

## Fluoride Levels in Drinking Water from Nine Study Sites in Peninsular Malaysia and Sabah

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**ABSTRACT:** Drinking water from nine areas in Peninsular Malaysia and Sabah were analysed for fluoride. A total of 2067 drinking water samples from 689 households were collected and analysed using a direct reading spectrophotometer model DR/2010 HACH Brand. Water samples from Seri Serdang, Selangor had the highest mean fluoride level, at  $0.71 \pm \text{s.d } 0.12$  mg/L, while water samples from Kota Kinabalu, Sabah had the lowest mean fluoride level, at  $0.08 \pm \text{s.d } 0.06$  mg/L. This is the result of non-fluoridation of drinking water in Sabah. The mean levels of fluoride in water samples were lower than the level recommended by the health authorities, and may not be enough to prevent or eliminate dental caries, which was the main reason fluoride is added into tap water.

**Keywords:** drinking water, fluoride, dental fluorosis, water sample, health

### Introduction

Fluoride is an element which has an important but subtle use to the human health, especially in the area of oral health. It is important during teeth development during teeth calcification in children, and also to prevent dental caries.

Fluoridation of public drinking water system is the last segment in the process of turning raw water from the river into potable water suitable for human consumption. Before the processed water is sent into holding tanks, fluoride in the form of sodium fluoride (NaF) or hydrofluoric acid (HF) is added into the water. Normally, the levels of fluoride that reach households range from 0.5 mg/L to 1.0 mg/L. Fluoridated public drinking water system is by far the most effective way to ensure healthy teeth of the community. This is because water is one of the main nutrients for humans and fluoride readily dissolves into water. Fluoridated drinking water can be classified as a diet that influences the prevention of tooth-related diseases (Ericsson and Ribellius, 1971).

The important period of which fluoride levels must be at the optimum level is when the tooth is being formed during the mineralization process. The period

is 1 to 1.5 years for incisors, 6 years for premolars and 16 – 17 years for molars. Fluoride also may disturb the process of calcification, resulting in fluorosis. Therefore, optimum levels of fluoride are important especially during these periods.

Dean (1954) found that fluoride levels of 1.0 mg/L would not increase the severity of dental fluorosis. However, fluoride levels must be controlled and the standard of 1.0 mg/L is still adhered to until today. Fluoride has the potential to become toxic. As fluoride is used as a means to control and eradicate dental caries, it is important to know the amount of fluoride to be used and the types of treatment for each exposure. The toxic effect of fluoride can be chronic or acute. Acute toxicity will result in death when a person ingests doses of 2.5 g to 5.0 g which is equivalent to 2,500 to 5,000 litres of water containing 1.0 mg/L of fluoride. For dissolved fluoride such as hydrofluoric acid and sodium fluoride, the acute dosage is 2.0 to 10.0 g (Horowitz et al., 1984).

Ingestion of water containing 1.0 mg/L or less of fluoride during tooth calcification may contribute to the emergence of dental fluorosis, but it was not categorized as serious (Jackson et. al, 1995). The World Health Organization (WHO) concluded that at a fluoride level of 0.9 mg/L to 1.2 mg/L, very mild fluorosis occurs (World Health Organization, 1997).

A Ministry of Health Malaysia (MOH) report indicated that 62.2% of the Malaysian public receives processed water with artificial fluoridation and the levels are at 0.5 mg/L to 0.9 mg/L (Ministry of Health, Malaysia; 1996). Another study by the

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Ministry of Health Malaysia in the year 2002 showed that fluoride levels in a few Malaysian states were above the recommended levels and this may be a factor contributing to the higher prevalence of dental fluorosis among the people (Ministry of Health Malaysia, 2002).

The aim of this report is to determine the level of fluoride in water samples collected, and to ascertain whether the levels are above or below the levels recommended by the health authorities.

**Methodology**

A total of 689 households took part in this study, which was part of wider study to determine the levels of fluoride in drinking water and whether there were any significant relationships to dental fluorosis. A total of 9 areas were selected, where the main criteria was that water was used for drinking and cooking purposes. Drinking water samples were collected

using pre-cleaned HDPE bottles for 3 consecutive days, and were analyzed within 72 hours using a direct reading spectrophotometer HACH Brand model DR/2010.

The areas chosen (FIG. 1) for the studies were:

1. Seri Serdang, and Serdang, Selangor
2. Masjid Tanah, Melaka
3. Kuala Kangsar, Perak
4. Kajang, Selangor
5. Pasir Mas, Kelantan
6. Bangsar, Kuala Lumpur
7. Kuala Terengganu, Terengganu
8. Kota Kinabalu, Sabah

**Results**

A total of 2067 samples were analysed for fluoride (TABLE 1). The range and means of fluoride in water samples can be seen in TABLE 2.

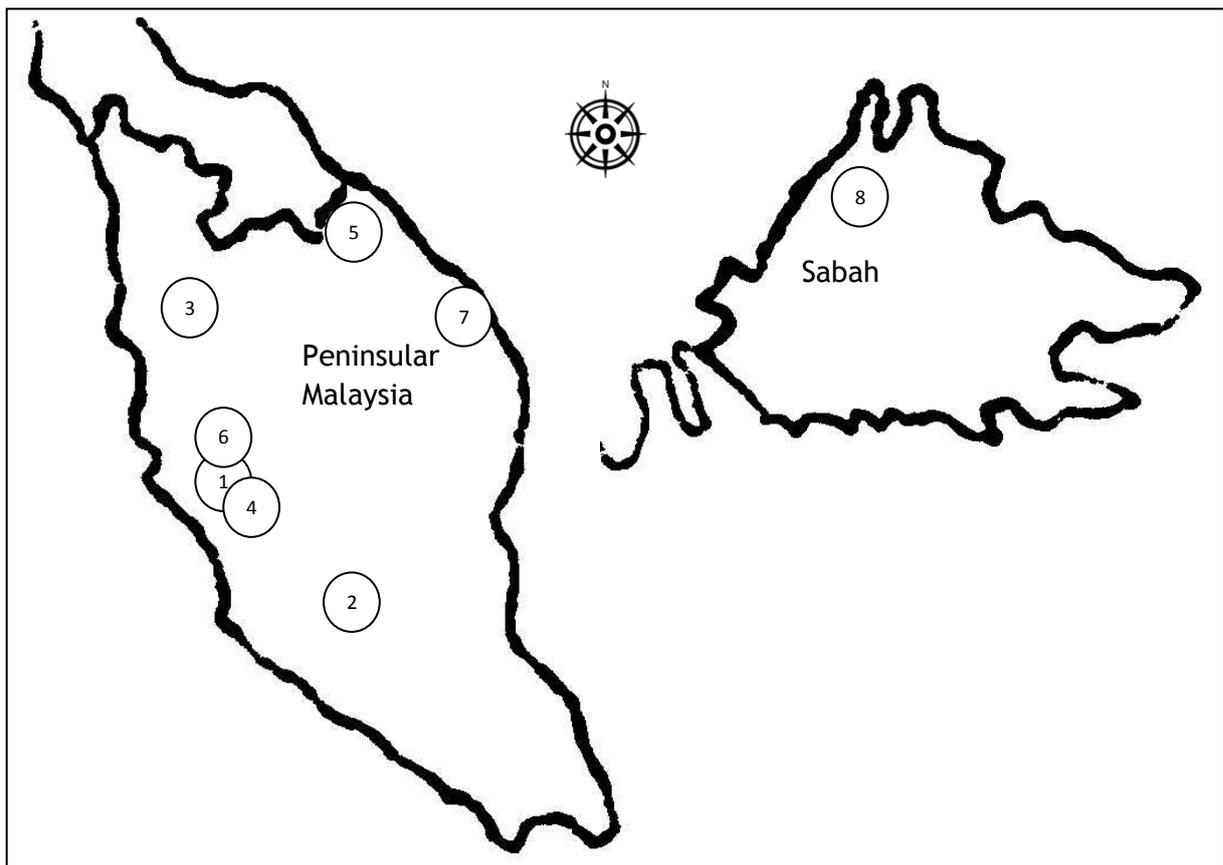


FIG. 1- Location of study sites

TABLE 1: Type of water samples and number of samples

Type of water sample	No. of samples
Public tap water	2067

TABLE 2: Range and mean of fluoride in study sites

No	Area	Range of fluoride level (mg/L)	Mean of fluoride level (mg/L)
1	Seri Serdang, Selangor	0.68 – 0.89	0.71 ± sd 0.12
2	Masjid Tanah, Melaka	0.03 – 0.30	0.18 ± sd 0.06
3	Serdang, Selangor	0.55 – 0.80	0.64 ± sd 0.07
4	Kuala Kangsar, Perak	0.12 – 0.90	0.40 ± sd 0.16
5	Kajang, Selangor	0.35 – 0.81	0.62 ± sd 0.09
6	Pasir Mas, Kelantan	0.24 – 0.85	0.44 ± sd 0.02
7	Bangsar, Kuala Lumpur	0.05 – 0.78	0.36 ± sd 0.16
8	Kuala Terengganu, Terengganu	0.07 – 0.62	0.34 ± sd 0.13
9	Kota Kinabalu, Sabah	0.00 – 0.36	0.08 ± sd 0.06

## Discussion

Mean fluoride levels in all 9 study sites were lower or within the level recommended by the Ministry of Health, Malaysia, which is at 0.5 – 0.9 mg/L. The highest fluoride level was found in Seri Serdang, Selangor with a mean of 0.71 ± sd 0.12 mg/L, while the lowest mean was found in Kota Kinabalu, Sabah, at 0.08 ± sd 0.06 mg/L. The low level was a result of non-fluoridation of drinking water in Kota Kinabalu by the local health authorities. Sabah is the only state in Malaysia that does not have artificial fluoridation of drinking water.

A study in Pakistan to map natural fluoride in drinking water, where samples from 987 water supplies were analyzed, showed that 84.0% contained less than 0.7 mg/L of fluoride. This showed a clear indication for use of alternate sources of fluoride to ensure optimal intake necessary for the control of dental caries (Ayyaz and O'Mullane, 2002).

In an investigation to determine the level of fluoride concentration in a rural district of Togtok county, inner Mongolia Autonomous Region, China, Wang et al (1999) found that 62% of wells used for water supply had a fluoride level of higher than 1.5 mg/L, and the highest value was 8.0 mg/L. There were signs of dental and skeletal fluorosis in a village where fluoride concentration was extremely severe.

Alabdula'aly (2004) reported that in Riyadh, the capital city of Saudi Arabia, where 34% of the total water demands comes from groundwater supply, and the other 66% is desalinated seawater, the fluoride range in the influent at the 7 groundwater treatment plants and final products were in the range of 0.63 to 1.6 and 0.23 – 1.1mg/L, respectively. Blending of the finished water with desalinated seawater resulted in the fluoride levels ranging from 0.01 – 0.5 mg/L in the distribution network. The authors thus recommend that fluoridation be considered in water treatment plants since the fluoride levels in drinking

water supply is below the optimum level of 0.7 – 1.2 mg/L.

## Conclusion

The mean levels of fluoride in drinking water samples were lower than the level recommended by the health authorities. This may not be enough to prevent or eliminate dental caries, which was the main reason fluoride is added into tap water.

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