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STUDIES ON CHRONIC FLUOROSIS IN DOMESTIC BUFFALOES

(with 3 tables and 6 figs.)

By

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دراسات إكلينيكية على التسمم بالفلورين في الجاموس

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أجريت هذه الدراسة على عدد ٥٠ جاموسة بلدى متقاربة الأعمار (٥ ـ ٨ سنوات) من على أبعاد ومناطق مختلفة من مصنع السوبر فوسفات في أسيوط وذلك لبيان مدى تأثير أحد مخلفات المصنع الهامة وهو غاز الفلورين على صحة الحيوانات التى تربى في تلك المناطق وقد إشتملت الدراسة على تحديد نسبة الفلورين (جزء في المليون) في كل من مصادر الغذاء الرئيسية للحيوانات (البرسيم والتبن) ومصادر مياه الشرب بتلك المناطق ، ودراسة الأعراض الإكلينيكية وعلاقتها بمستوى الفلورين في مصل الدم . وقد إتضح من الدراسة مايلى: ظهرت الأعراض الإكلينيكية على معظم الحيوانات متمثلة في ضعف البنية والهزال وصعوبة أثناء التحرك وعرج بعض الحيوانات مقرونا بزوائد عظيمة أسفل مفصلى الركبة والعرقوب ـ لوحظ تلون أسنان الحيوانات المصابة باللون البنى بدرجات مختلفة حسب شدة الإصابة بالإضافة إلى تآكل بعض الأسنان وتعرضها للسقوط . ـ إرتفاع مستوى الفلورين في مصل دم الحيوانات المصابة عن مثيلاتها التى لم تظهر عليها الأعراض الإكلينيكية ـ إرتفاع معنوى في نسبة الفلورين في مصادر مياه الشرب وبعض مصادر الغذاء بجميع المناطق تحت الدراسة والتى أعتبرت مسئولة عن ظهور الأعراض الإكلينيكية في الحيوانات المصابة .

SUMMARY

Various clinical signs of fluorine intoxication appeared on buffaloes grazing nearby Menqabad Superphosphate Plant. These signs included loss of appetite, dryness of skin and stiffness emaciation. Saining, mottling and excessive wearing of the teeth was also noticed. Elevation of fluoride in serum, feed stuffs, water sources at all localities rather than control area was evident. As a conclusion, the prenent study pointed out the importance of prevention of environmental pollution by fluorides to animal health and production.

INTRODUCTION

Chronic industerial fluorosis has been reported in many countries in areas adjacent to industerial plants. GREEN (1946) stated that the leaves of the plants may absorb

fluorine and collect some of contaminated dust on their surfaces. BODDIE (1955) established a relationship between the degree of contamination and the severity of resulting fluorosis. OCKERSE (1941) observed mottled enamel and excessive attrition in teeth of cattle reared on water supply of.12 p.p.m fluorine content. Majumdar et al (1946) indicated that fluorine content of the blood appreciably increases with the ingestion of large amounts of fluorides. AGATE et al, (1949) in their studies on chronic fluorsis in cattle, noted a gradation in the fluorine content of the soil and plants with increasing distance from aluminium plant emitting fluorine fumes. The authors recorded that the forage samples nearby the factory contained 20 to 100 p.p.m. fluorine.

Symptoms of chronic fluorosis:

Variations in the effects produced by ingestion of fluorine in domestic animals, depends upon the rate of ingestion. BODDIE (1947) recorded that ingestion of small amounts of fluorine my produce only dental changes which involve permanent teeth. The author added that mottling of incisor enamel, thining, wearing away with upper edge project little above the gum level were almost chracterestic of dental fluorosis. If contamination is heavy, there will probably be signs of generalized effects as loss of appetite, stiffness, lameness and articular pain.

Agate et al (1949) found marked chronic fluorosis in cattle with symptoms of excessive tooth wear, lowered weight gain, loss of milk production and general poor health. SCHMIDT and RAND (1952) stated that the most sensitive clinical index to fluoride toxicity was mottling, staining and excessive wearing of permanent teeth. TOWERS (1954) recorded the chief clinical signs of fluorosis in severely, affected cattle is lameness. CRISSMAN et al (1979); SHUPE et al (1983) and SUTTIE et al (1985) studied fluorosis in cattle and reported that dental lesion was the most obvious external sign. It includes brown discolouration, mottling, attrition, bulging of gingva and delayed eruption of permanent incisor teeth.

The aim of the present study was to investigate the clinical manifestations of fluorosis in buffaloes, supported by determination of fluoride in serum, feed stuffs and water sources.

MATERIAL and METHODS

Materials:

A total number of 50 Egyptian buffaloes were examined in the present study. Age of examined animals ranged between 5 and 8 years. The animals were selected from different areas around Manquabad Superphosphate Factory (Fig. 1), Assiut Governorate where suspicion of environmental pollution from the factory by products specially fluorine compounds was evident. By clinical and laboratory investigation 28 buffaloes showed the clinical signs of chronic fluorine intoxication and the rest animals were proved to be clinically healthy. Animals of control group were chosen from area about 15 km far away from the factory.

Methods:

Blood samples were collected in a clean, sterile centrifuge tubes. The cloted blood samples were centrifuged at 3000 r.p.m. for 30 minutes (COLES, 1980) and non haemolysed blood serum samples were stored and then used for determination of fluoride level (p.p.m) by aid of the method described by FRAY and TAVES (1970), using expandble ion analyzer E.B. 920, Orion Research. Drinking water and feeding stuff samples were collected from various localities and analysed according to the methods of FRAY and TAVES (1970) and PEARSON (1972) respectively.

The obtained data were analysed according to the method of SNEDECOR and COCHRAN (1974).

RESULTS

The clinical signs of diseased animals were loss of appetite, rough hair, elongated claws, emaciation and weakness and general poor health. Dental lesion was very obvious and teeth showed mottling, brownish discolouration, pitting, fast wearing and attrition of the perminant teeth (Fig. 3-6).

Biochemical analysis for the determination of blood serum level of fluoride in buffaloes grazing around the factory was presented in table (1). Fluoride level, in feeding stuffs and water supplies were presented in table (2 & 3).

DISCUSSION

Clinical signs of chronic fluorosis were recorded in many countries, in areas adjacent to industerial plants emitting fluorine containing gasses (ALLCROFT, 1954). When agriculature and manufacturing plants are in close proximity, there is always a danger of contamination of livestock, feed stuffs and water supplies with toxic materials (TOWERS, 1954). Cattle are the most sussciptible of the farm animals to chronic fluorine poisoning (RADELEFF, 1970).

From our field investigation, examined animals showed variations in obvious clinical symptoms depending upon the distance from the factory. Therefore while animals in Abnoub (15 kms far away from the factory) did not show any objective symptoms and were apparently healthy, animals in the other localifties showed clinical signs of fluorosis in general. This appeared in loss of appetite, dryness of the skin and stiffness, poor condition of the coat, decreased weight gain, emaciation, and general poor health. Dental lesions were very obvious specially in animals grazing nearby the factory. The teeth lesions varied from slight staining of the incisors up to complete attrition (Fig. 3:6). Other teeth lesions were slight to severe mottling or brown discolouration. These symptoms were commonly mentioned in fluorotic cattle and sheep (BODDIE, 1947; RAND SCHMIDT, 1952; RADELEFF, 1970; SUTTIE and FALTIN, 1971, SHUPE, et al. 1983 and SUTTIE, et al. 1985 a). The authors concluded that the most sensitive signs of absorption of abnormal amounts of fluorine are dental fluorosis. TOWERS (1954) on the contrary

stated that the most obvious symptom in cattle was lameness which may be very severe with marked seasonal incidence.

FRAY and TAVES (1970) stated that the determination of serum fluoride level confirms the previous exposure to fluoride compounds. SUTTIE and FALTIN (1973) explained that analysis of fluoride level in serum or plasma was related to their concentration in ration or rate of ingestion.

Depending upon the distance of examined localities serum fluoride level in buffaloes was variable (table 1). At distance less than 2.5 km (Gaz. El-Akrad, Ezbet-Mohamed and El-Tawabiya) buffaloe serum fluoride level was 2.5±2.6, 1.7±0.2 and 2.4±1.03 p.p.m respectively. Animals living at rather far distance (up to 4 km) had also rather high serum fluoride value of 1.6±0.6 p.p.m. Animals grazing at (15 km) far from the factory were comparatively normal in serum fluoride level (0.7±0.08 p.p.m). The obtained results were in agreement with BODDIE (1947), KAHL and KLEWSKA (1974) and EWY, et al. (1976) in cattle. Those authors concluded that the levels of serum fluoride depends mainly upon the distance from the source of contamination as well as the wind direction. This fact was emphasized here by feed stuffs analysis and estimation of fluoride level in water sources of examined localities (table 2 & 3). The tables revealed that the levels of fluorides in feed stuffs and water supplies were dependant on the locality of examination. High fluoride level in both feed stuffs and water sources was explained on the basis that hydrofuoric acid (HF) that is emitted in gaseous state from Manqabad super-phosphate factory, carried away by wind, dropps on fooders and water sources and thus contaminating them. High levels of fluoride in barseem (4.33±1.03 to 28.00 p.p.m), hay (3.95±1.09 to 18.00 p.p.m) and water (2.00±0.56 to 6.00±0.56 p.p.m) were incriminated in this study, for the appearance of clinical signs of fluorosis in buffaloes. A close relationship between obvious symptoms and the average fluorine contamination of barseem, hay and water sources in such animals was thus existed. This agreed with previous data obtained by IBRAHIM (1983) at the same localities. Similar observations were recorded by AGATE, et al. (1949); TOWERS (1954); BODDIE (1955); CRISSMAN, et al. (1979); SHUPE, et al. (1983) and SUTTIE, et al. (1985 a).

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Table (1)
Serum fluoride level of tested animals in the vicinity of super-phosphate factory (p.p.m)

Area	Distance from the factory "km"	Mean serum fluoride level (p.p.m)
Gaz. El-Akrad	Adjacent to the factory	3.5**±2.6
Ezbet-Mohamed	1.5 - 2.5	1.7* ±0.2
El-Tawabiya	0 - 0.75	2.4**±1.03
Manqabad	1 - 2	1.7 ±0.2
Elwan	1.75	1.1 ±0.2
El-Willidiya	4	1.6 ±0.6
Abnoub	15	0.7 ±0.08

* : Significant (P/ 0.05).
* : Highly significnat (P/ 0.01).

Table (2)
Fluoride levels (p.p.m) on dry matter basis infeeding stuffs at various lacalities from the super-phosphate factory

Areas	Dist. from the factory (km)	Barseem	Hay
Gaz. El-Akrad	0.0-1.5	4.33± 1.03	3.96±1.09
Ezbet-Mohamed	1.5-2.5	12.00± 1.400	5.28±2.19
El-Tawabiya	0.0-0.75	22.00±17.32	12.67±16.77
Manqabad	1-2	28.00± 0.00	22.00± 0.00
Ilwan	1.75	26.67± 2.31	27.00± 0.00
El-Willidiya	4	8.00± 2.00	4.00± 2.00
Abnoub	15	4.03± 1.53	3.33± 2.31

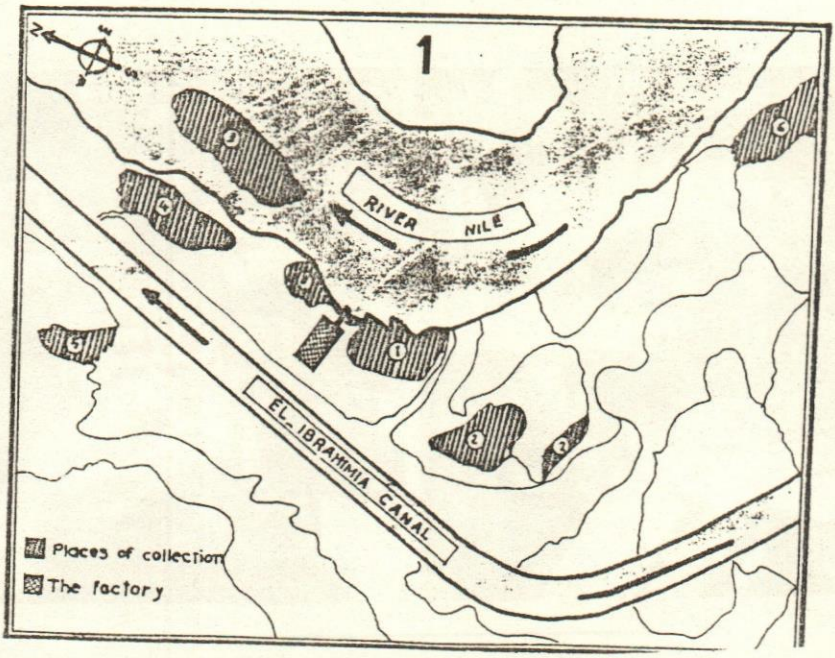
ANOVA of feed stuffs fluoride content.

S.V	D.F	SS	M.S	F
Area	6	3864.245	644.041	13.48**
Peeds	2	822.847	411.424	8.61**
Error	42	2006.765	47.780	
Total	50	6693.857		

** : Highly significant (P/ 0.01).

Table (3)
Water fluoride levels in selected areas

Areas	Sources	Distance from the factory (km)	Fluoride concentration
Gaz. El-Akrad	River nile	0.50-0.75	2.60±0.52
	The canal	0.25-0.50	2.67±0.50
	Artisian water	0.50	2.00±0.49
	Surface water	0.50	4.00±0.69
	Water pump	0.10	2.00±0.41
	Surface water	2.00	6.00±0.55
Ezbet-Mohamed	Surface water	2.50	4.00±0.79
	Driven water	3.00	4.00±0.55
	The canal	2.5 - 3	4.20±0.52
	The canal	0.50	2.64±0.53
El-Tawabiya	Surface water	0.75	6.00±0.79
	Water pump.	1.00	4.90±0.43
	River nile	0.50	2.68±0.54
Manqabad	Ibrahimia	0.20-0.50	2.97±0.54
	The canal	0.50	2.50-0.55
	Tap water	1.50	2.00±0.56
Elwan	The canal	1.50	2.28±0.63
	Artisian water	0.75	2.96±0.63
	River nile	4.00	2.66±0.41
El-Willidiya	Tap water	4.00	3.81±0.72
	Surface water	0.50-4.00	5.20±0.69
	Driven well	15.00	2.00
Abnoub	Surface water	15.00	2.00
	Tap water	15.00	2.00
	The canal	15.00	2.00



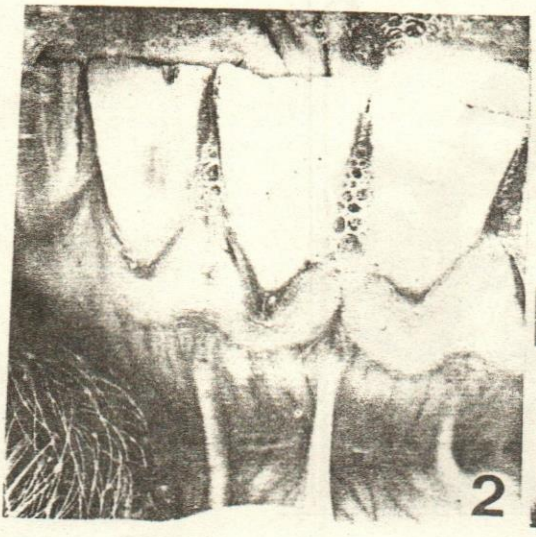


Fig. (1): Topographical Map of the factory and the places of collection.
Fig. (2): Normal incisor teeth in a buffaloe.
Fig. (3): Dental fluorosis showing light brown pigmentation.

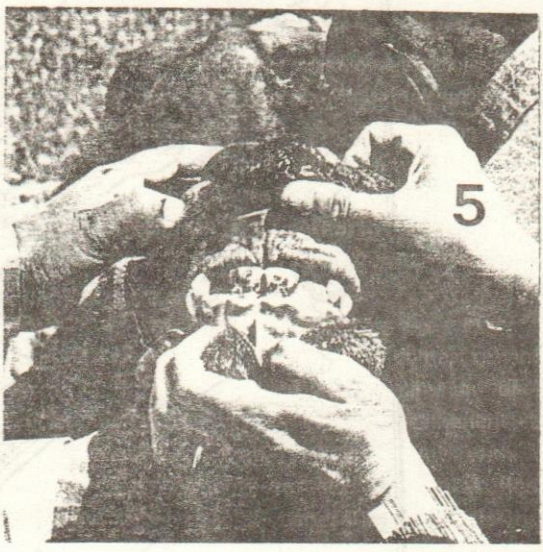


Fig. (4): Dental fluorosis showing dark brown calour of incisor teeth.
Fig. (5): Dental fluorosis showing mottling and pitting of incisor teeth.
Fig. (6): Advanced stage of dental fluorosis showing attrition of teeth with bulging of gum.