Pregnancy and fluorine in hard tissues
A preliminary report

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Alvesalo, L., Mäkinen, K. K. & Nieminen, L. S. Pregnancy and fluorine in hard tissues. A preliminary report. *Acta Odont. Scand.* 31, 71—74, 1973.

The mean fluorine content of the bones and teeth of pregnant rats was in most cases lower than that of non-pregnant animals. This result was obtained when using distilled water and tap water (the latter containing approximately 0.3 ppm fluorine) as a constituent of the diet. It is suggested that the need of fluorine of the growing foetus is related to the lowered values and that a release of fluorine would occur to some extent from the maternal hard tissues.

Key-words: Fluorine; hard tissues; pregnancy

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Three mechanisms have been considered in the removal of fluorine from hard tissues; a) back exchange with ions contained in tissue fluids, b) resorption of tissue, and c) mechanical abrasion (*Armstrong et al.*, 1970). It has been shown that the fluorine concentration of dentine in the crowns of deciduous teeth dropped sharply when the process of resorption began (*Hargreaves & Weatherell*, 1964). It has also been suggested in dental literature that hormonal action could be involved in this physiological resorption.

The present communication provides information about the content of fluorine in teeth and certain bones of the rat during pregnancy.

MATERIAL AND METHODS

The test animals consisted of non-inbred Strague-Dawley strain female rats which were kept in identical conditions (temperature, light, relative moisture, diet: chow and water) before the experiments. The fluorine content of drinking water was during that time approximately 0.3 ppm. The chow given to all test animals contained throughout the study approximately 50 μg/100 mg fluorine (determined according to *Wharton*, 1962). This concentration formed the base level of fluorine of the diet. The only experimental variables accomplished in this study were in the fluorine content of the drinking water and pregnancy. The age range of the used animals was at the beginning of the experiments from 4.5 to 5 months. The weight range was from 230 to 270 g.

In the first series of experiments (I) the pregnant group included 31 rats, the non-pregnant (control) group comprising 25 ones. The groups were formed at random from the available animals before breeding. The time of conception was evaluated with the aid of sperm specimens from

Received for publication, November 16, 1972.

Table I. (*Experiment I*). *Mean fluorine contents (μg/mg) of different maternal hard tissues during pregnancy. The numbers in parentheses give the numbers of rats as indicated in »Material and methods».*

	Pregnant group $\bar{x}$ S.D.$_k$		Control group $\bar{x}$ S.D.$_k$
Incisor	0.319 0.058 (8+12+11=31)	< n.s.	0.315 0.053 (10+5+5+4=24)
Molar	0.286 0.070 (8+12+11=31)	< *	0.333 0.082 (10+5+5+4=24)
Frontal	0.464 0.044 (8+12+11=31)	< n.s.	0.486 0.119 (10+5+5+5=25)
Tibia	0.541 0.054 (8+12+11=31)	< **	0.620 0.134 (10+5+5+5=25)

n.s. = not significant, * = $p<0.05$, ** = $p<0.01$.

the vagina. Both groups were then kept in identical conditions as before the experiment; the chow and drinking water (tap water containing approximately 0.3 ppm fluorine) were also the same. The quantities of water and chow were not limited. On the 17th (ossification begins in foetus), 20th and 21st day of pregnancy (the day following breeding not being included), the specimens from different hard tissues of decapitated rats were removed for the determination of the fluorine content. In the control group the same measurements were made on the 8th, 17th, 20th and 21st days after the experiment had begun. The number of rats which were sacrificed on respective days are shown in Tables I and II.

The tissue specimens were taken from the lower incisor, all lower molars, frontal bone and tibia bone on the left side of the body. The whole bones and teeth were used to determine fluorine. The membranes and other soft tissues were removed mechanically as carefully as possible.

In the second series of experiment (II) both the pregnant group and control group comprised of 14 rats. The specimens from hard tissues were taken on the 8th and 21st days after the pregnancy had begun. The difference between this (II) and the previous experiment (I) was the diet where the chow (as in experiment (I) contained the same amount of fluorine, but the content of fluorine in drinking water was lowered by passing distilled water through an ion exchange column. Its specific conductivity was approximately 1.5 million ohms and no traces of fluoride ions could be detected electrometrically.

The hard tissue specimens were ground in a diamond mortar. The fine and homogenous powder resulting was analyzed for fluorine according to the procedure of *Wharton* (1962) which measures fluorine spectrophotometrically after a 24 hours' diffusion at 60°C. The error of the method was estimated to be +5.9%. This error was obtained for the whole procedure, comprising also grinding and weighing of the samples. The error of the chemical determination itself was less. The concentration of fluoride ions in water was

Table II. (*Experiment II*). *Mean fluorine contents (μg/mg) of different maternal hard tissues during pregnancy. The numbers in parentheses give the numbers of rats as indicated in »Material and methods».*

	Pregnant group $\bar{x}$	S.D.$_k$		Control group $\bar{x}$	S.D.$_k$
Incisor	0.287	0.029	< n.s.	0.300	0.045
	(5+9=14)			(7+7=14)	
Molar	0.248	0.048	< o	0.280	0.044
	(5+9=14)			(7+7=14)	
Frontal	0.472	0.052	< o	0.524	0.094
	(5+9=14)			(7+7=14)	
Tibia	0.509	0.033	< n.s.	0.512	0.051
	(5+9=14)			(7+7=14)	

o = $p>0.1$, n.s. = not significant.

analyzed electrometrically with a Beckman fluoride electrode. The *t*-test was used in statistical analysis of the data.

RESULTS

It can be seen from Table I that the mean fluorine content of the hard tissues in the pregnant group was with one exception (incisor) lower than that in the control group. The differences were statistically significant or nearly significant in tibia bone and molars.

Table II shows that the mean contents of fluorine of different hard tissues were lower in the pregnant group than in the control group. The differences were indicative in molars and frontal bone.

DISCUSSION

In both experiments the mean fluorine content of hard tissues was with one exception lower in pregnant animals than in the control, non-pregnant ones. There are two probable explanations for the lower values. Thus, due to the low content of fluoride ions in water, the pregnant animals might have received this element from a body source to supply the tissues of growing foetuses with a sufficient amount of fluorine. The fluorine could have been released by increased hormonal action from bones and teeth. The pregnant animals might also have utilized the fluorine present in blood to build up the foetal tissues. Thus the fluorine content in maternal hard tissues did not increase as a function of increasing age and weight, which possibly took place in the control group. In spite of the fact that the present results did not show in which parts of the teeth an eventual release of fluorine would take place, it is suggested that adequate dietary fluorine would be of special importance for the teeth of the expectant dam. It seems that nature takes care primarily of the adequate supply of fluorine of the growing foetus.

Acknowledgements. The skilled technical assistance of Mrs. Irma Rintanen and Miss Leena Lehto is gratefully acknowledged.

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