

Scientific symposium by Assist. Prof. Dr. Nada Jafer Mohammed Hassan .

Microelements and oral health/Part II

Ultratrace elements may enter the body through absorption from water and diet as well as inhalation from the atmosphere. Ultratrace elements comprises fluorine (F), aluminium (Al), molybdenum (Mo), and cobalt (Co). The presence of low but constant levels of topical F in the fluid phase at the tooth enamel surface are more important in controlling tooth decay in people of all ages. An inverse relationship between incidence of dental caries and levels of Al in drinking water, food, and soils has been indicated by some epidemiological studies. Co and Mo, whilst occasionally showing potential beneficial oral health effects in laboratory experiments, do so at concentrations much higher than found in vivo.

ندوة علمية

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العناصر الدقيقة وصحة الفم

تشتمل العناصر الدقيقة على الفلور (F)، والألومنيوم (Al)، والموليبيدينوم (Mo)، والكوبالت (Co). يعد وجود مستويات منخفضة ولكن ثابتة من F الفلور الموضوعي في الطور السائل على سطح مينا الأسنان أكثر أهمية في السيطرة على تسوس الأسنان لدى الأشخاص من جميع الأعمار. أشارت بعض الدراسات الوبائية إلى وجود علاقة عكسية بين حدوث تسوس الأسنان ومستويات الألومنيوم Al في مياه الشرب والغذاء والترربة. على الرغم من أن الكوبالت Co والموليبيدينوم Mo يظهران أحياناً تأثيرات مفيدة محتملة على صحة الفم في التجارب المعملية، إلا أنهما يفعلان ذلك بتركيزات أعلى بكثير مما هو موجود في الجسم الحي.

Full Lecture: The Role of Trace Elements in Oral and Dental Health

Title:

Trace Elements and Their Impact on Dental Caries and Oral Health

1. Introduction

Good morning/afternoon everyone.

Today's lecture focuses on an important but often overlooked aspect of oral biology: **the role of trace elements in dental and oral health**. Although required in very small amounts, trace elements can significantly influence **enamel integrity, caries development, and overall oral environment**.

In this lecture, we will discuss the effects of **fluoride (F), aluminum (Al), molybdenum (Mo), and cobalt (Co)** on the dentition, with emphasis on their mechanisms, benefits, limitations, and clinical relevance.

2. What Are Trace Elements?

Trace elements are minerals needed in extremely small quantities but have important physiological roles.

In dentistry, their influence is mainly expressed through:

- Enamel mineralization
 - Salivary composition
 - Microbial activity
 - Remineralization and demineralization processes
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3. Fluoride (F)

3.1 Importance of Fluoride in Caries Prevention

Fluoride is the most widely studied trace element in dentistry.

The presence of **low but constant levels of topical fluoride in the liquid phase at the enamel surface** is critical for **caries control across all age groups**.

3.2 Mechanisms of Action

- **Enhances remineralization** of early enamel caries.
- **Reduces demineralization** by forming fluorapatite, which is more acid-resistant than hydroxyapatite.
- **Inhibits bacterial metabolism**, reducing acid production by cariogenic bacteria.
- **Promotes enamel maturation** during tooth development.

3.3 Sources of Fluoride

- Fluoridated water
- Toothpaste and mouth rinses
- Fluoride varnishes and gels
- Professional fluoride therapy

4. Aluminum (Al)

4.1 Epidemiological Evidence

Some epidemiological studies suggest **an inverse relationship** between the prevalence of dental caries and **levels of aluminum in drinking water, food, and soil**.

This means higher aluminum exposure may correlate with **lower caries rates**.

4.2 Possible Mechanisms

Although not fully understood, proposed explanations include:

- Aluminum may **alter enamel solubility** and reduce demineralization.
- It may influence the **mineral content** of enamel during formation.
- Aluminum can interact with **fluoride**, potentially enhancing its effect under certain conditions.

4.3 Clinical Relevance

Even though aluminum shows potential protective effects, **it is not used clinically** for caries prevention due to limited evidence and potential systemic concerns.

5. Cobalt (Co)

5.1 Role in Oral Health

Cobalt is essential for human health as a component of **Vitamin B12 (cobalamin)**. Its direct role in oral health is less clear, but laboratory experiments have shown **possible beneficial effects** at high concentrations.

5.2 Experimental Findings

- May inhibit certain oral bacteria.
- May affect enamel or dentin mineralization in vitro.

5.3 Limitations

These effects appear **only at concentrations far higher than those naturally found in the human body**, making them **clinically irrelevant** under normal physiological conditions.

6. Molybdenum (Mo)

6.1 Potential Benefits

Molybdenum has been reported to have **possible cariostatic properties** in experimental models. Some areas with high natural molybdenum levels show **lower caries incidence**.

6.2 Experimental Effects

- May reduce enamel solubility.
- May influence mineral uptake in enamel.
- Could affect bacterial metabolism.

6.3 Limitation

Like cobalt, these effects occur **only at high experimental concentrations** not attainable **in vivo**.

Therefore, the practical clinical use of molybdenum in dentistry remains **limited and inconclusive**.

7. Summary of Trace Elements and Their Effects

Element	Potential Effect	Mechanisms	Clinical Relevance
Fluoride (F)	Strong anti-caries effect	Remineralization, reduced demineralization, antimicrobial action	Very high
Aluminum (Al)	Possible inverse relation with caries	Altered enamel solubility, interaction with fluoride	Low
Cobalt (Co)	Experimental antibacterial/mineralization effects	Observed only in vitro at high concentrations	Very low
Molybdenum (Mo)	Possible cariostatic effect experimentally	Affects enamel solubility & bacteria	Low

8. Clinical Implications

- Among all trace elements, **fluoride remains the only clinically effective and safe agent** for caries prevention.
 - Aluminum, cobalt, and molybdenum show **theoretical or experimental** benefits but **lack practical application**.
 - Understanding these elements helps in research, public health, and evaluating environmental influences on oral disease.
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9. Conclusion

Trace elements play varying roles in oral and dental health.

While fluoride remains the cornerstone of caries prevention worldwide, other elements such as aluminum, cobalt, and molybdenum contribute mainly in **experimental or environmental contexts**.

Continued research is needed to better understand their interactions with enamel, saliva, and the oral microbiome.

Thank you for your attention.

I am happy to answer any questions.