Quantitative Determination of some heavy metals in Lipsticks available in Iraqi market

Amal H. Mhemeed *

* Masan University, College of pharmacy  
Email: ahamya12486@yahoo.com

Summary

The U.S. FDA defines cosmetics as "articles intended to be applied to the human body...for cleansing, beautifying, promoting attractiveness, or altering the appearance." This includes a large number of preparations that have become an integral part of the modern human daily life, who starts to apply and use routinely from early morning. These products usually consist of mixture of chemical components derived from natural or artificial sources that are not free of toxic element traces resulting of combination of components themselves or environmental pollution. This materials such as carcinogens or mutagens or metal components may adversely affect human heals. Because of the lack of adequate studies on this subject, in addition to the fact that heavy metals are toxic substances to the human body so this research was aims to determine the concentrations of some heavy metals in some facial cosmetics (lipstick) that are available in the Iraq market, either imported or locally manufactured. We collect 30 samples of lipsticks for 5 trademarks every trademark has 6 colors and applying the method of wet digestion and ashing, we weight 1 g of each sample of lipstick, then prepare the sample with high purity nitric acid 65% then drying and placed in the furnace on heat 550 ° and after cooling has been treated by high purity nitric acid again then determine the concentration of each of lead, cadmium, iron, copper, nickel, cobalt, chromium and zinc using flame atomic absorption spectroscopy. The results showed that the concentrations of lead and cadmium, iron, copper, nickel, chromium and zinc in lipstick were higher than the limit value allowed in drinking water, according to the World Health Organization (WHO) and the iron concentration only surpassed the limit value.
Keywords: atomic absorption spectroscopy, heavy metals, quantitative determination.

Introduction

Cosmetics are that are applied to the body, especially the face, in order to change its appearance (1), it is also known as the care materials used to improve the appearance of the human body or its scent. It usually consists of a mixture of chemical compounds derived from natural or industrial sources (2). In the United States, the U.S. Food and Drug Administration is regulating everything related to cosmetics (3). The US Food and Drug Administration defines cosmetics as substances whose application to the human body aims to cleanse, beautify, enhance the attractiveness, or change the appearance without affecting the body's structure and functions. This broad definition also includes any material intended for use as an ingredient of cosmetic products (4). One of the cosmetics that has been studied is lipstick, which is a colored substance that women put on her lips to make them more attractive (5). The main components of lipstick are candles, such as animal waxes such as beeswax or vegetable waxes such as Carnauba wax, as well as consist of creamy materials that are a complex mixture of heterogeneous components of creamy materials that are rich in triglycerides (6). It also consists of oils such as natural oils, such as olive oil, castor oil, and industrial oils such as silicon oils (7). It also consists of colored materials, and it is a soft industrial or mineral powder, and there are two types of dyes used in lipstick that are dissolved in water or not dissolved in water, and are usually 10-25% ( w/w). Lipstick also contains preservatives, antioxidants and perfumed materials (8). The lipstick is made in three steps, which are melting, mixing and casting in molds, then packing and packaging (9). In this study the concentration of some toxic heavy metals that are not authorized for their presence or amount in some commonly used cosmetics such as lipstick available in the leaqi market was determined which determines the protection of consumers from excessive use of them.

Materials and Methods:
30 lipsticks were chosen from 5 different brands, from 6 different colors from each of which is : {red, orange, Pink, Purple, Beige (light brown), brown}.

Samples preparations
The method of burning and wet incineration was used with heat 50± 500 °C for three and a half hours. [10,11,12,13,14,15,16,17]

**Machines used**
Sensitive electric balance, electric Incineration oven, electrical heater type (Memert), Atomic absorption spectroscopy Company making (Varian) Australian (SpectrAA-200).

**Materials used**
- Porcelain crucibles, capacity 25 ml, clean and dry.
- Calibrated glass pipettes, Glass pipettes graduated.
- Calibration flasks 25 ml.
- Glass funnels clean and dry.
- Graduated tubes, capacity 25 ml.
- Filter papers.

**Chemical used**
- Concentrated nitric acid (65%) Manufacturing company Merck.
- Dense water chlorine acid (37) manufacturing company Merck.
- Distilled water.
- Standard solutions stored for measured metals manufacturing company Merck concentration of each of which (1000ppm).

**Method**
1. Weighing precisely 1 g of each sample of studied lipstick samples using an electric sensitive balance.
2. Each weighted sample shall be placed in a clean, dry porcelain crucible.
3. Each of them is added 0.5 ml of dense nitric acid.
4. Heated all each sample by electric heater until dry and left to cool.
5. Repeat steps 3 and 4 twice.
6. After cooling, the previous crucibles are placed in the incineration furnace with heat 50± 500 °C for three and a half hours and then left to cool.
7. After cooling add 3ml of dense nitric acid to each sample and dry it on the electric heater as in step 4 this process is repeated twice as.
8. Samples are filtered using glass funnels and filter papers.
9. The concentration of each of the minerals studied is measured using an atomic absorption spectroscopy.
**Preparation of standard solutions and witness solutions:**
A witness and standard solution were prepared for each of the measured metals as follows:

- **Prepare the witness solution:**
  3ml of concentrated nitric acid was placed in a 100 ml volumetric flask, and then diluted with distilled water.
  Shake mixture as it is used to define all the analyzed elements.

- **Prepare the standard series as follows**
  The standard solution used was prepared for each of the elements (Lead, cadmium, iron, copper, nickel, cobalt, chrome and zinc) it is a standard solution stored for metal in high purity Manufacturing Company Merck.
  Initially, a standard solution was prepared in concentration 100 ppm by taking 10 ml of the mother's standard solution in a 100 ml volumetric flask, complete the volume with distilled water up to the mark from this solution, the standard ppm series of elements was prepared as follows:
  Standard series of lead 0.5, 1, 1.5 ppm.
  Standard series of Cadmium 0.05, 0.1, 0.2 ppm.
  Standard series of iron 0.05, 0.1, 0.2 ppm.
  Standard series of copper 10, 20, 50 ppm.
  Standard series of Nickel 0.25, 0.5, 1 ppm.
  Standard series of Cobalt 0.5, 1.5, 2ppm.
  Standard series of Chrome 0.5, 1, 1.5 ppm.
  Standard series of zinc 0.25, 0.5, 1ppm.
  And it is prepared according to the following method:
  We take 3 volumetric flasks for each element, each with a capacity of 100 ml
  We put the previously mentioned concentrations of the solution with a concentration of 100ppm according to Moore's law for the preparation of solutions $N_1 \cdot V_1 = N_2 \cdot V_2$, We add to it the same amount of nitric acid added to the samples during processing then we complete the volume with distilled water until the required volume.

**Procedure**
After turning on the machine We calibrate the special hollow lamp (for Each metal is lamp)
By taking the highest absorbency by during calibrating the automatic IUD found in the device
Then, we pass the witness solution and the standard solutions previously prepared on the flame atomic absorption apparatus, so that we get the graph for each metal. That indicates a linear relationship between the standard chain concentrations and the absorbance values corresponding to each concentration. Then, we pass the studied samples, it appears absorbance values, give it corresponding concentrations estimated in ppm, compared to the results of the known concentration standard series.

**Standard analysis of solutions**

1. **Lead:**
   - The length of the wave used / 217.0 nm
   - Slit width / 1.0 nm
   - The stream of the lamp/ 5mA
   - Gas used / Air-Acetylene

   | Absorbance values | Concentration (ppm) | Standard number |
   |-------------------|---------------------|----------------|
   | 0.0011            | 0                   | 0 (witness)    |
   | 0.0193            | 0.5                 | 1              |
   | 0.0372            | 1                   | 2              |
   | 0.0543            | 1.5                 | 3              |

   ![Fig (1): the graph of the lead according to the concentrations of the standard series and Absorbance](image)

2. **Cadmium:**
   - The length of the wave used / 228.8 nm
   - Slit width / 0.5 nm
   - The stream of the lamp/ 4mA
   - Gas used / Air-Acetylene

   | Absorbance values | Concentration (ppm) | Standard number |
   |-------------------|---------------------|----------------|
   | 0.0018            | 0                   | 0 (witness)    |
   | 0.0189            | 0.05                | 1              |
   | 0.0368            | 0.1                 | 2              |
3. Iron:
The length of the wave used / 248.3 nm
Slit width / 0.2nm
The stream of the lamp / 5mA
Gas used / Air-Acetylene

| Absorbance values | Concentration (ppm) | Standard number |
|-------------------|---------------------|-----------------|
| 0.0014            | 0                   | 0 (witness)     |
| 0.0261            | 1                   | 1               |
| 0.0512            | 2                   | 2               |
| 0.1232            | 5                   | 3               |

Fig (2): the graph of the cadmium according to the concentrations of the standard series and Absorbance
Fig (3): the graph of the Iron according to the concentrations of the standard series and Absorbance

4- Copper:
The length of the wave used / 324.7 nm
Slit width / 0.5nm
The stream of the lamp/ 4mA
Gas used / Air-Acetylene

| Absorbance values | Concentration (ppm) | Standard number |
|-------------------|---------------------|----------------|
| 0                 | 0                   | 0 (witness)    |
| 0.2049            | 10                  | 1              |
| 0.4007            | 20                  | 2              |
| 0.9503            | 50                  | 3              |

Fig (4): the graph of the copper according to the concentrations of the standard series and Absorbance
5. **Nickel:**
The length of the wave used / 232.0 nm
Slit width / 0.2nm
The stream of the lamp / 4mA
Gas used / Air-Acetylene

| Absorbance values | Concentration (ppm) | Standard number |
|-------------------|---------------------|-----------------|
| 0                 | 0                   | 0 (witness)     |
| 0.023             | 0.25                | 1               |
| 0.0452            | 0.5                 | 2               |
| 0.0667            | 1                   | 3               |

![Graph](image)

**Fig (5):** the graph of the nickel according to the concentrations of the standard series and Absorbance

6. **Cobalt:**
The length of the wave used / 240.7 nm
Slit width / 0.2nm
The stream of the lamp / 7mA
Gas used / Air-Acetylene

| Absorbance values | Concentration (ppm) | Standard number |
|-------------------|---------------------|-----------------|
| 0.000             | 0                   | 0 (witness)     |
| 0.0378            | 0.5                 | 1               |
| 0.0726            | 1                   | 2               |
| 0.1402            | 2                   | 3               |
Fig (6): the graph of the cobalt according to the concentrations of the standard series and Absorbance

7. Chrome:
The length of the wave used / 357.9 nm
Slit width / 0.2nm
The stream of the lamp / 7mA
Gas used / Air-Acetylene

| Absorbance values | Concentration (ppm) | Standard number |
|-------------------|---------------------|-----------------|
| 0.0013            | 0                   | 0 (witness)     |
| 0.0156            | 0.5                 | 1               |
| 0.0287            | 1                   | 2               |
| 0.0418            | 1.5                 | 3               |

Fig (7): the graph of the chrome according to the concentrations of the standard series and Absorbance
8. Zinc:
The length of the wave used / 213.9 nm
Slit width / 1.0nm
The stream of the lamp/ 5mA
Gas used / Air-Acetylene

| Absorbance values | Concentration (ppm) | Standard number |
|-------------------|---------------------|-----------------|
| 0.0016            | 0                   | 0 (witness)     |
| 0.1529            | 0.25                | 1               |
| 0.2953            | 0.5                 | 2               |
| 0.4475            | 1                   | 3               |

Fig (8): the graph of the zinc according to the concentrations of the standard series and Absorbance

Results
Lipstick results:

1. Lead:
Table (1) shows lead concentrations in studied lipstick samples, estimated in (ppm).

| Brand number studied | |
|----------------------|--|
| Sample color for lipstick | Lead concentrations ppm |
|--------------------------|-------------------------|
| Red                      | 6.911 11.011 22.116 14.755 7.905 |
| Orange                   | 7.194 12.033 15.104 9.531 11.345 |
| Pink                     | 4.116 9.890 9.198 31.484 4.922 |
| Purple                   | 5.202 6.176 16.344 27.686 6.763 |
| Beige                    | 8.955 3.204 5.002 11.990 7.546 |
| Brown                    | 4.022 11.662 6.991 4.688 15.822 |

2. Cadmium:
Table (2) shows cadmium concentrations in studied lipstick samples, estimated in (ppm).

| Brand number studied | Cadmium concentration ppm |
|----------------------|---------------------------|
| Fifth                | Fourth | Third | Second | First |
| 0.491               | 0.827  1.842 0.983 0.658 | red   |
| 0.368               | 0.463  1.361 1.845 0.563 | orange|
| 0.291               | 0.743  0.766 2.098 0.411 | Pink  |
| 0.511               | 0.904  1.258 1.258 0.945 | Purple|
| 0.634               | 0.242  0.416 0.798 0.628 | Beige |
| 0.284               | 0.826  0.525 0.392 1.044 | brown |
3. Iron:
Table (3) shows iron concentrations in studied lipstick samples, estimated in (ppm).

| Sample color for lipstick | Iron concentration ppm |
|---------------------------|------------------------|
| Fifth                     | 266.113                |
| Fourth                    | 396.361                |
| Third                     | 871.411                |
| Second                    | 450.861                |
| First                     | 308.333                |
| red                       |                        |
| Orange                    | 200.315                |
| First                     | 433.225                |
| Fourth                    | 275.484                |
| Third                     | 1041.032               |
| Second                    | 294.332                |
| First                     | 191.998                |
| Pink                      | 158.506                |
| First                     | 222.373                |
| Fourth                    | 197.038                |
| Third                     | 554.825                |
| Second                    | 263.795                |
| First                     | 200.315                |
| Pink                      | 277.007                |
| Fifth                     | 356.075                |
| Fourth                    | 595.138                |
| Third                     | 358.327                |
| Second                    | 442.493                |
| First                     | 617.098                |
| Beige                     | 344.807                |
| Fifth                     | 419.867                |
| Fourth                    | 643.994                |
| Third                     | 1183.835               |
| Second                    | 617.098                |
| First                     |                        |
| Brown                     |                        |

4. Copper:
Table (4) shows copper concentrations in studied lipstick samples, estimated in (ppm).

| Sample color for lipstick | Copper concentration ppm |
|---------------------------|--------------------------|
| Fifth                     | 3.874                    |
| Fourth                    | 6.706                    |
| Third                     | 14.561                   |
| Second                    | 8.107                    |
| First                     | 5.261                    |
| red                       |                          |
| Orange                    | 4.032                    |
| Fifth                     | 7.328                    |
| Fourth                    | 10.766                   |
| Third                     | 15.208                   |
| Second                    | 4.508                    |
| First                     |                          |
| Orange                    |                          |
| Pink                      | 2.308                    |
| Fifth                     | 6.023                    |
| Fourth                    | 6.055                    |
| Third                     | 6.588                    |
| Second                    | 3.272                    |
| First                     |                          |
| Pink                      |                          |
| Purple                    | 2.914                    |
| Fifth                     | 3.763                    |
| Fourth                    | 3.293                    |
| Third                     | 5.234                    |
| Second                    | 5.032                    |
| First                     |                          |
| Purple                    |                          |
| Beige                     | 5.017                    |
| Fifth                     | 6.800                    |
| Fourth                    | 9.933                    |
| Third                     | 17.288                   |
| Second                    | 7.566                    |
| First                     |                          |
| Beige                     |                          |
| Brown                     | 2.255                    |
| Fifth                     | 1.953                    |
| Fourth                    | 4.152                    |
| Third                     | 3.221                    |
| Second                    | 8.433                    |
| First                     |                          |
| Brown                     |                          |

5. Nickel:
Table (5) shows nickel concentrations in studied lipstick samples, estimated in (ppm).
Nickel concentration ppm

| Fifth | fourth | Third | Second | First | Nickel concentration ppm |
|-------|--------|-------|--------|-------|--------------------------|
| 0.784 | 0.826  | 0.641 | 1.012  | 0.682 | red                      |
| 0.663 | 2.544  | 1.041 | 1.903  | 0.448 | orange                   |
| 0.723 | 0.583  | 1.018 | 0.664  | 0.386 | Pink                     |
| 0.744 | 0.704  | 0.973 | 0.533  | 2.474 | Purple                   |
| 0.498 | 0.861  | 0.817 | 0.823  | 1.930 | Beige                    |
| 0.823 | 1.068  | 3.306 | 0.921  | 3.347 | brown                    |

6. Cobalt:
Table (6) shows cobalt concentrations in studied lipstick samples, estimated in (ppm).

| Cobalt concentration ppm |
|--------------------------|
| 0.423  | 0.446  | 0.265  | 0.106  | 0.658  | red             |
| 0.362  | 0.318  | 0.098  | 0.000  | 0.137  | orange          |
| 0.376  | 0.343  | 0.158  | 0.283  | 0.308  | Pink            |
| 0.331  | 0.458  | 0.156  | 0.353  | 0.401  | Purple          |
| 0.323  | 0.542  | 0.318  | 0.268  | 0.395  | Beige           |
| 0.577  | 1.137  | 0.841  | 0.367  | 1.464  | brown           |

7. Chrome:
Table (7) shows chrome concentrations in studied lipstick samples, estimated in (ppm).

| Chrome concentration ppm |
|--------------------------|
| 0.681  | 1.088  | 2.212  | 1.492  | 0.792  | red             |
8. Zinc:
Table (8) shows zinc concentrations in studied lipstick samples, estimated in (ppm).

| Sample color for lipstick | Zinc concentration ppm |
|---------------------------|------------------------|
| orange                    | 0.895                  |
| Pink                      | 0.413                  |
| Purple                    | 0.721                  |
| Beige                     | 0.522                  |
| brown                     | 0.401                  |

A statistical study of the concentration of each of the heavy metals studied in lipstick samples according to the trademark of each.

1. Lead results/

| trade mark | Number of samples studied | The average | standard deviation | Minimum value | The highest value |
|------------|---------------------------|-------------|--------------------|---------------|-------------------|
| First      | 6                         | 9.052       | 3.924              | 4.923         | 15.823            |
| Second     | 6                         | 16.690      | 10.592             | 4.689         | 31.485            |
| Third      | 6                         | 12.460      | 6.504              | 5.001         | 22.117            |
2. Cadmium results:

Table (10) Descriptive statistical study of cadmium metal in studied lipstick samples

| trade mark | Number of samples studied | The average | standard deviation | Minimum value | The highest value |
|------------|---------------------------|-------------|--------------------|---------------|------------------|
| First      | 6                         | 0.710       | 0.243              | 0.410         | 1.055            |
| second     | 6                         | 1.126       | 0.689              | 0.391         | 2.099            |
| third      | 6                         | 1.029       | 0.552              | 0.417         | 1.843            |
| fourth     | 6                         | 0.668       | 0.259              | 0.241         | 0.905            |
| fifth      | 6                         | 0.430       | 0.138              | 0.285         | 0.635            |
| Total      | 30                        | 0.793       | 0.475              | 0.241         | 2.099            |

Cadmium concentration rates in lipstick samples table (10)

3. Iron results:

Table (11) Descriptive statistical study of iron metal in studied lipstick samples

| trade mark | Number of samples studied | The average | standard deviation | Minimum value | The highest value |
|------------|---------------------------|-------------|--------------------|---------------|------------------|
| First      | 6                         | 353.009     | 153.018            | 191.997       | 617.097          |
| second     | 6                         | 627.531     | 398.254            | 176.306       | 1183.836         |
| third      | 6                         | 490.917     | 256.262            | 197.039       | 871.410          |
| fourth     | 6                         | 323.880     | 127.464            | 115.380       | 433.224          |
| fifth      | 6                         | 233.605     | 323.880            | 154.886       | 344.806          |
| Total      | 30                        | 405.788     | 257.394            | 115.380       | 1183.836         |

Iron concentration rates in lipstick samples table (11)
4. Copper results:

Table (12) Descriptive statistical study of copper metal in studied lipstick samples

| trade mark | Number of samples studied | The average | standard deviation | Minimum value | The highest value |
|------------|--------------------------|-------------|-------------------|---------------|------------------|
| First      | 6                        | 5.683       | 1.943             | 3.282         | 8.439            |
| second     | 6                        | 9.276       | 5.677             | 3.220         | 17.296           |
| third      | 6                        | 8.128       | 4.361             | 3.292         | 14.560           |
| fourth     | 6                        | 5.412       | 2.101             | 1.952         | 7.329            |
| fifth      | 6                        | 3.400       | 1.094             | 2.254         | 5.018            |
| Total      | 30                       | 6.380       | 3.867             | 1.952         | 17.296           |

Copper concentration rates in lipstick samples table (12)

5. Nickel results:

Table (13) Descriptive statistical study of nickel metal in studied lipstick samples

| trade mark | Number of samples studied | The average | standard deviation | Minimum value | The highest value |
|------------|--------------------------|-------------|-------------------|---------------|------------------|
| First      | 6                        | 1.546       | 1.228             | 0.387         | 3.346            |
| second     | 6                        | 1.142       | 0.617             | 0.534         | 1.920            |
| third      | 6                        | 1.299       | 0.994             | 0.640         | 3.305            |
| fourth     | 6                        | 1.097       | 0.727             | 0.582         | 2.545            |
| fifth      | 6                        | 0.705       | 0.115             | 0.497         | 0.823            |
| Total      | 30                       | 1.158       | 0.818             | 0.387         | 3.346            |

Nickel concentration rates in lipstick samples table (13)

6. Cobalt results:

Table (14) Descriptive statistical study of cobalt metal in studied lipstick samples

| trade mark | Number of samples studied | The average | standard deviation | Minimum value | The highest value |
|------------|--------------------------|-------------|-------------------|---------------|------------------|
| First      | 6                        | 0.561       | 0.473             | 0.138         | 1.463            |
| second     | 6                        | 0.230       | 0.146             | 0             | 0.368            |
| third      | 6                        | 0.310       | 0.277             | 0.099         | 0.851            |
|        | Number of samples studied | The average | standard deviation | Minimum value | The highest value |
|--------|---------------------------|-------------|-------------------|---------------|------------------|
| Fourth | 6                         | 0.540       | 0.304             | 0.317         | 1.136            |
| Fifth  | 6                         | 0.340       | 0.095             | 0.323         | 0.578            |
| Total  | 30                        | 0.408       | 0.300             | 0             | 1.463            |

Cobalt concentration rates in lipstick samples table (14)

7. Chrome results:

| trade mark | Number of samples studied | The average | standard deviation | Minimum value | The highest value |
|------------|---------------------------|-------------|-------------------|---------------|------------------|
| First      | 6                         | 0.905       | 0.392             | 0.492         | 1.582            |
| second     | 6                         | 1.686       | 1.070             | 0.474         | 3.180            |
| third      | 6                         | 1.246       | 0.650             | 0.500         | 2.212            |
| fourth     | 6                         | 0.890       | 0.350             | 0.317         | 1.190            |
| fifth      | 6                         | 0.607       | 0.195             | 0.402         | 0.896            |
| Total      | 30                        | 1.067       | 0.683             | 0.317         | 3.180            |

Chrome concentration rates in lipstick samples table (15)

8. Zinc results:

| trade mark | Number of samples studied | The average | standard deviation | Minimum value | The highest value |
|------------|---------------------------|-------------|-------------------|---------------|------------------|
| First      | 6                         | 2.987       | 1.295             | 1.625         | 5.222            |
| second     | 6                         | 5.900       | 3.745             | 1.658         | 11.131           |
| third      | 6                         | 4.735       | 2.472             | 1.900         | 8.404            |
| fourth     | 6                         | 3.115       | 1.226             | 1.110         | 4.166            |
| fifth      | 6                         | 2.184       | 0.703             | 1.448         | 3.224            |
| Total      | 30                        | 3.784       | 2.444             | 1.110         | 11.131           |

Chrome concentration rates in lipstick samples table (16)
Conclusions

By studying the previous minerals in lipstick we conclude:

1. Concerning lead, its concentrations in the studied samples of lipstick exceeded the maximum permitted level in drinking water according to the World Health Organization (WHO) most of their concentrations did not exceed the maximum permitted level in lipstick. This requires increased attention to the presence of lead metal in lipstick as it is a toxic metal on the body when ingested chronically.

2. With regard to cadmium, its concentrations in the studied samples of lipstick exceeded the maximum permitted level in drinking water according to the World Health Organization (WHO) However, it did not exceed the maximum permitted level in lipstick, and this requires increased attention to the presence of cadmium metal in lipstick, as it is toxic metal on the kidneys and bones when eaten chronically.

3. With regard to iron, its concentrations in the studied samples of lipstick exceeded the maximum permissible presence in drinking water according to the World Health Organization (WHO), as it exceeded the maximum permitted level in lipstick; this is considered a risk because iron works to form free radicals in the body and thus cellular necrosis occurs.

4. With regard to copper, its concentrations in the studied samples of lipstick exceeded the maximum permitted level in drinking water, according to the World Health Organization (WHO) However, it did not exceed the maximum permitted level in lipstick, and this requires increasing attention to the presence of copper metal in lipstick and working to find ways to reduce it wherever possible.

5. With regard to nickel, its concentrations in the studied samples of lipstick exceeded the maximum permitted level in drinking water according to the World Health Organization (WHO) However, it did not exceed the upper limit allowed in lipstick, and this requires increased attention to the presence of nickel metal in lipstick and work to find ways to reduce it as possible.

6. With regard to cobalt, its concentrations in the studied samples of lipstick did not exceed the maximum permissible presence in drinking water according to
the World Health Organization, nor did it exceed the maximum permitted level in lipstick.

7. With regard to chromium, its concentrations in the studied samples of lipstick exceeded the maximum permissible presence in drinking water according to the World Health Organization, but it did not exceed the maximum permissible presence in lipstick.

8. With regard to zinc, its concentrations in almost half of the studied samples of lipstick exceeded the maximum permissible presence in drinking water according to the World Health Organization, but it did not exceed the maximum permissible presence in lipstick, and this requires increased attention to the presence of zinc metal in lipstick and work to find ways to lower them.

9. The presence of iron metal has been linked to certain colors, which are red, brown, light brown, and orange. This indicates the use of dyes containing iron in its chemical composition, such as iron oxide.

10. The presence of copper metal has been associated with certain colors in lipstick, which are red, light brown, and orange. This indicates the use of dyes containing copper in its chemical composition, such as bronze copper powder.

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