The objective of this study is to determine the composition of the cement commonly used in the dental offices and to compare this composition with the one recommended by manufacturer. The attention will focus specifically on the presence of Cr, Co, Ni, knowing that these elements are potential allergens and implicitly could harm the patient’s health.

Keywords: dental cement, chemical composition, extraction

In dental practice, there are materials whose composition recommended by manufacturer does not fulfill reality. It is exactly what we tried to do in the present study.

Experimental part
To determine the chemical composition of the dental cement considered, we used the cation extraction method in Aqua Regia. The method is based on measurement by atomic absorption spectrometry of an element concentration in a sample extract in Aqua Regia prepared according to ISO 11466.

Materials and methods
Reagents used: hydrochloric acid, 37%, 1.18 g/mL, nitric acid 65%, 1.42 g/mL, nitric acid diluted 1+3 (V/V), sulfuric acid, 98%, 1.84 g/m, sulfuric acid diluted 1+9 (V/V), lanthanum chloride solution 37 g/L, lanthanum, calibration blank solution without lanthanum, calibration blank solution with lanthanum, acetone.

Sample preparation is done according to ISO 11464 “Pretreatment of samples for physico-chemical analysis”: Extraction of trace elements (microelements) according to ISO 11466:1999 “Extraction of soluble trace elements in Aqua Regia.”

A blank sample is prepared at the same time with Aqua Regia extraction, following the same procedure and using the same quantities of all reagents for determination.

The atomic absorption spectrometer is turned on as described in the manufacturer instructions, at the appropriate wavelength according to the conditions recommended and with the background correction system operating properly.

A calibration solution is aspirated, optimizing the extraction conditions, burner height and flame conditions. The instrument response is adjusted to zero absorbance while water is sucked.

The calibration solutions set is aspirated in ascending order and the blank calibration solution is sucked as “zero term”. After about 10 min, the absorbance of each solution is read twice at least. If the values fall within an accepted interval, they are averaged. When using standards of higher concentrations, the absorbance must be > 1, preferably <7.

Note: Nickel presents a severe curve at the absorbance units above 0.5 even at a spectral band width of 0.2 nm.

<table>
<thead>
<tr>
<th>Element</th>
<th>Wave length (nm)</th>
<th>Flame type</th>
<th>Lanthanum chloride</th>
<th>Main interference</th>
<th>Background correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chrome</td>
<td>357.9</td>
<td>Air/acetylene or acetylene/N2O reductive</td>
<td>Yes</td>
<td>Fe, Al</td>
<td>Halogen</td>
</tr>
<tr>
<td>Cobalt</td>
<td>240.7</td>
<td>Air/ oxidizing acetylene</td>
<td>No</td>
<td></td>
<td>Deuterium</td>
</tr>
<tr>
<td>Nickel</td>
<td>232.0</td>
<td>Air/ oxidizing acetylene</td>
<td>No</td>
<td>Fe</td>
<td>Deuterium</td>
</tr>
</tbody>
</table>

*email: proiectetm@yahoo.com
Plotting the calibration curves

A curve is plotted for each element, having on abscissa the concentrations of calibration solutions, from which there was subtracted the reading for calibration blank solution in mg/L, and on ordinate - the corresponding values of absorbance.

Special factors

Chromium. When measured in flame/acetylene, there is added 10 mL of lanthanum chloride in the blank balloon and in each balloon with standards and samples.

Note: chromium extraction efficiency from the analyzed samples with Aqua Regia depends on the nature of actual chromium compounds; the analytical serum is strongly affected by the matrix elements in the extract.

Nickel. For wavelength $\lambda = 232.0$ nm, it has to be selected a spectral band width of 0.2 nm to separate the analytical line from the non-absorbant adjacent lines.

Results and discussions

From the obtained calibration curve, the element content corresponding to the tested sample absorbance and blank sample. Calculate the content ($W$) of the element M in the sample, using the equation:

$$W_M = \frac{(\Lambda_1 - \Lambda_0)}{W} \cdot f \cdot V$$

in which:

- $W_M$ - quantity of element M in the sample, mg/kg
- $\Lambda_1$ - content of element corresponding to the tested sample absorbance, mg/L
- $\Lambda_0$ - content of element corresponding to the absorbance in the blank sample solution, mg/L
- $f$ - dilution factor, if the tested sample was diluted
- $V$ - sample volume taken for analysis, in liters; 0.1L according to ISO 11466
- $m$ - sample weight in kg corrected, compared to water content according to ISO11465, and treated according ISO 11466.

Measurement uncertainty reported for results should reflect the findings from the quality control measurements and should also include the deviation between the individual readings for the sample in question. In general, the values should not be expressed with a degree of accuracy more than two significant figures. Rounding the values depends on the statistic of control procedures of the quality mentioned above and on the analysis requirements.

Comparing the results obtained by extraction in Aqua Regia with those indicated by manufacturer[4-7]for the cement considered in this study and with european directives[1-3], we found Ni, Cr, Co, in relative small quantities.

Conclusions

In conclusion, for the cement considered in this study, were found Ni, Cr, Co in small amounts, but they still exist. The manufacturer does not mention the presence of these elements in the formula that they provided us on request. Perhaps the reason is the fact that it is about very small amounts. However, in some cases, these small amounts are quite sufficient to our patients to develop allergic reactions.

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