ENVIRONMENTAL FLUORIDE LEVEL IN ANEKAL TALUK OF BANGALORE DISTRICT.

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ABSTRACT

The objective of the study was to evaluate the fluoride concentration in ground water, vegetables and cow's milk in 25 locations of Anekal Taluk, Bangalore Karnataka. The Groundwater is the main source of drinking water for a major part of the population. The concentration of fluoride in ground water, cow's milk and vegetables varied 0.48 - 21.50 mg/L, 0.13-0.35 µg/mL and 1.8-296 µg/g. The pH of the water samples varied between 6.0 and 8.5. Majority of the samples do not comply with Indian as well as WHO standards for most of the water quality parameters measured. It was also found that the concentration of fluoride was higher in Cabbage than the other vegetables analysed[9]. Fluoride levels in Ground water in all locations was lower than the standard values except in industrial locations such as Gudanahalli , Madivala, Chandapura, Jigani, Kadujakkanahalli, Garatiganabele ,Thimasandra, Kavalahosahalli, Naganayakanahalli was high ranging from7.16 and 21.50 mg/L . The highest F content was characteristic of Cabbage ***(Brassica oleracea)*** *samples 296 µg/g dry weight from Jigani Station , the lower one was found in Pumpkin* ***(Curcubita Maxima.)*** *1.6 µg/g dry weight The highest fluoride concentration in the milk samples examined was 0.35 µg/mL from Jigani Station.*

Keywords: F*luoride pollution; Groundwater; Cattle; vegetables*

INTRODUCTION

The source of fluoride in groundwater is mainly due to the fluoride bearing materials like fluorspar, cryolite, fluorapatite, sellaite etc. These fluoride minerals are generally insoluble in water. Fluorides in water will be present only when conditions favour their presence. The effect of excess fluoride in drinking water on human beings leads to Fluorosis. This is a condition of Fluoride accumulating in bones. The skeletal fluorosis affects the young and old alike. Fluoride can also be harmful for pregnant women and breast feeding women. The disease causes pain in bones, stiffness of back bone etc. Fluorosis can also affect the teeth. It turns teeth to yellow and patches. These may lead to brown horizontal streams on the teeth. The teeth may also affect the whole tooth, get pitted perforated and ultimately chipped off. Apart from these two major effects of Fluorosis, other ailments are also reported viz, Neurological, muscular allergic manifestations. It may also said to cause gastro intestinal problems.[1-4] The atmosphere contains very small amounts of fluorine. However the content of fluorine is high in industrial areas, especially near aluminium plants and near factories manufacturing super phosphate fertilizers. The magmatic gases contain 95 per cent steam and may contain very small quantities of fluorine. Concentration of F– between 0.6 to 1.0 mg/l in potable water protects tooth decay and enhances bone development. Indian drinking water standards have suggested permissible limit of F– in drinking water at 1.0 mg/l, which is lower than the maximum tolerance limit (1.5 mg/l) of F^- in drinking water specified by WHO[6]. Ingestion of water with F^- concentration above 1.5 mg/l results in fluorosis. Presence of fluorides in drinking water is reported from many states in India. From Karnataka the presence of fluoride is reported in 21 districts.[10]
Fluorides are general protoplasmic poisons. The sources of fluorine intoxication are drinking water containing 1 ppm or more of fluorine, fluorine compounds used as insecticidal sprays for fruits and vegetables and the mining and conversion of phosphate rock to superphosphate, which is used as fertilizer. The fluorine content of phosphate rock, about 25% of the fluorine present, is volatilized and represents a pouring into the atmosphere of approximately 25,000 tons of pure fluorine annually. The

known effects of chronic fluorine intoxication are those of hypophasia of the teeth, which has been called mottled enamel, and of bone sclerosis.
Fluoride is essential in small quantities for the prevention of dental caries especially in children[5]. Therefore, it is a common practice to add very low concentrations of fluoride to tooth pastes and drinking water (less than 1ppm) at places where there is a natural deficiency of flourides. Skeletal and dental fluorosis Skeletal fluorosis, which has a crippling effect on the individual, occurs due to the deposition of fluoride in the bones. The most sensitive effect, "tooth paste mottling", occurs at very low concentrations of 0.8 ppm to 1.6 ppm.
Skeletal fluorosis occurs if 2 to 80 ppm of fluoride is ingested daily for a period of more than 10 years. Fluoride gets deposited in the bones, and so do lead (Pb) and strontium (St). The deposition on the bones is due to the surface chemistry of the bones where an exchange takes place between the surface of the bone and the fluid which is in contact with the bone[7-9]. The "Hydroxyaptite" crystals in the bone are mainly involved in this exchange. The fluoride (F-) ions have a similar charge when compared to the hydroxyl ions (OH-) and therefore replace
the OH- of the hydroxyaptite crystals and thus get deposited in the bone. (Casarett & Doull, 1986). Groundwater occurs under phreatic conditions in the weathered zone, fractured and vesicular basalts (shallow aquifer) and under semi-confined to confined conditions in
the fractured zone (deep aquifer). The depth to water level varies from 2 to 10.2 m below ground level (bgl) in shallow aquifers and from 21 to 50.50 m (bgl) in deeper aquifers.
Rainfall is the main source of groundwater recharge.

EXPERIMENTAL

Study Area

Anekal is a taluk of Bangalore district. It lies in the southern part of Bangalore metropolitan area around 40 Kilometres from downtown. Kannada is the spoken language. Anekal is located at 12.7° N 77.7° E. It has an average elevation of 915 meters. Electronic city the pride of India and hub of Bangalore's Information Technology companies is situated in Anekal Taluk. It is home to the Jigani Industrial Estate. Anekal is known for its Silk industry and is home to a number of Skilled Weavers. Water as a resource, basic amenity and universal solvent is shared by population. The ground water was collected from the borewells located in these stations during the months of June 2008 to August 2008. The depth of the bore wells ranged from 100-240 feet in all these stations. The sampling locations and their physicochemical characters are shown in Table 1.Water samples were collected from wells, of 25 villages covering in Anekal Taluk. The quality of groundwater has been made through the analysis of pH, colour, electrical conductivity, total dissolved solids, alkalinity, chlorides, total hardness, calcium, fluoride, nitrate and sulphate. The Fluoride level was assessed in of radish *(Raphanus sativas* L.) Pumpkin *(Curcubita Maxima.)*, Cabbage*(Brassica oleracea),* and Turnip *(Brassica .rapa) which w*ere randomly collected from the cultivated areas. All samples were collected and stored in polythene bags according to their type and brought to the laboratory for study area.

Samples Study

The samples were collected in clean polythene bottles without any air bubbles. The bottles were rinsed before sampling and tightly sealed after collection and labelled in the field. The temperatures of the samples were measured in the field itself at the time of sample collection. The samples were kept in refrigerator maintained at 4^{o}C. The chemical analysis of the samples was carried out for 25 stations of Anekal taluk, Bangalore in triplicates. Samples were analyzed for parameters namely pH, Specific conductivity, Calcium, Magnesium, Carbonate, Bicarbonate, Chloride, Fluoride and Nitrate using the standard chemical analytical techniques[1,3], and the results are presented in Table1.
Cattle had played a pivotal role in the upliftment of human culture and civilization. Besides being used mainly as a beast of burden and ceremonial animal in prehistoric and historic time, cattle were also used as a rich source of protein and fat. The present-day domestic cattle are broadly classified into two groups:

zebu (humped) and taurine (humpless), which are scientifically referred as *Bos indicus* and *Bos taurus* respectively.

Fresh milk samples (taurine-cattle) in triplicate were collected from 10 different locations Milk was thawed to room temperature, the samples were diffused overnight. Fluoride concentration was determined using an ion-selective electrode (Orion 210A apparatus and TISAB III buffer) by the microdiffusion method[9], ie., by adding 1 ml of deionized water into 1 ml of milk in a 10 cm plastic dish followed by 2 ml of 5M perchloric acid saturated with hexamethyldisiloxane. One ml of 0.1 M sodium hydroxide solution was added into a 3 cm plastic dish as the trapping solution. This dish was then placed on the 10 cm dish with a cover and immediately sealed to prevent air leakage and subsequently incubated at 40ºC with continuous shaking by rotary motion at 100 rpm for at least 12 hours. One ml of deionized distilled water was added into the trapping solution and the pH was adjusted with TISAB III solution.

Vegetable samples in triplicate of radish *(Raphanus sativas* L.) Pumpkin *(Curcubita Maxima.),* Cabbage*(Brassica oleracea),* and Turnip *(Brassica .rapa) w*ere randomly collected from the cultivated areas. All samples were collected and stored in polythene bags according to their type and brought to the laboratory for preparation. Samples were oven-dried in paper sacks at 80^{o}C for 40 hours, finely ground and placed in an acid-cleaned plastic beaker and 1 mL of analytical grade acetone was added for wetting the dry material. Most of the acetone was allowed to evaporate from the sample and, 20 mL of 0.05 N nitric acid solutions was added. This mixture was stirred for at least 30 min with a magnetic stirrer, followed by 20 mL of 0.1 N potassium hydroxide solution was added and stirred for an additional 30 min. Finally, 5 mL of 0.2 N nitric acid solution was added along with 5 mL of 0.4 M sodium citrate solution (pH 5.5). Samples from at least two different digests were analyzed in triplicate using an ion-selective electrode.

RESULTS AND DISCUSSION

The results of the physico-chemical analysis of the groundwater samples from 25 stations collected are presented in Table 1.pH is considered as an important ecological factor and provides an important piece factor and piece of information in many types of geochemical equilibrium or solubility calculation. pH is an important parameter in water body since most of the aquatic organisms are adapted to an average pH and do not withstand abrupt changes. The pH values were between (5.9-6.2) Naganayakanahalli, Indlivadi , Mayasandra , Baesthanahalli and Madivala and between (8.3-9.3) in Thimasandra ,Gudanahalli, Chandapura and ,Jigani Stations . Generally pH of water is influenced by geology of catchments area and buffering capacity.

The samples have electrical conductivity (EC) values in the range of 197 to 1780 mS/cm. The value of alkalinity in water provides an idea of natural salts present in water. The cause of alkalinity is the minerals which dissolve in water from soil. The various ionic species that contribute to alkalinity include bicarbonate, hydroxide, phosphate, borate and organic acids. These factors are characteristics of the source of water and natural processes taking place at any given time **.**The standard desirable limit[5] of alkalinity in potable water is 120 mg/L. The maximum permissible level is 600 mg/L. The values of alkalinity in the ground water of Anekal Taluk under the desirable limit in all stations except Madivala, Kuvempunagara ,Muthukatti , Maenasinahalli ,Vanakanahali (672-900). The observed total hardness values were well within the limits except Thimasandra and ,Samandhur,(840 and 9325 mg/L).

The values of total dissolved solids in the ground waters of Anekal Taluk ranged between (128-2000 mg/L) are with the desirable limits. Calcium was under the desirable limits in all station except in Soluru, Maenasinahalli, Vanakanahali (254,256 and 286 mg/L).Calcium concentrations were found to vary from 66 to 287 mg/L. Maximum was in Vanakanahali (287mg/L) The calcium hardness observed in all the 25 stations are well within the desirable limits. Similarly, sodium (Na^{+}) concentration ranges from 12 to 128 mg/l. The concentration of chloride (Cl^{-}) is also within the permissible limits. The F^{-} concentration ranges from 0.90 to 13.41 mg/l.[11] Fluoride levels in Ground water in all locations was lower than the standard values except in industrial locations such as Gudanahalli , Madivala, Chandapura, Jigani, Kadujakkanahalli, Garatiganabele ,Thimasandra, Kavalahosahalli, Naganayakanahalli was high ranging from7.16 and 21.50 mg/L . Therefore Fluoride level was measured in these 8 stations for, cow's milk and vegetables. It varied between 0.13-0.35 µg/mL and 1.8-296 µg/g. The highest F content was characteristic

of Cabbage ***(Brassica oleracea)*** samples 296 µg/g dry weight from Jigani Station , the lower one was found in Pumpkin ***(Curcubita Maxima.)*** 1.6 µg/g dry weight The highest fluoride concentration in the milk samples examined was 0.35 µg/mL from Jigani Station.

CONCLUSIONS

Fluorine may affect the food components taken from soil by plants in various ways. It is also known that nitrogen and phosphorus, as well as K^+, $Mg^{2+}$and Ca^{2+} increase vegetables' immunity to fluorine toxicity. Fluorine is an inhibitor of a series of enzyme, including vegetable enzyme, and it fixes covalently with protein. The results of the present study show that the F level of some vegetables can be markedly influenced by the F content in irrigation water. All vegetables do not accumulate F to the same extent and variations among vegetables are significantly high.

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Table-1: Chemical Composition of groundwater in 25 stations of Anekal Taluk, Bangalore.

Sl. No.	Sample locations	pH	EC(mS/cm at 25°C)	TDS	Ca^{2+}	Mg^{2+}	Alkalinity	Total Hardness	Cl^-	F^-	NO^{3-}	SO_4^{2-}
				mg/L								
	Standard Limit	6.5 to 8.5	-	1500 - 3000	200	100	600	600	1000	1.5	100	400
1	Hompalagatta	7.12	197	128	66	12	66.0	180	7.09	0.48	123	347
2	Gudanahalli	8.5	1780	1157	206	353	304	647	572	11.4	134	245
3	Samandhur	8.3	201	1190	167	34	563	840	647	1.85	156	298
4	Thimasandra	8.4	234	128	154	56	345	932	200	8.74	101	156
5	Madivala	6.2	168	452	208	66	672	784	207	18.3	54	145
6	Muthukatti	7.5	231	462	167	52	732	656	205	7.16	94	167
7	Kuvempunagara	7.4	246	1187	135	78	695	631	365	0.95	156	300
8	Karpuru	7.4	276	1158	165	125	500	675	359	0.78	123	450
9	Haldenahalli	7.5	254	670	174	376	324	634	452	0.86	145	500
10	Baesthanahalli	6.1	276	530	185	346	432	456	524	1.1	165	357
11	Mayasandra	6.0	254	435	203	34	459	562	256	1.24	121	387
12	Sunavara	7.5	1765	470	205	56	459	638	198	1.45	145	200
13	Vanakanahali	7.2	211	520	287	76	900	744	178	1.36	178	187
14	Maenasinahalli	7.4	220	418	256	85	854	700	146	1.42.	34	194
15	Soluru	7.9	225	1186	254	99	320	692	249	0.56	56	156
16	Gouraenahalli	8.1	227	1156	145	105	400	452	257	1.51.	75	194
17	C.D.Hosakottae	8.1	228	1148	162	125	472	200	342	0.42	198	520
18	Indlivadi	6.0	223	1193	175	134	542	320	321	0.57	187	182
19	Kavalahosahalli	6.5	225	1145	177	154	430	432	421	5.85	195	341
20	Chandapura	8.6	1755	2000	139	165	678	600	523	21.5	54	342
21	Naganayakanahalli	5.9	245	566	156	166	444	602	986	4.75	156	178
22	Kadujakkanahalli	7.6	263	573	148	176	453	605	674	11.8	178	195
23	Jigani	9.28	1635	578	145	134	498	625	632	21.3	189	178
24	Garatiganabele	5.9	211	1345	169	58	456	603	723	11.1	201	144
25	Chikkahosahalli	7.8	222	1367	130	76	200	225	203	1.35	934	98

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Table-2 : Fluoride concentration in biological parameters of 10 stations of Anekal Taluk, Bangalore.

Sl. No.	Sample location	Cow's Milk	Cabbage(*Brassica oleracea)*	Pumpkin *(Curcubita Maxima.)*	radish *(Raphanus sativas* L.)	Turnip *(Brassica .rapa)*
		µg/mL	µg/g dry weight			
1	Gudanahalli	0.34	98	2.8	7.2	8.9
2	Madivala	0.13	284	3.2	120	7.5
3	Chandapura	0.28	276	3.5	77.9	12.5
4	Jigani	0.35	296	2.7	145.5	136.0
5	Kadujakkanahalli	0.13	254	1.8	2.5	34.6
6	Garatiganabele	0.25	234	1.6	2.5	43.5
7	Thimasandra	0.34	198	2.0	2.7	32.5
8	Muthukatti	0.13	176	2.5	48.5	17.0
9	Kavalahosahalli	0.27	145	2.5	34.5	14.6
10	Naganayakanahalli	0.24	139	2.7	44.0	11.5

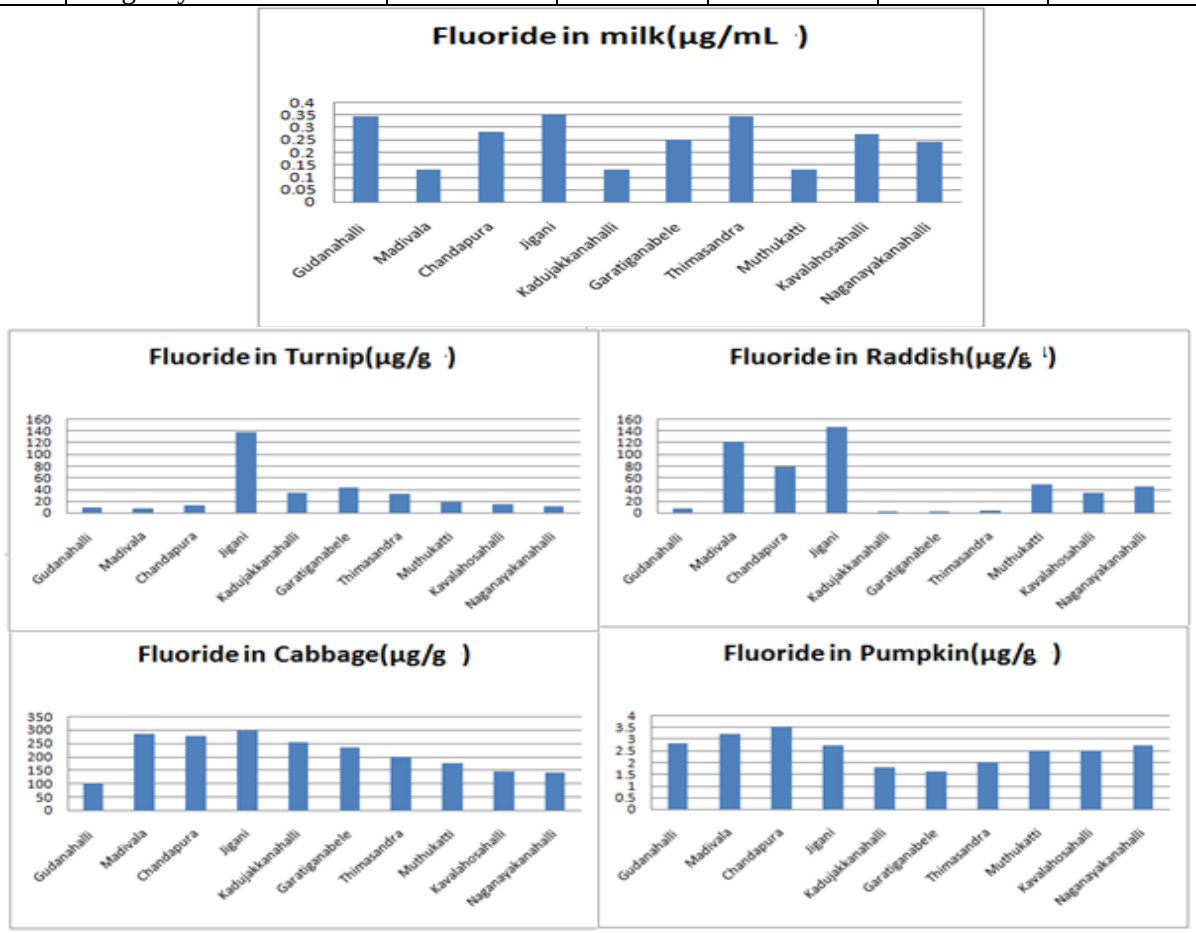

Fig.-1: Showing Physico-chemical parameters in 25 Stations of Anekal Taluk, Bangalore .

Fig.-2: Showing Concentration of Fluoride in Cattle and in Vegetables of 8 Station of Anekal Taluk

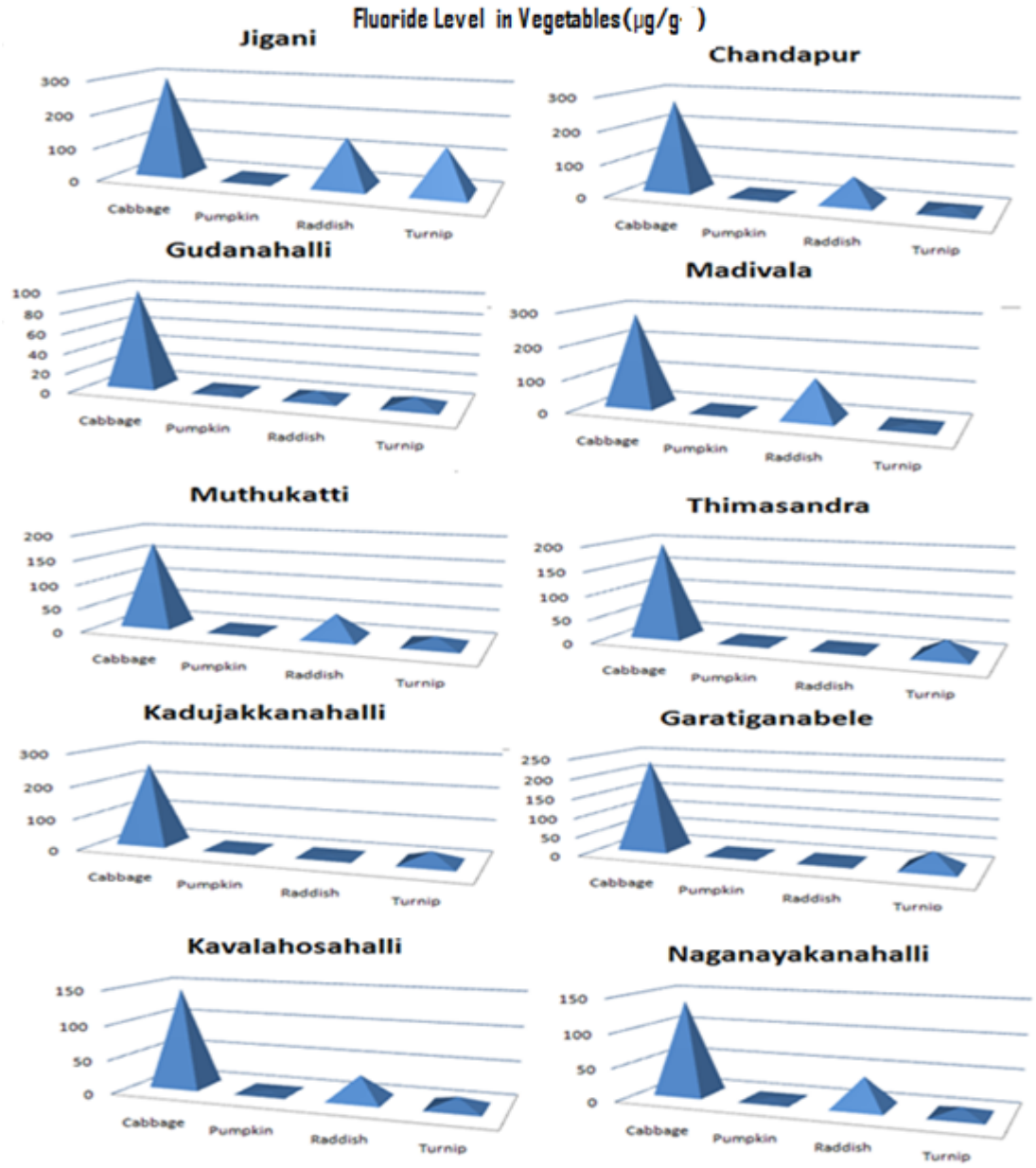

Fig.-3: Showing Concentration of Fluoride in Vegetables, Station –wise of Anekal Taluk

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