Ministry of Health, 2024).

Aligning with the Traditional Medicine Division's mission - to conduct survey and mapping all the medicinal plants and resources, mapping of both Tshachus and Menchus, in the country were undertaken. Understanding the detailed physicochemical and microbial properties of these springs will help establish their therapeutic potential for healthcare and recreational use by both locals and tourists. This report was prepared with technical support from the Royal Centre for Disease Control (RCDC) and a review of therapeutic evidence from the Faculty of Traditional Medicine (FoTM) at KGUMSB. The report aims to compile comprehensive data on the springs, including their GPS coordinates, temperature, physicochemical composition, microbial properties, and sociocultural history, beliefs, and practices. This information will support public health awareness campaigns on the safe use of Menchus. Additionally, the findings will assist the Ministry of Health in developing a health advisory package to ensure the proper therapeutic and recreational use of these springs across 5 locations under Dagana, Wangdue Phodrang and Punakha Dzongkhags.

2. Purpose of the field survey:

This field survey aimed to map and document medicinal/ mineral spring (Menchu) in Drukjeygang in Dagana, Basochu Wangdue Phodrang and Toebisa under Punakha Dzongkhags Study assesses their physio-chemical properties, traditional medicinal uses, and compares with scientific evidence. The study seeks to understand their distribution, quality, and therapeutic potential to support sustainable use and preservation.

3. Objectives of the field survey:

i. To map and document potential medicinal/ mineral springs sources (Menchu) Drukjeygang under Dagana, Basochu under Wangduephodrang and Toebisa under Punakha Dzongkhag.

ii. To analyze and evaluate the physio-chemical properties (e.g., temperature, pH, mineral content, dissolved solids, and trace elements) and assess their suitability for therapeutic purpose.

iii. To document the traditional uses, cultural significance, and therapeutic claims associated with each hot spring and mineral spring source from a traditional medicine perspective.

iv. To raise awareness, disseminate knowledge, and promote the conservation and sustainable management of Menchu, emphasizing their cultural, medicinal, and ecological importance among local communities, policymakers, and researchers

4. Descriptions of Menchus

This section presents a brief information about the Menchus from the socio-cultural perspectives, gathered through one-on-one spot interviews with local residents. It covers their history, background, beliefs, traditions and practices, as well as their location and distance from the nearest road point.

4.1 Tshering-Ma Menchu

According to local residents, visitors in the past bathed at the Menchu and, during their stay, killed and consumed animals on the site. Upon hearing of these practices, Drupthob Yeshi Phuntsok, a resident of the village, intervened and stopped people from using the Menchu in this manner. Historically, it has also been referred to as Jetsun Dolma Menchu and is known for providing relief to individuals suffering from body pain and joint-related discomfort.

The Menchu is situated at an altitude of 1,217 meters on a steep 80˚ slope, located on a private land under Pangna Chiwog, Drukjeygang Gewog, Dagana

Dzongkhag. However, concerns must be raised over the declining water source, emphasizing the importance of maintaining good forest cover in the upper catchment area.

4.2 Tashi Dargay Menchu

According to the locals, the Menchu was used by people just a few years ago. It is believed to help alleviate heart-related ailments, and it has been reported that people from other Dzongkhags also visit the Menchu to seek relief from joint and body pain. The local government of Drujaygang Gewog constructed infrastructure, including a bathtub, for bathing in this Menchu, which was leased to a local resident who managed it until recently. This indicates that people have been using the Menchu to treat various ailments and shows continued interest in reviving the tradition. The Menchu is situated at an altitude of 1,186 meters above sea level, flowing from the eastern side towards west at an elevation angle of 80˚. From the Sowa Rigpa perspective, three key properties were identified in this Menchu: Sindura, Do Chur, and Chongzhi. Its temperature was recorded at 17.5˚C.

The Menchu is located in Pangserpo village under Drujaygang Gewog,Dagana Dzongkhag which is approximately 1.5 kilometers from the Gewog Center.

4.3 Baykey Menchu

According to the locals, this Menchu has been used for generations and has earned popularity and trust among its users. It is believed to relieve musculoskeletal pain and people also experienced special healing properties for tongue wounds, which has led to its recognition within the community as Bayken Menchu. It emerges from a rock and collects in natural stone basins,According to gSowa Rigpa, this Menchu contains the mineral Chongzhi, and laboratory tests have confirmed its mineral content as shown in the results table. Situated at an altitude of 935.8 meters with a 20˚

slope, the site once had a shed and pathway constructed by Druk Green Power Corporation (DGPC) officials a few years ago. However, these structures have deteriorated due to a lack of proper maintenance. The Menchu is located above the Ruri Chu Bridge within Uma-Khatoed Chiwog, Daga Gewog, Wangdue Dzongkhag, and is about a seven-minute walk from the Wangdue–Tsirang Highway.

4.4 Omchu Menchu

The Menchu is located on private land, and the owner reported that it was first discovered by Choejay Drukpa Kuenlay. In earlier times, the Menchu was warm; however, over the years, it is believed to have lost its warmth as villagers disposed of dead animal carcasses in it and neglected its care. The Menchu is also known as Omchu Menchu because of its milky appearance.

The Menchu is located at an elevation of 1,892 meters on a gentle 1° slope, with a temperature of 13°C. Surrounding the pond are Sindhura and Shudag herbs. According to local tradition, annual prayers are held here, believed to bring good fortune and abundant harvests to the community. There is also a story that the statue of Zambhala, the goddess of wealth, used to appear near the Menchu, highlighting its significance in wealth accumulation.

This Menchu is located in Toeb Phenteykha village, Menchuna Chiwog within Thinleygang Gewog, Punakha Dzongkhag, which is approximately 1.5 kilometers downhill from the Punakha-Thimphu main highway.

4.5 Damithang Menchu

According to locals, this Menchu is also believed to have been identified by Choejay Drukpa Kuenlay. It is said that the Menchu was once used by the community, but later the area was converted into a paddy field, after which it was no longer utilized.

The Menchu emerges from underground and as the surrounding area is muddy and swampy so it is called Damithang Menchu. And its surrounding is covered by shudhag herb and sindhura. People have observed and reported that this mineral water is unsuitable for irrigation, as it negatively affects crop yields, leading them to believe it is a Menchu.

The Menchu is located in Toeb Phentoekha village, Menchuna Chiwog within Thinleygang Gewog, Punakha Dzongkhag, approximately 1.5 kilometers downhill from the Punakha-Thimphu main highway.

5. Methodology

List of Menchu Surveyed Under Dagana, Wangdue Phodrang & Punakha Dzongkhag 2025

Table 1: List of Menchus surveyed

Menchu

Sl. No.	Name of Menchu	Dzongkhag	Gewog	Chiwog	Location
1	Tsheringma	Dagana	Drujeygang	Pangna	Menchulum
2	Tashi Dargay	Dagana	Drujeygang	Pangserpo-toe	Pangserpo
3	Baykey	W/phodrang	Dakar	Uma-Khatoe	Above Rurichu bridge
4	Omchu	Punakha	Thinleygang	Menchuna	Teop Phenteykha
5	Damithang	Punakha	Thinleygang	Menchuna	Teop Phenteykha

5.1 Study Design:

An integrated field survey was conducted to map, assess, and provide a holistic understanding of Menchu (mineral-spring) from both traditional medicine and scientific evidence perspectives

5.2 Study Area:

The field study was carried out in purposive settings of Drukjeygang in Dagana, Basochu in Wangduephodrang and Toebisa under Punakha Dzongkhag.

5.3 Study Period:

The study was conducted from January 2025 to March 2025. The data collection period was from January 21, 2025 to February 2,2025, whereas data analysis was performed in the month of March 2025.

5.4 Study Tools

An open- ended structured questionnaire in Dzongkhag was used as a study tool for data collection.Study tool was divided into two categories:

5.4.1 The first section consists of questionnaires related to the location, description, and open-ended structured questions about Menchu.

5.4.2 The second section includes sample collection to investigate physical, chemical and microbial properties.

5.5 Sampling Points

The Traditional Medicine Division, Department of Health Services, Ministry of Health in coordination with the district health authorities of Dagana, Wangdue Phodrang and Punakha Dzongkhag considered formal requests to perform initial line listing of the Menchus. Additionally, request from private individuals in Drujeygang (Dagana Dzongkhag) and Toebisa (Punakha Dzongkhag) were considered for inclusion in the survey.

5.6 Sample Collection

A total of 5 Menchu water samples were collected from Dagana, Wangdue Phodrang and Punakha Dzongkhags.

All the samples were collected and preserved as per the sample collection and preservation protocols 1060 of APHA 23rd edition. Standard operating procedure (SOP) for sample collection, preservation and transportation at the water and environment laboratory at RCDC was also referred. 1000mL of water sample was collected in a high-density polyethylene (HDPE) sample container for measuring inorganic chemical parameters. 250mL of water sample was also collected in a HDPE container and immediately acidified using trace metal grade ultrapure Nitric Acid to pH <2 for elemental analysis using ICP-OES. Another 250mL was immediately brought to the laboratory in a sterile container for microbial analysis. All the samples were transported maintaining a temperature of <8°C to the laboratory. Some of the physicochemical parameters were measured at the site using portable field test kits.

6. Parameters

6.1 PHYSICAL PARAMETERS ANALYSIS

Physical parameters including temperature, pH, turbidity, conductivity and TDS were measured at the sampling site using portable water test kits. Temperature,

Conductivity and TDS were measured using Orion star A220, portable meter (Thermo Fisher Scientific, US). Turbidity of the samples were analysed using HACH 2100Q turbidimeter (Iowa, USA). Likewise, the pH of the samples was determined using a portable pH meter (Mettler Toledo FiveGo, Switzerland).

6.2 CHEMICAL PARAMETERS

UV spectrophotometer (HACH DR6000, USA) wasis used to analyze inorganic chemicals (fluoride, sulphate and nitrate) following instrument manual for respective parameters. Fluoride was measured using the SPADNS colorimetric method, in accordance with APHA 23rd edition, method 4500-F D. Sulphate was analyzed using the HACH DR5000 procedure (method 8051) with Sulfaver® 4 reagent powder pillows, and cross-referenced with APHA 23rd edition, method 4500-$SO4^{2-}$ E. Nitrate was tested using the Ultraviolet Spectrophotometric Screening method (APHA 23rd edition, method 4500-$NO3^{-}$ B). Total Hardness, Calcium Hardness and Alkalinity were measured using Titration technique. Other trace elements and heavy metals were analyzed using an inductively-coupled plasma optical emission spectrometer (Agilent 5110, Agilent, USA). 10mL of the acidified samples were filtered through Whatman Polyethersulfone (PES) Membrane Filters with pore size of 0.2 µm and processed using ICP-OES using following operating conditions:

- Replicate 3
- Pump speed, rpm 12
- Uptake delay, S 25
- Plasma gas flow, L min−1 15 (fast pump)
- Read time, S 15
- RF power, kW 1.2
- Nebulizer flow, L min−1 0.7
- Auxiliary flow, L min−1 1
- Plasma flow, L min−1 12.0
- Make up flow, L min−1 0.00
- Viewing mode Radial
- Viewing height (mm) 8
- Standards (3 standards) 0.1ppm, 0.25ppm and 1.0ppm
- Correlation coefficient limit 0.9990
- Wavelength, nm

- Ag (328.068); Al (396.15); As (188.980); Au (242.794); B (249.772); Ba (455.403); Bi (223.061); Ca (396.847); Cd (214.439); Co (238.892); Cr (267.716); Cu (327.395); Fe (238.204); Ga (294.363); In (230.606); K (766.491); Li (670.783); Mg (279.553); Mn (257.610); Mo (202.032); Na (589.592); Ni (231.604); Pb (220.353); Se (196.026); Sr (407.771); Tl (190.794); Zn (213.857)

6.3 MICROBIAL ANALYSIS

E. coli and total coliform were tested using membrane filtration technique. Chromogenic coliform agar (HICrome) was used for simultaneous detection of E. coli and coliform at 37 °C.

7. Results

7.1 Physical parameters

In all the Menchus, the physical parameters were largely within acceptable levels recommended by USEPA and WHO for drinking water and recreational water quality. However, Damethang Menchu (Totokha) recorded the highest turbidity of 22.9 NTU, which is significantly above the USEPA, WHO, and BDWQS standard of 5 NTU for drinking water. Similarly, Baykey Menchu (Basachu) had a turbidity of 13.9 NTU, also exceeding the safe limit. Higher turbidity can lead to microbial contamination and reduce disinfection efficiency in drinking water.

All Menchus were within acceptable TDS and conductivity levels, remaining below the USEPA and BDWQS MCL. For more detailed information, refer to Table 1.

7.2 Chemical Parameter

The trace element profile of the five Menchus indicates generally low concentrations of heavy metals, with many elements such as Al, Co, Cu, Mn, and Ni either not detected or present at very low levels, suggesting minimal contamination and a predominantly natural geochemical origin.

Arsenic (As) is detected in all samples (0.006–0.011 mg/L), but at low levels, though it warrants continued monitoring due to its toxicity even at trace concentrations. Barium (Ba) is present in some springs (up to 0.035 mg/L in Omchu), remaining within low environmental levels. Zinc (Zn) and copper (Cu) are also present only in trace amounts, indicating limited anthropogenic input.

Macronutrient elements such as potassium (K), magnesium (Mg), and sodium (Na) show greater variability. Sodium is particularly elevated in Baykey Menchu

(57.654 mg/L), distinguishing it from other sites and suggesting strong mineral-water interaction or unique geological influence. Potassium is highest in Omchu Menchu (11.918 mg/L), while magnesium remains moderate across sites (1.37–3.741 mg/L), reflecting natural mineral dissolution.

Overall, the findings suggest that the Menchus are largely free from significant heavy metal contamination and are chemically dominated by natural geological processes. However, site-specific elevations in arsenic and sodium highlight the need for periodic monitoring to ensure continued safety, especially if these waters are used for therapeutic or drinking purposes.

7.3 Microbial Parameter

The microbial analysis of the Menchu samples showed varying levels of E. coli and total coliforms. Omchu Menchu Toktokha had the highest contamination, with 245 CFU/100mL E. coli and 490 CFU/100mL total coliforms, significantly exceeding acceptable limits. Baykey Menchu (Basachu) also showed E. coli (6 CFU/100mL) and total coliforms (350 CFU/100mL), indicating contamination. Tshering Menchu and Tashi Dargay Menchu at Drujeygang had few to no E. coli, but high total coliform counts. These findings suggest the potential for fecal contamination, requiring proper disinfection and source protection to ensure water safety and health. For more detailed information, refer to Table 2

Table 1: Physical parameters of five Menchus from Dagana , Wangduephodrang and Punakha Dzongkhags, Bhutan, 2025.

	Sampling Station (n=8)	Temperature (^{o}C)	pH	Conductivity (µS/cm)	TDS (mg/l)	Turbidity (NTU)
1	Tsheringma Menchu (Drujeygang)	17.9	7.38	182.1	109.8	1.89
2	Tashi Dargay Menchu (Drujeygang)	17.5	6.8	128.1	77.39	3.42
3	Baykey Menchu (Basachu)	17.12	7.43	351.8	211.6	13.9
4	Omchu Menchu (Toktokha)	15.6	6.86	146.6	88.47	1.29
5	Damethang Menchu (Totokha)	11.6	6.41	74.15	45.15	22.9

Table 2: Inorganic and microbial parameters of five Menchus from Dagana, Wangduephodrang and Punakha dzongkhags, Bhutan, 2025.

	Sampling Station (n=8)	Fluoride (mg/l)	Nitrates (mg/l)	Sulphate (mg/l)	Calcium Hardness (mg/l as CaCO3)	Total Hardness (mg/l as CaCO3)	Alkalinity (mg/l as CaCO3)	E. coli (CFU/100ml)	Total coliform (CFU/100ml)
1	Tsheringma Menchu (Drujeygang)	0.05	0.1	7	40.5	103.6	11.5	0	200
2	Tashi Dargay Menchu (Drujeygang)	ND	0.6	3	66.57	71.3	11.9	0	210
3	Baykey Menchu (Basachu)	2.73	0.1	4	24	87	22.6	6	350
4	Omchu Menchu (Toktokha)	ND	0.1	21	6.8	50.8	15.6	245	490
5	Damethang Menchu (Totokha)	ND	0.2	ND	10.5	48.8	11	0	72

Table 3: The trace elements and heavy metals of five Menchu from Sarpang, Dagana and Wangduephodrang dzongkhags, Bhutan, 2025.

	Sampling Station (n=8)	Al (mg/l)	As (mg/l)	Ba (mg/l)	Co (mg/l)	Cu (mg/l)	K (mg/l)	Li (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Ni (mg/l)	Zn (mg/l)
1	Tsheringma Menchu (Drujeygang)	ND	0.009	0.007	ND	ND	4.706	0.005	3.692	ND	5.814	ND	0.003
2	Tashi Dargay Menchu (Drujeygang)	ND	0.008	0.008	ND	ND	4.075	0.004	3.741	0.024	5.857	ND	0.006

	Sampling Station (n=8)	Al (mg/l)	As (mg/l)	Ba (mg/l)	Co (mg/l)	Cu (mg/l)	K (mg/l)	Li (mg/l)	Mg (mg/l)	Mn (mg/l)	Na (mg/l)	Ni (mg/l)	Zn (mg/l)
3	Baykey Menchu (Basachu)	0.008	0.010	ND	0.001	ND	1.994	0.031	2.219	0.015	57.654	ND	0.001
4	Omchu Menchu (Toktokha)	0.001	0.011	0.035	0.001	0.043	11.918	ND	2.160	0.001	10.303	0.001	0.004
5	Damethang Menchu (Totokha)	ND	0.006	0.007	ND	0.029	1.055	ND	1.370	0.009	3.559	0.001	0.008

Note: *Lead, Cadmium, Chromium, Molybdenum, Bismuth, Boron, Silver, Gold, Iron and Nickle were not detected (ND). Selenium were below <0.006 in all samples. Iron is detected only Tsheringma Menchu (0.13 mg/l).*

Table 4: Demonstrating Sowa Rigpa based properties observed in 5 Menchus 2025

Menchu

སྨན་ཆུའི་མིང་།	སྨན་ཆུའི་རྒྱུ།				དོས་འཛིན།	ཡན་ལག	
	སྨན་ཙཱ་སྨ།	ནོ།	མདོག་དང་ཉ་ཚིགས།	བཐས་ཕྱོགས།			
ཆོམ་མེ་མ་སྐྱ་སྨན་ཆུ།	སིམ་རྩུ་ར།	རླུང་ཚོ།	སྔོ་སེར།	ཁོ།	ཀུང་ཁཐིམ་སེར་བའི་སྨན་ཆུ།	ཀུང་ཁང་མཐིམ་པའི་ཁ་ཁྱི་ཚུ་ཁུ་ཡན།	
བཀྲིམ་ད་ར་རྒྱས་སྨན་ཆུ།	སིམ་རྩུ་ར་ཆོང་ཁྱི། རྡོ་རླུ་ར།	ཁ་རླུ་ར།	སེར་ལོ་རྒྱ་ར་ལོ།	ཤི་ར།	བཟ་མཐིམ་སེར་བའི་སྨན་ཆུ།	བཟ་ཁ་ཁྱ་ང་མཐིམ་པའི་ཁ་ཁྱི་ཚུ་ཁུ་ཡན།	
བཟ་ཁ་སྨན་ཆུ།	ཆོང་ཁྱི།	མ་ར་ཁ། རླུ་ར།	ད་ཁ་ར་ལོ། སྔོ།	མས་ཁྱས་ས་ར།	འབྲས་པ་སེར་བའི་སྨན་ཆུ།	བཟ་ཁ་ཁྱ་བཟ་ཁ་སྨུ་ཁ་པོ་ཤི་ད་ཁྱ་ཁ་ཁྱི་ཚུ་ཁུ་ཡན།	
ཙོ་མ་ཚུ་སྨན་ཆུ།	སིམ་རྩུ་ར།	རླུང་ཚོ།	སྔོ་རླུ།	ཤི་ར།	བཟ་ཁ་སེར་བའི་སྨན་ཆུ།	བཟ་ཁ་ཁི་ད་ཁྱ་ཁ་ཁྱི་ཚུ་ཁུ་ཡན།	
འདྲ་ཤེ་ར་སྨན་ཆུ།	སིམ་རྩུ་ར།	རླུང་ཁ།	སྔོ་དམ་ར།	ཀུང་ཁཐིམ་སེར་བའི་སྨན་ཆུ།	བཟ་མཐིམ་པའི་ཁ་ཁྱི་ཚུ་ཁུ་ཡན།		

Table 5: Summary table presenting the unusual observation in Menchus

S/n	Tsachu & Menchu	Physical	Microbial	Chemical	Remarks	Recommendation
1	Tsheringma Menchu		Few E coli	Within normal limit	Indicating contamination.	Not safe for drinking
2	Tashi dargay menchu		Few E coli	Within normal limit	Indicating contamination.	Not safe for drinking
3	Baykey Menchu	A turbidity of 13.9 NTU, also exceeding the safe limit.	E. coli & Coliform	Within normal limit	Higher turbidity can lead to microbial contamination and reduce disinfection efficiency in drinking water.	Not safe for drinking
				Fluoride concentration of 2.73 mg/	Prolonged consumption of high fluoride water may lead to dental and skeletal fluorosis.	Caution for drinking
4	Omchu Menchu		E Coli high	Arsenic (0.011 mg/L) slightly higher	Arsenic levels above the threshold pose a serious health risk, including potential for cancer and skin lesions with prolonged exposure.	Not safe for drinking
5	Damethang Menchu	Recorded the highest turbidity of 22.9 NTU		Within normal limit	Higher turbidity can lead to microbial contamination and reduce disinfection efficiency in drinking water.	Caution for drinking

8. Discussion

In the context of traditional medicine, springs used for therapeutic purposes are broadly categorized into two types based on temperature and odor. The identification of Tshachu (hot springs) and Menchu (medicinal/mineral springs) is commonly guided by parameters such as temperature, color, odor, taste, and turbidity. While both contain similar minerals, the quantities of these minerals vary. However, there is no existing literature in journals that specifically addresses and supports this classification. Unlike Tsachus (hot springs), there is limited research conducted in other countries on Menchus (medicinal/mineral springs). Due to the lack of sufficient literature to clearly distinguish between Menchu and Tshachu, this report treats them as a single category for the purpose of discussion.

8.1 Physical Parameters

The physical characteristics analyzed in Menchu were compared with international standards, such as those set by the USEPA, WHO guidelines for drinking and recreational water, and Bhutan's drinking water quality standards.

The observed temperature range confirms that the studied Menchus are non-thermal in nature, suggesting that their therapeutic value is likely associated with mineral composition rather than heat. The near-neutral pH across all sites supports their suitability for traditional balneotherapy and potential human use without significant acid–base-related risks.

The marked variation in conductivity and TDS indicates heterogeneous geological influences across the springs, with Baykey Menchu exhibiting comparatively higher mineralization, which may enhance its perceived medicinal properties but also warrants careful assessment for long-term use.

Differences in turbidity highlight variability in water clarity and possible influence of surface runoff or sediment disturbance, particularly at Damethang and Baykey Menchus. Elevated turbidity may reduce aesthetic quality and necessitate pre-use treatment for bathing or consumption purposes.

Overall, the hydrochemical diversity among the springs suggests site-specific therapeutic potentials, reinforcing the need for individualized management and further correlation with traditional healing practices to better understand their medicinal relevance.

Turbidity measures the suspended minerals, micro-organism, plankton, and dissolved organic and inorganic substances (Gichuki & Gichumbi, 2012). The

highest turbidity level was recorded in Sershong Tshachu Pond-3, with a reading of 22.8 NTU.

8.2 Chemical Parameter

The study evaluated the chemical parameter of Menchu waters using both national (BDWQS) and international (USEPA, WHO) drinking water standards, as well as recreational water guidelines. Most of the chemical parameters in the Menchu waters were found to be within acceptable limits for drinking, as per USEPA, WHO, and BDWQS standards. The consistently low nitrate and sulphate levels across all Menchus indicate minimal anthropogenic influence, suggesting that the springs largely retain their natural hydrogeochemical characteristics.

The absence or very low fluoride levels in most sites, contrasted with the elevated concentration at Baykey Menchu, indicates strong localized geological control over water chemistry, necessitating site-specific risk assessments. The variation in water hardness from soft to moderately hard reflects differences in mineral dissolution processes and aquifer characteristics, which may also influence the perceived therapeutic value of the springs. Low alkalinity across all sites suggests limited buffering capacity, making the springs more susceptible to external environmental or contamination influences. Overall, the chemical uniformity in most parameters supports a generally pristine hydrogeochemical system, while the distinct chemistry of Baykey Menchu highlights spatial heterogeneity relevant to both health considerations and traditional therapeutic classification.

Similarly, the overall low concentrations of heavy metals (Al, Co, Cu, Mn, Ni) across all Menchus indicate minimal anthropogenic pollution and confirm a predominantly natural geochemical origin. The consistent presence of arsenic in all samples, although at low levels, is noteworthy and warrants continuous monitoring due to its potential toxicity even at trace concentrations. Barium, zinc, and copper occur only in trace amounts, further reinforcing the relatively unpolluted nature of the springs. Variability in major ions such as potassium, magnesium, and sodium reflects differences in underlying geology and water–rock interaction processes, with Baykey Menchu showing distinctly high sodium levels and Omchu exhibiting elevated potassium. Magnesium levels remain relatively stable across sites, suggesting consistent mineral dissolution within the aquifers. Overall, while the Menchus are largely free from hazardous heavy metal contamination, site-specific geochemical variations—particularly elevated sodium and detectable arsenic—underscore the need for periodic water quality monitoring to ensure safe therapeutic and potential potable use.

8.3 Microbial Parameter

The microbiological findings indicate clear spatial variation in sanitary water quality among the five Menchus, with only Tsheringma, Tashi Dargay, and Damethang remaining free from E. coli, suggesting relatively intact sanitary protection or limited recent fecal contamination at these sites. In contrast, the presence of E. coli in Baykey Menchu and the very high contamination level in Omchu Menchu indicate active fecal pollution, making these sources unsafe for direct human use without treatment.

The detection of total coliforms in all samples highlights a broader issue of environmental microbial contamination across all sites, suggesting that none of the springs are completely protected from surface or subsurface microbial ingress. Particularly high coliform counts in Omchu and Baykey Menchus point to possible influence from surface runoff, inadequate catchment protection, or nearby anthropogenic and animal activities.

Overall, the findings emphasize that while some Menchus maintain relatively good microbiological integrity, the widespread presence of coliform bacteria and site-specific E. coli contamination underscore the need for targeted source protection measures, improved sanitation around catchment areas, and routine microbiological monitoring to ensure safe therapeutic and potable use.

8.4 Menchu As Unique

The literature review revealed that Tshachus (hot springs) are found in many countries, and various studies have been conducted on them. However, Menchu (mineral or medicinal springs) are unique in Bhutan, where they are widely used for medicinal baths unlike in other parts of the world. This highlights a distinctive opportunity for Bhutan to develop Menchu as a wellness brand in the future. Further studies should be conducted to analyze the differences between Tshachu and Menchu, focusing on their physicochemical properties from both scientific and Sowa Rigpa perspectives. It is important to encourage Traditional Medicine (TM) professionals to pursue more research on Menchu moving forward

9. Limitation of the Study

- Sample sizes of the study were small and cannot represent the nationwide.
- Findings may vary according season of study, this was done in winter season
- Limit of quantification of some parameters is higher than the sample analyzed, this may limit correct interpretation, eg, arsenic.

- Dependence on RCDC in conducting the study as TM do not have capacity
- Limited reference on the Sowa Rigpa literatures

10. Recommendation

1. Publication and sensitization on the chemical, heavy metal and microbial report to the public.
2. TMD to carry out sensitization periodically on the above Menchu and Herbals preservation usage.
3. Install health advisory in the Menchu areas for the public.
4. Conduct further in-depth study on individual Menchus as deemed appropriate.
5. Conduct Study on diseases /health conditions cured by Menchus.
6. Further studies with more samples and using comparable or higher end technology or equipment (eg. using ICPMS for trace metal analysis).
7. Identification of a person who has good knowledge of Menchu for collecting information in the future.
8. Need further literature, review, study and training on correlation and interpretation of the benefit between sowa rigpa and scientific.
9. Explore for capacity building and enhancing coordination with RCDC and relevant organizations.

11. Conclusion

The Tsachhus and Menchus across Bhutan hold deep cultural, medicinal, and historical significance. Bayken Menchu is known for their mineral richness and skin-healing properties. Others, like Tshering-Ma and Omchu Menchu, carry spiritual legends and serve as vital sources for both people and animals. Most are accessible by road or short walks, with some located in remote forested areas, emphasizing their natural purity.

Overall, the findings reflect significant hydrogeological diversity across the sampled springs, impacting their suitability for various uses and underscoring the importance of regular quality assessments for public health and sustainable utilization.

The recommendations emphasize the need for continued research, public awareness, and preservation of Menchus. Key actions include presenting findings to authorities, conducting further scientific and traditional studies, engaging communities, and enhancing collaboration with relevant institutions to promote

sustainable use and understanding of these natural medicinal resources. Menchu use as a medicinal bath is unique to Bhutan, offering potential to develop it as a national wellness brand. Further research comparing Tshachu and Menchu, both scientifically and through Sowa Rigpa, should be encouraged among TM professionals.

Despite the challenges of remote access and rugged terrain, the study of Tsachu and Menchu was a rewarding and enriching experience. It strengthened team coordination and provided valuable insights. The findings underscore the need for continued research, public awareness, preservation efforts, and promotion of wellness tourism centered on these medicinal resources.

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