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Geopharmacology of Hot Springs with Special Reference to Khandesh in Maharashtra, India

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Abstract

Geopharmacology is an emerging and novel branch of research in Geography of Health. The word Geopharmacology consists of two words, i.e., one is Geography and another is Pharmacology, in which geographical components or elements are studied from pharmaceutical and medicinal point of views. These points of views are useful for the wellness of human being. Hot spring is one of the core components of geopharmacological research. Khandesh is province of Maharashtra state in India. It's having reach geoheritage from ancient era and hot springs are one of them. For this research study, hot springs water samples are collected from Ramtalab hot springs and tested for antimicrobial activity using agar diffusion method. For testing the antimicrobial activity of hot spring water sample, 1 bacterial (Gram positive and Gram negative) and 2 fungal strains are used, to detect the versatility of water against each type of microorganism. The organisms used in the activity are E. coli, S. aureus Bacteria) and A. niger and C. albicans (Fungi). Results revealed on the basis of temperature, and pH, hot springs in Khandesh province came in category of hyper thermal hot springs and an alkaline hot springs in nature. antimicrobial study shows that, hot springs water samples are potential antimicrobial activity against fungal strains special A. niger, C. albicansare responsible for various skin diseases to human. Hence, these water samples can be used in the preparation of formulations against human skin diseases and very high potential properties recorded as new hope rays for balenotherapy centers in Khandesh region of Northern Maharashtra state in India.

Keywords: Geopharmacology, Geoheritage antimicrobial, Balenotherapy, Sustainable

1 Introduction

Geopharmacology of hot springs in India play and significant role in Indian cultural heritage as well as therapeutics benefits and natural beauty provinces of Maharashtra. Indian ancient civilization has unique and world best medicinal value in terms of therapeutic and cultural as well as geoheritage. Geopharmacology is an emerging and novel branch of research in geography of health. The word geopharmacology consists of two words, one is geography and another is pharmacology, in which geographical components and elements are studied from pharmaceutical and medicinal point of view. These points of views are useful for the wellness of human being. Khandesh region consists of three perennial hot springs named Unapdev, Ramtalab, Anakdev of Northern Maharashtra. All of these three hot springs have their socio-cultural as well geopharmacological importance.

Geologically Khandesh province is a basaltic flow of the Deccan trap. Geo-structurally, hot spring are situated along the dolerite dyke, faults and fractures almost parallel to the strike line of southern Satpura Mountain foothills of river Tapi valley. Review of literature show that, hot spring of Unapdev and Anakdev studied for geothermal and thermo stable enzymes and recreational and tourist point and but hot spring of Ramtalab was not study on any above dimension. Therefore, prime core for present research is to examine the geopharmacology of hot springs in Khandesh region.

2 Materials and methods

Hot springs are located at Unapdev(A) hot spring, near Adawad village (21°15'57"N 75°25'52"E,) Ramtalav (B) hot spring, near Vardi village, in Chopada 21°16'58"N 75°24'31"E) and Anakdev (C), near Dara village in Shahada (21°43'47"N 74°26'31"E). These three hot springs are situated along the dolerite dyke, faults and fractures with almost parallel to the strike line of southern Satpura mountains foot hill of river Tapi valley[1].

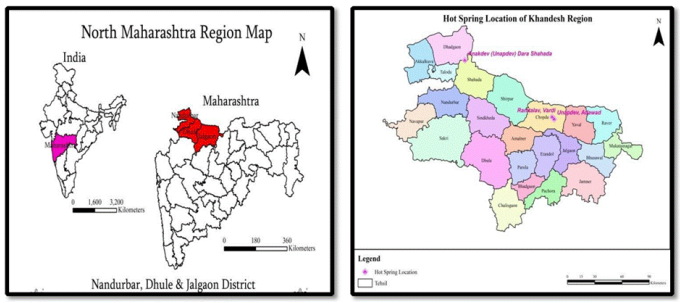


Fig. 1

Sampling of hot springs water in Khandesh:

The *in situ* temperatures of hot springs water are Unapdev (A), Ramtalav (B) Anakdev (C). According to 58°C, 47.3°C and 55.2°C and the in situ pH were 7.65, 7.37 and 7.68. The hot springs water samples are collected in sterile conical flasks aseptically by using standard sampling protocols are immediately transported to the lab of Microbiology.

Microbiological analysis

Enrichment of bacteria refers to the nourishment provided to the bacteria for isolation or other research purposes. This is done by aseptically inoculating the samples in Sterile Nutrient broth, which provides proper nourishment to bacteria in the form of source of Glucose, Nitrogen and other required nutrients. The test microorganisms were inoculated in Sterile Nutrient broth for enrichment of microbes to show activity and kept for incubation at 37°C for 24 hours.

Assay Method

From various antimicrobial assay methods, well-diffusion method is used for the detection of antimicrobial activity of water samples.

Test Microorganisms

For testing the antimicrobial activity of hot spring water sample, 2 bacterial (Gram positive and Gram negative) and 2 fungal strains were used, to detect the versatility of water against each type of microorganism. The organisms used in the activity were *E. coli, S. aureus* (Bacteria) and *A. niger* and *C. albicans* (Fungi). For this, Nutrient agar and Potato dextrose agar were prepared which support the growth of bacteria and fungi respectively. After preparation and pouring of media into Sterile petri dish, the enriched test organisms were spread as per standard protocol developed by Leoffler and Gaffkey in the laboratory of Robert Koch. This method is routinely employed for the isolation of bacteria in pure culture. After spread plate technique was carried out, 6 mm wells were prepared by standard methods using cork borer. The prepared the Sterile Nutrient agar and Sterile Potato dextrose agar plates with 6 mm wells were used for antimicrobial assay.

Anti-microbial assay

Antimicrobial activity test is done by the agar well diffusion method[4] after the preparation of Plates as mentioned in [Fig. 2], the water sampled from various sources was suspended in the wells by using micro-pipette. The size of sample was 5 µl for each well.

After this, the plates were incubated at 37°C for 24-48 hours.

Incubation process:

Incubation is an essential step in any microbial investigation. Incubation ray force to a control condition to keep a bacterium or cell can grow or develop, for this, the researcher has shifted culture petri dishes to incubate at 37°C for 24-48 hours, to observe zone of inhibition.

Measurement of zone of Inhibition:

Zone of inhibition is a zone formed around the wells of suspended sample. It indicates the microbes that are

inhibited by the sample, for its growth. The zone of inhibition is measured in mm, where the highest zone of inhibition states the highest antimicrobial activity, whereas no zone indicates negative results for antimicrobial activity. Therefore, after successful incubation for 24 hours, the zone of inhibition was measured by standard protocol and the zone of inhibition that was formed around the sampled well indicated positive results, whereas no zone indicated negative result.

3 Results

The antimicrobial activities done for the respective microorganism as indicated in [Fig. 2] separately for fungi and bacteria resulted in the formation of zone of inhibition, which indicated positive result for the sample A, B and C.

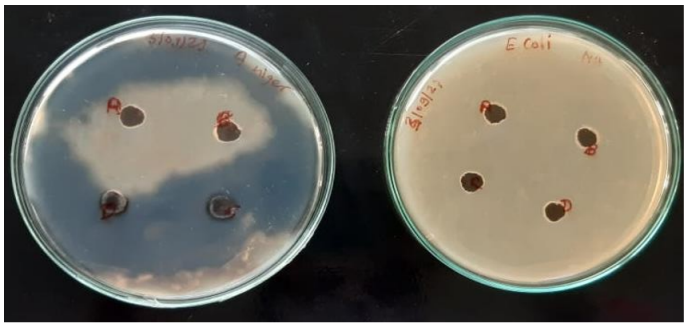


Fig. 2: Zone of clear inhibition formed in Plate A (Test), and growth of microorganism in Plate B (Control)

Photography:

The [Fig. 2] shows the patches of microorganisms grown in between the clear spots. The clear spots indicate the inhibited growth of microorganisms whereas the patches in between are grown microorganisms unaffected by the sample.

Zone of inhibition:

The zone of inhibition counted in mm were 1.8 cm, 2.0 cm, and 2.0 cm respectively for each sample, which indicates the efficiency of the sample in inhibiting the growth of microorganisms which cause severe skin diseases. Fungi like *A. niger, C. albicans*are responsible for the fungal skin diseases whereas bacterial species like *E. coli* and *S. aureus*are pathogenic microorganisms found on skin micro flora causing severe diseases like diarrhea. The inhibition indicates the successful action of the hot water spring against these kinds of pathogenic microorganisms[2].

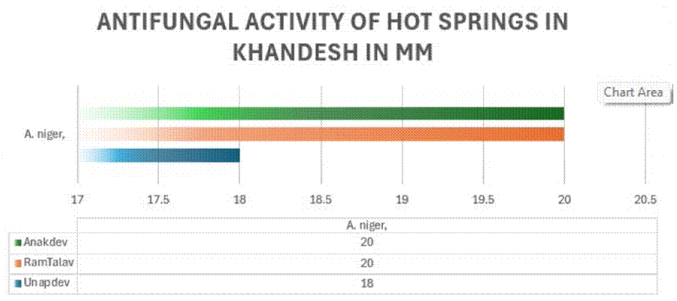


Fig. 3

4 Discussion

On the basis of hot springs temperature, scientifically, hot springs in Khandesh province came in category of hyper thermal hot springs[3]. Such types of hot springs are also found in Thailand, Tibet, Ethiopia, Malaysia, Algeria etc. names are Klong Thom, Huai Nam, Dang National Park Hot spring, Hulu Langat etc. while on the basis of pH, hot springs in Khandesh province detected as in category of an alkaline hot springs because pH levels above 7, indicating or basic environment, these springs are often associated with the dissolution of carbonated mineral or the presences of alkaline earth metal ions[4].

Research beam on antimicrobial activity of hot springs shows, hot springs water samples are potential antimicrobial activity against fungal strains special *A. niger, C. albicans* are responsible for various skin diseases to humans ,which is nowadays done with the help of costly chemical methods. These water samples are effective against pathogenic microorganisms which show its potency against fungal or bacterial diseases that occur on skin[5]. Hence, these water samples can be used in the preparation of formulations against human skin diseases. Same studies reported that hot springs' water has an antimicrobial activity[6]. Hot springs in Khandesh province fall into an alkaline hot springs, therefore, the pH of hot springs water samples seems to be within the normal pH range of raw water (6.5– 8.5) with a shift towards the alkaline condition. Therefore, the pH does not seem to play significant role in anti-microbial activity.

5 Conclusions

Geopharmacology of hot springs in Khandesh region reveals that hot springs have very high potential for therapeutic and medicinal value. The hot springs water can be used for the development of balneotherapy centers[7]. It

can be boost to health tourism industries for the wellness of human being with sustainable economy and health.

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