Importance of fluoridated salt in the strategy of caries prevention

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WHO’s World Health Assembly (2007)

Member states adopted a resolution on oral health, which urged the establishment of national plans for the use of Fluoride based on appropriate programmes for automatic administration through drinking water, salt or milk and the provision of affordable toothpaste.
Salt fluoridation: History

- Iodized salt in cretinism and goiter prevention
- Fluoridated salt in caries prevention

Dr. Hans Wespi, first to begin production of a salt containing iodine and fluoride in 1946

Industrial production of fluoridated salt started in Switzerland in 1955 @90 mg/kg
iodized salt in goiter and mental retardation prevention
fluoridated salt in caries prevention

Fluoridation benefits from iodine experience
Communication and quality control are complimentary
$\text{KIO}_3$ and KF are compatible in the mixture
Using a mixer for fluoridation process provides a mixture of greater homogeneity for the $\text{KIO}_3$
Salt Fluoridation in Switzerland

1969 the Canton of Vaud

250 mg F⁻ for the Canton of Glarus

1974 Swiss Rhine saltworks Glarus

1974-1977 urinary excretion studies (T M. Marthaler)

1980 the General Health Office recommended Cantons concentration of 250 ppm

Market share about 80%
Figure 18.29 Mean DMF teeth per child aged 12 or 14 years in the canton of Zurich, 1963–1987, and in the canton of Glarus, 1974–1987. Glarus uses fluoridated salt in households and bakeries. (Source Marthaler et al., 1988; Steiner et al., 1986, 1989.)
Salt Fluoridation in other countries

1966-1984 Hungary (*K. Toth*)

mid 1990s Czech and Slovak Republics

1985 France [1993 market share 60% to 27%]

1991 Germany Market Share 63% in 2005

Romania 2010

Belarus comprehensive program with toothpaste F- and health education
Cariostatic Effectiveness of Fluoridated Salt

**Germany**: Caries dropping sharply DMFT$_{12}$ fell from **2.44 in 1994 to 1.24 in 2000**. Number of individual and group preventive measures and the application of sealants increased substantially. Moreover, market share of fluoridated salt rose rapidly.


**Spain** Recent data not available but initial studies indicated caries reduction **12 year-olds = 57.9%** (*Marthaler T.M.*)
Cariostatic Effectiveness of Fluoridated Salt

France: National mean $DMFT_{12}$ decreased from 4.2 to 2.07 from 1987-1993

Montpellier $DMFT_{12}$ 1.42 in 1999 and 1.29 in 2002

Heidelberg $DMFT_{12}$ 1.56 in 1999 and 1.15 in 2002

Status of Implementation by countries in the Americas

- **Jamaica**
  - Initiated in 1986-1987

- **Costa Rica**
  - Initiated in 1989

- **Mexico**
  - Trials in 1973
  - Started 1989-1991

- **Colombia**
  - Initiated in 1989

- **Venezuela**
  - Initiated in 1994

- **Uruguay**
  - Preliminary studies in 1992

- **Belize**
  - Access since 1987?

- **Bolivia**
  - Initiated in 1995

- **Ecuador**
  - Initiated in 1997

- **Peru**
  - Approved in 1989
  - Initiated in 1992
  - Initiated in 1995

- **Paraguay**
  - Preliminary studies in 1996

- **Panama**
  - Preliminary studies in 1997

- **Honduras**
  - Preliminary studies in 1997

- **Nicaragua**
  - Preliminary studies 1997

- **Access since 1987?**

- **IF-SALT MADAGASCAR, PRATIH PHANTUMVANIT**
Tanks for Iodide and Fluoride solutions with pumping mechanism [Jamaica]
<table>
<thead>
<tr>
<th>Year</th>
<th>Costa Rica</th>
<th>Jamaica</th>
<th>State of Mexico</th>
<th>Uruguay</th>
</tr>
</thead>
<tbody>
<tr>
<td>1984</td>
<td>9.1</td>
<td>6.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1986</td>
<td>8.4</td>
<td>4.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1988</td>
<td>4.9</td>
<td>4.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1990</td>
<td>4.8</td>
<td>1.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1992</td>
<td>2.5</td>
<td>2.5</td>
<td></td>
<td></td>
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<tr>
<td>1994</td>
<td>2.5</td>
<td>2.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>2.5</td>
<td>2.5</td>
<td></td>
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</tr>
</tbody>
</table>

State of Mexico & Uruguay initiated F in salt in 1995.

E.D. Beltran Personal Communication
Results on Caries Reduction and Type of Salt Fluoridated

Jamaica 84% (all salt fluoridated)

Costa Rica 73% (household use)

Mexico 44% (household use)

Uruguay 40% (household use)

Colombia 50% (household use)
Fluoridated Salt

Salt is consumed by virtually all populations
Amount consumed is constant (~10 g/day)
Overdose is virtually excluded (safe)
Fluoride addition is inexpensive
Possible same technique for addition of fluoride as iodized salt
Demonstrated cariostatic efficacy, 44% caries reduction in Mexico (Irigoyen ME et al. Caries Res 2000; 34:303-7)
Salt Fluoridation in the Americas

Successful
Effective, Safe and Economic
Countries with adequate planning
Proper technology
Epidemiological surveillance
Internal and external quality control

Cost less than US$ 0.06/person/year
Salt Fluoridation Essentials

Assessment of fluoride exposure
Baseline studies on caries and enamel fluorosis
Assessment of salt processing plants, capacity, technology, salt quality, quality control, distribution networks
Cost: Benefit estimates
Attributes to Salt Fluoridation

Inexpensive
Effective
Eminently safe
Equitable – entire population benefits
Requires no cooperative effort or direct action
Benefits continue for a life time if consumption continues
Reduces cost for dental treatment
Does not depend on professional services
Proper Use of Fluorides the Most Feasible Way to Reduce Dental Caries

<table>
<thead>
<tr>
<th>Method</th>
<th>Estimated cost</th>
<th>person/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>US $ 0.52</td>
<td></td>
</tr>
<tr>
<td>Salt</td>
<td>$&lt;0.06</td>
<td></td>
</tr>
<tr>
<td>Milk</td>
<td>$ 3.49</td>
<td></td>
</tr>
</tbody>
</table>
Community Fluoride Approach in Asia

Water fluoridation
- China SAR Hong Kong, Malaysia, Singapore, Korea, Vietnam, Brunei

Milk fluoridation
- Thailand

Salt fluoridation
- Lao PDR, Vietnam, Taiwan
Paddle mixer for iodized and fluoridated salt

batch production with a paddle mixer
good results for a combined mixture of KIO₃ and KF, perfectly homogeneous
90% of the samples have a good concentration of iodine and fluorine.
## Monitoring Urinary Fluoride in 4-yr children

<table>
<thead>
<tr>
<th></th>
<th>Baseline morning ug/hr</th>
<th>Baseline afternoon</th>
<th>After 6-mo morning</th>
<th>After 6-mo afternoon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salt F in Lao</td>
<td>4.7 (3.32)</td>
<td>9.5 (4.65)</td>
<td>4.8 (2.49)</td>
<td>9.6 (5.33)</td>
</tr>
<tr>
<td>WHO standard</td>
<td>7-12 (low)</td>
<td>8-13 (low peak)</td>
<td>15-20 (optimum)</td>
<td>18-27 (optimum peak)</td>
</tr>
<tr>
<td>Milk F in Thai</td>
<td>9.0 (4.87)</td>
<td>9.0 (4.62)</td>
<td>10.7 (6.49)</td>
<td>26.5 (12.02)</td>
</tr>
</tbody>
</table>
Fluoridated salt

The recommendation of fluoridated salt must be considered along the amount of salt consumption due to concern to minimize salt intake for hypertension prevention (5g/day – WHO)
Fluoride in the oral environment

Posteruptive application of fluoride plays the dominant role in caries prevention.

Low level of fluoride in the acidic solution around the enamel crystallites may completely inhibit lesion development.

Fluoride impedes caries progression rather than interferes with caries induction.

Fluoride should be presented in the oral cavity throughout life, particularly during tooth eruption.
Dynamic Process of Dental Caries Plaque/Enamel Interface

(Zero 2011)

\[ 8H^+ + Ca_{10}(PO_4)_6OH_2 \]

Supersaturated conditions in oral fluids

\[ 6(HPO_4)^{-} + 10Ca^{++} + 2H_2O \]

Undersaturated conditions in oral fluids
Improved oral health and enhanced quality of life

Oral disease (dental caries) need to be treated or prevented as to control pain and discomfort and enhance the quality of life.
Globally only 20% of the world’s population benefit from appropriate exposure to Fluoride

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Thank you

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