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Is drinking groundwater in India safe for human health in terms of fluoride? Prof. Shailendra Singh Rathore

Department of Chemistry,

Government PG Girls College, Sirohi, Rajasthan 307001, India shailendrasingh41@gmail.com

Abstract Groundwater has been an invaluable resource for humanity for centuries. India is the world's largest user of groundwater. It is mostly used not only for drinking and cooking but also for miscellaneous domestic purposes and irrigation in agriculture. Hand-pumps, bore-wells, step-wells, and open deep dug-wells continue to be the primary and major sources of groundwater production in India. However, in rural areas of the country, handpumps are the most common and major drinking water sources for households. According to a survey, 42.9% of households in rural areas use hand- pumps as their main source of drinking water, while 40.9% of households in urban areas use piped or surface water as their main source. In rural India, >90% of drinking groundwater sources are naturally contaminated with varying amounts of fluoride. In India, groundwater of 23 out of 37 states and union territories is found to be fluoridated. Among these, 70-100% districts in the states of Andhra Pradesh, Gujarat, Rajasthan, and Telangana and 40-70% districts in the rest of the states have fluoride-contaminated groundwater with maximum permissible levels >1.0 ppm or 1.5 ppm. Such water is not at all safe for human health, even for the health of animals. In fact, drinking such water for a long period of time, a dangerous disease called fluorosis (hydrofluorosis) develops. Due to fluorosis, people's teeth become weak and discoloured (dental fluorosis) and their bones become porous or hollow and weak (skeletal fluorosis). Due to the development of fluoride-induced deformities in various bones, people become hunchbacked and eventually start walking with a limp. These anomalies are, generally, permanent, irreversible, and incurable and persist throughout life. According to the National Programme for Prevention and Control of Fluorosis (NPPCF), the population at risk based on population in habitations with high fluoride in drinking water is >11.7 million in the country. However, NGOs have warned that the threat is far more widespread, affecting more than 60 million people across the country. In the current communication focuses on how safe drinking groundwater is for human health in India and also draws attention to those responsible for addressing this drinking water health problem.

Keywords: Bore-wells, Dental fluorosis, Groundwater, Hand-pumps, Human health, Hydrofluorosis etc.

Introduction:

Groundwater has been an invaluable resource for humanity for centuries. India is the world's largest user of groundwater. It is mostly used not only for drinking and cooking but also for miscellaneous domestic purposes and irrigation in agriculture. Hand-pumps, bore-wells, step- wells, and open deep dug-wells. continue to be the primary sources of groundwater production in India. However, in rural India, the most common and major drinking water sources for households are hand-pumps. Before the 80s, stepwells and open deep dug-wells were the main sources of drinking water in almost every state and union territories of India. Since at that time, outbreak of the disease called dracunculiasis, caused by infection with the human nematode worm, Dracunculus-worm (Dracunculus medinensis), was also high in India, especially in its rural areas.

This disease was spread in the rural areas of many states by drinking the water of these groundwater

sources. To eradicate this disease, thousands of handpumps and bore-wells were dug at various places to provide clean water by closing these traditional water sources. That is why, these water sources are found in abundance in the rural areas of the country.

According to the National Sample Survey (NSS) report on drinking water, sanitation, hygiene, and housing condition, 42.9% of households in rural areas use hand- pumps as their main source of drinking water, while 40.9% of households in urban areas use piped or surface water as their main source [6]. In rural India, >90% of drinking groundwater sources is contaminated with varying amounts of fluoride. In the country, groundwater of 23 out of 37 states and union territories is found to be contaminated with fluoride with varying amounts. Among these, 70-100% districts in the states of Andhra Pradesh, Gujarat, Rajasthan, and Telangana and 40-70% districts in the rest of the states have fluoride-contaminated groundwater [4,5] with maximum permissible levels

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>1.0 ppm or 1.5 ppm [7]. The fluoride distribution with varying level in different states and union territories has been shown in Figure 2. Such water or fluoride containing groundwater is not at all safe for human health, even for the health of domestic animals. Drinking such water for a long time develops a dangerous disease called fluorosis (hydrofluorosis) in human beings [7,]. Due to which the teeth of humans become weak, defragmented, and discoloured (dental fluorosis), while they also become victims of lameness (skeletal or crippling fluorosis) . In fact, these fluoride-induced changes or deformities in teeth and bones are permanent and irreversible and remain in humans for life. More importantly, there is no cure available for these changes. In the current communication focuses on how safe drinking groundwater is for human health in India and also C draws attention to those responsible for addressing this drinking water health problem.

Is Drinking Groundwater Safe for Human Health?

 \mathbf{S} Fluoride has a potential role in the mineralization of developing teeth and is beneficial in preventing dental aries [7]. But when people repeatedly drink water with fluoride levels above 1.0 ppm or 1.5 ppm over a long period of time, it becomes toxic to the body [7]. Due to its toxic effect, many types of physical disorders or deformities develop in humans. These disorders are collectively referred to as fluorosis [7]. This means that people who drink or have been drinking groundwater for a long time have a higher risk of developing fluorosis (hydrofluorosis) than people who drink surface water (ponds, rivers, dams, etc.), which is usually free of fluoride. Because the groundwater of hand-pumps and bore-wells in most rural areas of India is fluoridated, in which the amount of fluoride is more than the safe level or permissible limit, 1.0 ppm or 1.5 ppm. That is why in rural India, wherever the amount of fluoride in groundwater exceeds the prescribed parameters, it is harmful and unsafe for human health. The reason for fluorosis being endemic in most of the rural areas is the groundwater itself, drinking of which this disease is commonly seen in people. According to the National Programme for Prevention and Control of Fluorosis (NPPCF) the population at risk based on population in habitations with high fluoride in drinking water is >

11.7 million in the country . However, NGOs have warned that the threat is far more widespread, affecting more than 60 million people. However, in India, the maximum and outstanding research work on fluoride distribution in drinking groundwater and its chronic intoxication or endemic fluorosis has been done in the state of Rajasthan, especially in the scheduled area where more tribals are residing.

In fluorosis, the teeth become weakened, defragmented, and discoloured light to deep brownish (dental fluorosis) and crippling deformity (skeletal fluorosis) due to diverse bony changes are the main features among fluorosed people. In fluorosis, people's teeth become light to dark brown in colour (Figure 2), and people become disfigured, due to various changes in their bones such as periosteal exostosis, osteosclerosis, osteoporosis, osteophytosis, etc.. These anomalies in the teeth and bones are permanent and last for life. Apart from these, many types of health problems (nonskeletal fluorosis) such as gastro-intestinal discomforts, anaemia, body weakness, polydipsia, polyuria, repeated abortion, impaired reproduction and endocrines, neurological disorders, etc. also develop in people of all age groups from drinking of fluoridated groundwater or suffering with fluorosis [7,]. Although, these fluoride- induced health problems are temporary, however, these are significant and helpful in the diagnosis of chronic fluoride intoxication not only in humans. but also in domestic animals . However, the severity and prevalence of fluorosis depends on many factors other than the amount of fluoride in the drinking water and its duration and frequency of exposure, and density or rate of bio-accumulation. The most common and potential determinants are found to be chemical constituents in drinking water, age, gender, habits, food constituents, environmental factors, and individual susceptibility, biological response or tolerance, health, and genetics. The special thing is that due to the easy availability of water from handpumps and bore-wells, the villagers also started feeding water from these water sources to their domesticated animals, cattle (Bos taurus), water buffaloes (Bubalus bubalis), sheep (Ovis aries), goats (Capra hircus), dromedary camels (Camelus dromedarius), horses (Equus caballus), and donkeys (Equus asinus), due to which these domesticated

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animals also started getting fluorosis disease. Due to which these animal herders are also facing financial loss, which is not known to these people. Not only has this, irrigating agriculture with fluoridated groundwater also caused mild to severe damage to various agriculture crops, which also affects agricultural production or vield. "Overall, fluoridated groundwater in most rural areas of India is unsafe and harmful not only to humans but also to the health of domestic animals and agricultural crops".

How can Fluoride Free Drinking Water be Made Available to the People?

In rural India, fluoride-free drinking water can be provided to the human population at both the community and household or domestic levels by adopting appropriate defluoridation techniques. Although several defluoridation techniques are

🗢 available in India. However, one of them, the Mulgonda defluoridation technique" is most suitable, ideal, appropriate, and effective and is also less expensive . Although, this technique is cheaper and gives better results than other techniques but its success rate at community level is still very poor and at rightarrow many places it is totally failure due to lacking proper monitoring, maintenance, taking responsibility, and perfect handling. However, author believe that instead these efforts, harvesting and conservation of rain water is the most ideal method to get regular fluoridefree water for drinking and cooking purposes in rural communities. Another effective option is to supply treated surface waters from perennial reservoirs, ponds, dams, rivers, etc.

Conclusion

In rural India, the groundwater is used not only for drinking and cooking but also in agriculture sector. Hand-pumps, bore-wells, step- wells, and open deep dug- wells continue to be the principal sources of groundwater production in India. However, the commonest and principal drinking groundwater sources for households are hand- pumps and borewells. The groundwater of most rural areas of 23 out of 37 states and union territories is contaminated with varying degrees of fluoride. Most of the groundwater of these drinking water sources has fluoride beyond the maximum permissible or safe limit, 1.0 ppm or 1.5 ppm. Prolonged use of such water for drinking and cooking is unsafe and harmful for human health and

causes the dreaded fluorosis disease. In fact, fluoridated water not only damages the teeth (dental fluorosis) and various bones (skeletal or crippling fluorosis) of the body, but it also damages various organs (non-skeletal fluorosis) of the body. In the country, > 11.7 million humans are at the risk of this serious fluorosis disease. However, this endemic fluorosis or public health problem can be controlled by providing fluoride free water to the rural population. Such water can be prepared by "Nalgonda defluoridation technology" both at community and household level. Fluoride-free drinking water can also be provided to villagers through rainwater harvesting and conservation, and supply of treated surface water from perennial reservoirs, dams, rivers, etc.

References:

- 1. NSO. Drinking Water, Sanitation, Hygiene, and Housing Condition, National Sample Survey (NSS) report number 584, The National Statistical Office (NSO), Ministry of Statistics and Programme Implementation, Government of India, New Delhi, India. 2019.
- Adler P, Armstrong WD, Bell ME, Bhussry 2. BR, Büttner W, Cremer H-D, et al. Fluorides and human health. World Health Organization Monograph Series No. 59. Geneva: World Health Organization, 1970.
- ICMR. Manual of standards of quality for 3. drinking water supplies. Special report series No. 44, Indian Council of Medical Research, New Delhi, India, 1974.
- BIS. Indian standard drinking water-4. specification. 2nd revision. New Delhi: Bureau of Indian Standards, 2012.
- Medjedovic E, Medjedovic S, Deljo D, 5. Sukalo A. Impact of fluoride on dental health quality. Materia Socio-Medica. 2015 Dec;27(6):395-8.
- Pollick H. The role of fluoride in the 6. prevention of tooth decay. Pediatric Clinics. 2018 Oct 1;65(5):923-40.
- NPPCF. National Programme for Prevention & Control of Fluorosis, National Health Mission, Ministry of Health and Family Welfare, Government of India, New Delhi, India, 2014.

Sharma SL, A brief review of ideal bioindicators, bio-markers and determinants of endemic of fluoride and fluorosis. Journal

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of Biomedical Research and Environmental Sciences. 2020;2(10):920-25.



Figure 1. Map of India showing fluoride (in ppm) contamination of drinking groundwater in different states and union territories (Source: Reference number 5).



Figure 2. A young villager afflicted with severe dental fluorosis due to drinking of fluoridated groundwater in the state of Rajasthan, India characterised with bilateral stratified deep brownish staining of anterior teeth



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