

# BASELINE INFORMATION ON FLUORIDE EXPOSURE GATHERED IN ORDER TO IMPLEMENT SALT FLUORIDATION



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## Faculty of Dentistry II

# Introduction

- Remarkable progress has been attained over the last decades in improving oral health and controlling dental disease in population



# Introduction

- Unfortunately, dental caries continues to affect individuals of all ages regardless of ethnicity and socio economic status, although it is recognized that persons from disadvantaged groups can be more severely afflicted.



# Introduction

- Dental caries remains a serious problem in Romania where the mean DMFT was one of the highest in Europe indicating the need for implementing community prevention programs.



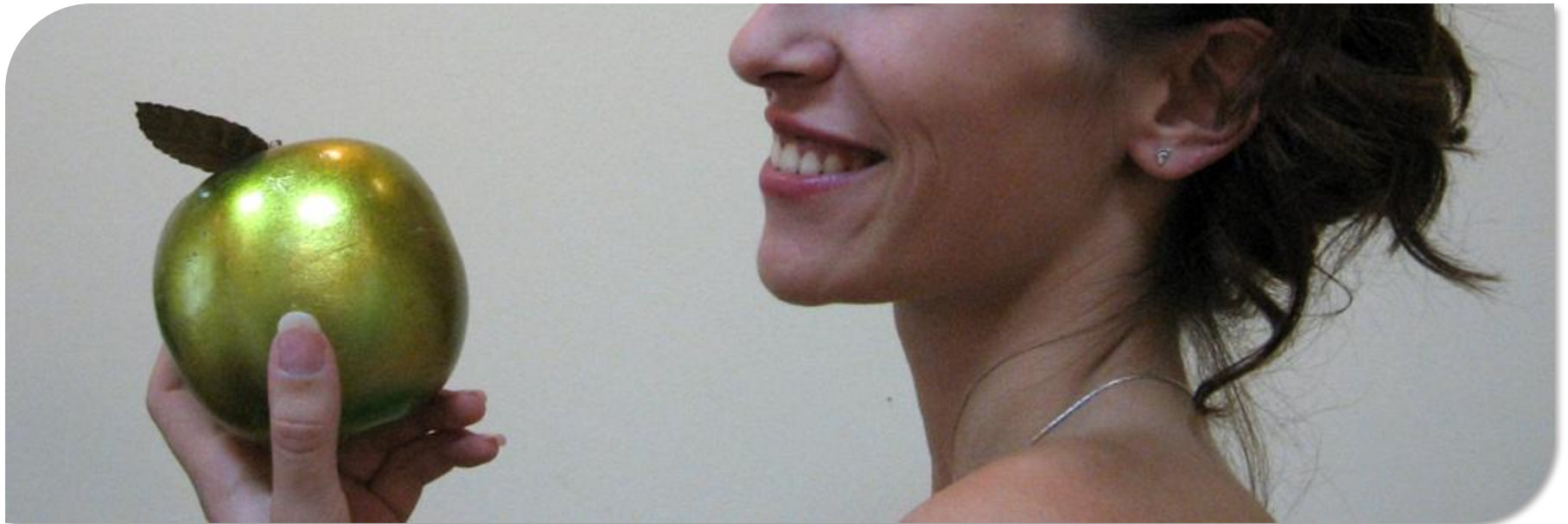
# Objective

- An essential prerequisite for developing and implementing a fluoridation program is the establishment of baseline information on the population exposure to fluoride
- A study examined fluoride excretion in order to gauge whether systemic fluoride is indicated in Romania



# Objective

- The study has been carried out between 1997-1998 at the Department of Preventive Dentistry, part of the Faculty of Dentistry, University of Medicine and Pharmacy Timisoara, Romania





Department of Preventive, Community Dentistry and Oral Health

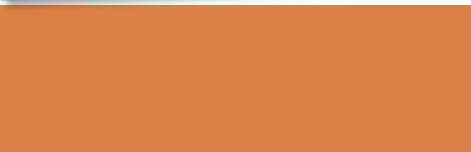
# Our team members were:

- ❑ Prof. Dr. Thomas Marthaler, University of Zurich, Switzerland
- ❑ Prof. Dr. Ramon Baez, University of Texas, USA
- ❑ Prof. Dr. Martha Baez, University of Texas, USA
- ❑ Prof. Dr. Angela Podariu, University of Medicine and Pharmacy Timisoara, Romania
- ❑ Assoc. Prof. Dr. Daniela Jumanca, University of Medicine and Pharmacy Timisoara, Romania
- ❑ Assoc. Prof. Dr. Atena Galuscan, University of Medicine and Pharmacy Timisoara, Romania
- ❑ Dipl. Chemist Lucia Podariu, Timisoara, Romania



At the study took part 450 children from the PPN special school and 20 children from the RW foundation in Timisoara





Also 87 elderly adults from the Home for Elderly participated in the study





# Materials and Methods



- Urines were collected from institutionalized children and elderly adults to estimate fluoride exposure in Timisoara.

Nume.....Nr.....  
 Colectarea urinei de peste noapte  
 1) Notati ora la care DVS./copilul DVS. a urinat  
 inainte de culcare: .....  
 Nu colectati aceasta urina !  
 2) Daca DVS.Copilul DVS. doreste sa urineze  
 peste DVS./copilul noapte, DVS. trebuie sa  
 foloseasca borcanul.  
 3) Cand DVS./copilul DVS. se scoala dimineata  
 DVS./copilul DVS. trebuie sa urineze in borcan.  
 Apoi inchideti borcanul si notati ora: .....  
 4) Va rugam aduceti borcanul inapoi dimineata !

|                                      |        |      |     |      |   |
|--------------------------------------|--------|------|-----|------|---|
| NAME                                 |        | AGE  | SEX | NO.. |   |
| SCHOOL                               |        | DATE |     |      |   |
| A                                    | TIME   | 1    | 2   | 3    | 4 |
|                                      | Vol/ml | X    |     |      |   |
| B                                    | TIME   | 1    | 2   | 3    | 4 |
|                                      | Vol/ml | X    |     |      |   |
| C                                    | TIME   | 1    | 2   | 3    | 4 |
|                                      | Vol/ml | X    |     |      |   |
| D                                    | TIME   | 1    | 2   | 3    | 4 |
|                                      | Vol/ml | X    |     |      |   |
| TIME OF CONSUMPTION OF FLUORID ..... |        |      |     |      |   |

# Materials and Methods



- The working procedures as described by the WHO manual were closely followed.
- From each subject nocturnal urine was collected in the morning at the first micturition and a daytime collection from morning to late afternoon followed.
- In this way 2 collections of time controlled urine covering roughly 24 h were obtained
- The fluoride concentration in the drinking waters used in the homes and schools were below 0.3 mg F/l.

# Materials and Methods



- The volumes of the urinary collections were determined in the laboratory of the University of Medicine Timisoara
- Approximately 30 ml were deposited into a tube containing a few crystals of Thymol
- 5 ml were taken and analyzed for fluoride using specific ion electrodes and portable potentiometers (Orion, Beverly MA)

# Materials and Methods



- Personal data, the urinary volume and the time at the beginning and end of each collection period were entered in a table (adapted from the WHO manual).
- The tables as well as the remaining probes were transported to Zurich where the fluoride concentrations were again determined according to other methods (Marthaler)
- These repeated analyses gave results similar to those in Timisoara

|                    | Mean Fluoride Concentration<br>Mg/l<br>Standard deviation |               | Excretion<br>I g/F/24h<br>Standard deviation | Excretion/body<br>Weight<br>I g/F/24h/kg<br>Standard deviation |
|--------------------|-----------------------------------------------------------|---------------|----------------------------------------------|----------------------------------------------------------------|
|                    |                                                           |               |                                              |                                                                |
| Children Timisoara | 0.366 (0.246)                                             | 0.621 (0.269) | 260 (142)                                    | 8.4 (4.5)                                                      |
| Adults Timisoara   | 0.299 (0.127)                                             | 0.259 (0.101) | 159 (121)                                    | 2.7 (1.7)                                                      |

- All data as determined in Timisoara were evaluated using the automated computing tables described in the WHO manual.

# Results



- The median and mean fluoride excretion were moderately lowered but both measures of variability, the standard deviation and ranges, were strongly reduced.
- Regarding flow, application of the lower limit of 200 ml/24 h led to the rejection of three children from Timisoara and six adult subjects.

# Urinary fluoride data from Romania, summary of data obtained in 1998

- The definitive samples appropriate for further statistical evaluation were 47 children and 38 adults.

|                                                                                                        | TIMISOARA CHILDREN | TIMISOARA ADULTS |
|--------------------------------------------------------------------------------------------------------|--------------------|------------------|
| <b>Number of subjects, age, weight</b>                                                                 |                    |                  |
| Subjects (females)                                                                                     | 50 (24)            | 48 (11)          |
| Subjects with both collections                                                                         | 50                 | 44               |
| Number of successful collections                                                                       | 100                | 92               |
| Median age, years (range)                                                                              | 12 (2 – 16)        | 72 (26 – 97)     |
| <b>Duration of collection, hours, within one 24 – hour cycle (only subjects with both collections)</b> |                    |                  |
| Average (range)                                                                                        | 22.6 (20 – 24)     | 20.1 (15 – 22)   |
| <b>Fluoride concentration, ppm</b>                                                                     |                    |                  |
| Nocturnal median (N)                                                                                   | 0.28 (50)          | 0.265 (48)       |
| range                                                                                                  | 0.08 – 1.40        | 0.13 – 0.72      |
| Average                                                                                                | 0.366              | 0.299            |
| Standard deviation                                                                                     | 0.246              | 0.127            |
| Daytime median (N)                                                                                     | 0.650 (50)         | 0.240 (44)       |
| range                                                                                                  | 0.12 – 1.200       | 0.010 – 0.56     |
| Average                                                                                                | 0.624              | 0.259            |
| Standard deviation                                                                                     | 0.269              | 0.101            |
| <b>Urinary flow, ml/h</b>                                                                              |                    |                  |
| Nocturnal median (N)                                                                                   | 19.9 (50)          | 23.7 (48)        |
| range                                                                                                  | 0.6 – 58.3         | 1.0 – 150        |
| Average                                                                                                | 23.4               | 34.9             |
| Standard deviation                                                                                     | 14.9               | 32.8             |
| Daytime median (N)                                                                                     | 21.1 (50)          | 17.0 (44)        |
| range                                                                                                  | 0.1 – 63.4         | 2.6 – 54.2       |
| average                                                                                                | 22.5               | 18.8             |
| Standard deviation                                                                                     | 13.6               | 10.7             |

# Urinary fluoride excretion in Romania

- Among the subjects included in the definitive statistics, the children had the highest excretion, 271  $\mu\text{g F}/24\text{h}$  on average.

|                                                                                                        | TIMISOARA CHILDREN | TIMISOARA ADULTS |
|--------------------------------------------------------------------------------------------------------|--------------------|------------------|
| <b>Fluoride excretion, <math>\mu\text{gF}/24\text{h}</math></b>                                        |                    |                  |
| All complete subjects, number                                                                          | 50                 | 44               |
| Median                                                                                                 | 228                | 129              |
| range                                                                                                  | 19 – 520           | 21 – 702         |
| Average                                                                                                | 260                | 159              |
| Standard deviation                                                                                     | 142                | 121              |
| Confidence limits ( $p=0.95$ )                                                                         | 220 - 301          | 122 – 196        |
| Mean fluoride concentration                                                                            | 0.490              | 0.267            |
| Mean urinary flow, ml/24h                                                                              | 535                | 606              |
| <b>Subject No.37 with excessive fluoride concentration eliminated</b>                                  |                    |                  |
| <b>Definitive samples after exclusions, fluoride excretion <math>\mu\text{gF}/24\text{h}</math></b>    |                    |                  |
| <b>Subjects with low/high urinary flow eliminated (3 from Tc, 6 from Ta)</b>                           |                    |                  |
| Remaining subjects, number                                                                             | 47                 | 38               |
| Median                                                                                                 | 247                | 147              |
| range                                                                                                  | 40 – 520           | 47 – 702         |
| Average                                                                                                | 271                | 170              |
| Standard deviation                                                                                     | 138                | 120              |
| Confidence limits ( $p=0.95$ )                                                                         | 142 – 189          | 47 – 702         |
| Mean fluoride c concentration                                                                          | 0.487              | 0.271            |
| Mean urinary flow, ml/24h                                                                              | 560                | 684              |
| <b>Definitive samples after excretion per bodyweight <math>\mu\text{g}/24\text{h}/\text{kg}</math></b> |                    |                  |
| Only subject with 6.53 ppm F excluded (child No.37)                                                    | 47                 | 37               |
| Median                                                                                                 | 7.8                | 2.2              |
| Average                                                                                                | 8.4                | 2.7              |
| Standard deviation                                                                                     | 4.5                | 1.7              |
| range                                                                                                  | 2.1 – 22.5         | 0.7 – 9.5        |
| Confidence limits ( $p=0.95$ )                                                                         | 5.1 – 7.2          | -                |

# Results

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- The changes in the fluoride parameters due to the exclusion were approximately 10% or less or even zero.
- When fluoride excretion was expressed per kg of bodyweight, the adults had less than half the excretion of the children.

## Average fluoride excretion when a selected number of subjects with the lowest urinary flow are excluded from sample

|                    | Number of subjects included | Percent excluded | Average excretion | % increase due to exclusion |
|--------------------|-----------------------------|------------------|-------------------|-----------------------------|
| Children Timisoara |                             |                  |                   |                             |
| All                | 50                          | 0                | 260               |                             |
| Who excluded       | 47 (3)                      | 6.0              | 271               | 4.1                         |
| 20%excluded        | 40 (10)                     | 20.0             | 297               | 14.2                        |
| Adults Timisoara   |                             |                  |                   |                             |
| All subjects       | 44                          | 0                | 159               |                             |
| Who excluded       | 38 (6)                      | 13.6             | 178               | 10.7                        |
| 20%excluded        | 35 (9)                      | 20.5             | 185               | 16.4                        |

# Discussion

- Exclusion of data must be done carefully.
- Incomplete urinary collections are difficult to avoid, particularly when 24 h urine should be obtained.
- The exclusion of a few individuals with less than 200 ml urine in 24 h did in fact result in higher excretion parameters but the changes were not substantial.



# Discussion

- In the resulting pool, 182  $\mu\text{g F}/24 \text{ h}$  and 8.1  $\mu\text{g F}/24 \text{ h/kg}$  were excreted on average.
- In these youngest children the average excretion of 182  $\mu\text{g F}/24 \text{ h}$  was about as low as those from German children not taking fluoride tablets

## Urinary fluoride excretion in Romania, children aged 4-9 years, definitive sample

| Romania                                                                               | Timisoara children | Children pooled |
|---------------------------------------------------------------------------------------|--------------------|-----------------|
| All complete subjects                                                                 | 11                 | 29              |
| Average age                                                                           | 6.4                | 7.4             |
| Average weight, kg                                                                    | 18.4               | 22.3            |
| <b>Fluoride excretion, <math>\mu\text{gF}/24\text{h}</math></b>                       |                    |                 |
| Median                                                                                | 179                | 179             |
| range                                                                                 | 40 – 427           | 40 – 427        |
| Average                                                                               | 180                | 182             |
| Standard deviation                                                                    | 101                | 76              |
| Confidence limits ( $p=0.95$ )                                                        | 112 – 247          | 153 – 211       |
| Mean fluoride concentration                                                           | 0.451              | 0.422           |
| Mean urinary flow, ml/24h                                                             | 417                | 473             |
| <b>Fluoride excretion, <math>\mu\text{gF}/\text{h}</math></b>                         |                    |                 |
| Average                                                                               | 7.5                | 7.6             |
| Confidence limits ( $p=0.95$ )                                                        | 4.7 – 10.3         | 6.4 – 8.8       |
| <b>Fluoride excretion, <math>\mu\text{gF}/24\text{h}/\text{kg}</math> body weight</b> |                    |                 |
| Median                                                                                | 10.0               | 7.5             |
| range                                                                                 | 2.7 – 22.5         | 2.2 – 22.5      |
| Average                                                                               | 10.0               | 8.1             |
| Standard deviation                                                                    | 5.6                | 4.1             |
| Confidence limits ( $p=0.95$ )                                                        | 6.2 – 13.7         | 6.8 – 79.3      |

- Statistics for subsamples restricted to age, four to nine for children have been reevaluated

## Urinary fluoride excretion in Romania, children aged 10 – 14 years, definitive sample

| Romania                                                                               | Timisoara children | Children pooled |
|---------------------------------------------------------------------------------------|--------------------|-----------------|
| All complete subjects                                                                 | 32                 | 43              |
| Average age                                                                           | 12.2               | 12.1            |
| Average weight, kg                                                                    | 37.3               | 37.3            |
| <b>Fluoride excretion, <math>\mu\text{gF}/24\text{h}</math></b>                       |                    |                 |
| Median                                                                                | 275                | 220             |
| range                                                                                 | 64 – 520           | 64 – 520        |
| Average                                                                               | 282                | 245             |
| Standard deviation                                                                    | 134                | 135             |
| Confidence limits ( $p=0.95$ )                                                        | 234 – 331          | 203 – 287       |
| Mean fluoride concentration                                                           | 0.493              | 0.451           |
| Mean urinary flow, ml/24h                                                             | 575                | 541             |
| <b>Fluoride excretion, <math>\mu\text{gF}/\text{h}</math></b>                         |                    |                 |
| Average                                                                               | 11.8               | 10.2            |
| Confidence limits ( $p=0.95$ )                                                        | 9.7 – 13.8         | 8.5 – 11.9      |
| <b>Fluoride excretion, <math>\mu\text{gF}/24\text{h}/\text{kg}</math> body weight</b> |                    |                 |
| Median                                                                                | 7.5                | 6.1             |
| range                                                                                 | 2.1 – 19.6         | 1.4 – 19.6      |
| Average                                                                               | 7.9                | 6.9             |
| Standard deviation                                                                    | 4.3                | 4.2             |
| Confidence limits ( $p=0.95$ )                                                        | 6.4 – 9.5          | 5.6 – 8.2       |

# Discussion

- Excretion in *Swiss children aged 3 and 4 years* who had been consuming fluoridated domestic salt was 245  $\mu\text{g F}/24\text{h}$  (Marthaler et al 2000, N=15) which was significantly higher than the present results.
- The Swiss children were younger and when excretion per body weight (14.7  $\mu\text{g F}/24\text{ h/kg}$ ) was used for the test, the test turned out to be highly significant.

# Discussion

- It is evident that in the homes studied, both the intake and excretion of fluoride in Romanian children are among the lowest when compared to the available European data
- When compared to WHO provisional standards for urinary fluoride excretion, the Timisoara results were in range corresponding to low fluoride intake
- That means that there is room for increasing fluoride supply by so-called systemic fluoride for prevention of dental caries.

# Discussion



- Salt fluoridation has been used successfully as an alternative choice in several countries
- Studies have confirmed salt fluoridation as an efficient, safe and inexpensive method for prevention of dental caries
- With 50 years experience and current technology available salt fluoridation programs can satisfy the need of large or small countries.

# Urinary fluoride excretion in micrograms by children aged 10-14 in Romania (definitive samples), Switzerland, France and WHO standards

|                                                   | <i>Morning <math>\mu\text{g}/\text{h}</math></i> | <i>Afternoon <math>\mu\text{g}/\text{h}</math></i> | <i>Night <math>\mu\text{g}/\text{h}</math></i> | <i><math>\mu\text{g}/24</math> hours</i> |
|---------------------------------------------------|--------------------------------------------------|----------------------------------------------------|------------------------------------------------|------------------------------------------|
| Romania present results                           |                                                  |                                                    |                                                |                                          |
| Timisoara                                         | (daytime: 15.0)                                  |                                                    | 7.4                                            | 282                                      |
| Bucharest                                         | (daytime: 5.9)                                   |                                                    | 5.7                                            | 139                                      |
| Switzerland from Marthaler et al (1995)           |                                                  |                                                    |                                                |                                          |
| Geneva                                            |                                                  |                                                    |                                                |                                          |
| Prior to salt fluoridation, 1984                  | 10.5                                             | 14.0                                               | 8.8                                            |                                          |
| Domestic salt with 250 ppmF, 1988                 | 16.2                                             | 43.3                                               | 16.5                                           |                                          |
| Glarus, F salt for household and bread, g/24h     |                                                  |                                                    |                                                | 516                                      |
| Binningen, water from Basel, 0.6 – 1.0 ppmF       | 23.5                                             | 33.3                                               | 19.0                                           |                                          |
| France (Strasbourg) from Orby-Musset et al (1992) |                                                  |                                                    |                                                |                                          |
| Control group                                     | 7.3                                              | 20.0                                               | 12.9                                           | 310                                      |
| 1mg fluoride tablets                              | 28.3                                             | 23.6                                               | 27.0                                           | 631                                      |
| <b>WHO PROVISIONAL STANDARDS</b>                  |                                                  |                                                    |                                                |                                          |
| Low F intake                                      | Low limit                                        | 12                                                 | 8                                              | 220                                      |
|                                                   | High limit                                       | 18                                                 | 12                                             | 340                                      |
| Optimal F usage                                   | Low limit                                        | 30                                                 | 19                                             | 600                                      |
|                                                   | High limit                                       | 48                                                 | 30                                             | 820                                      |

In the past years some efforts have been made to implement salt fluoridation in Romania through research projects:

- 1. 2006 - Complex epidemiologic, structural and functional systemic research regarding the implementation of salty products to prevent dental caries - *SANOSALT***
  - ▣ Project manager: UMF Cluj
  - ▣ Partners:
    - ▣ Babes Bolyai University
    - ▣ IPA
    - ▣ ICB (Institute for Biological Research)
    - ▣ UMF TIMISOARA
    - ▣ SC MINESA S.A.

In the past years some efforts have been made to implement salt fluoridation in Romania through research projects:

2. **2007 - Complex epidemiologic, structural and functional systemic research regarding dental caries prevention”, *PREVDENT***

- ▣ Project manager: UMF Cluj
- ▣ Partners:
  - ▣ IPA
  - ▣ Babes Bolyai University
  - ▣ ICB (Institute for Biological Research)
  - ▣ SC MINESA SA

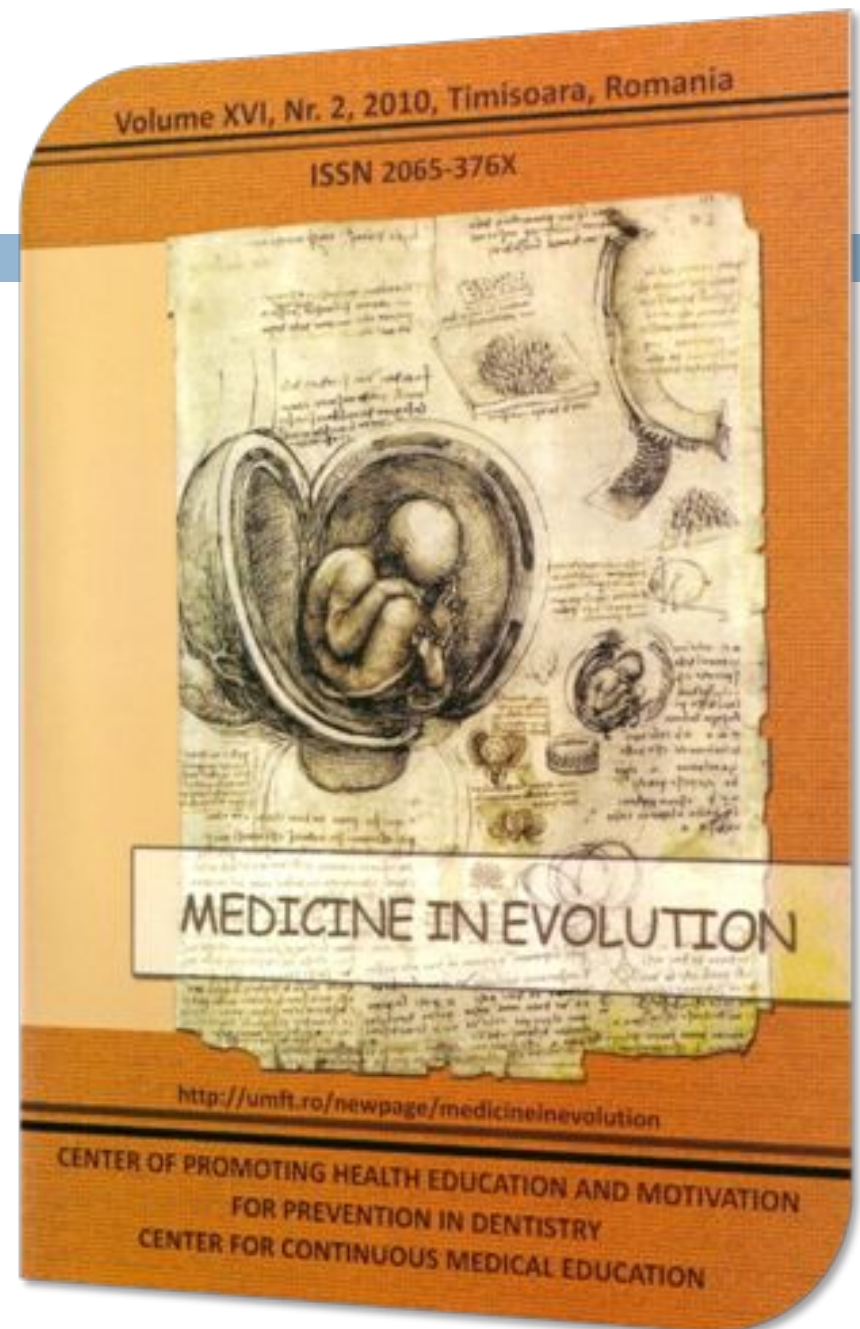
- **SC Minesa SA** has designed a product that fulfills the requirements of salt fluoridation



# Conclusions

- The fluoridation is made by adding calcium fluoride.
- At production time the salt contains 0,02% F, respectively 0,041%  $\text{CaF}_2$ .
- Regular consumption of 4-5 g of this fluoridated salt daily means the ingestion of 1 mg F, and the consumption of 10 g of salt daily leads to the ingestion of 4 mg/day.

- Nationwide salt fluoridation could be easier to implement in Romania, thereby improving substantially the health of the teeth, a benefit that could reach all socio-economic strata.



Thank you!

