

# Quantification Of Heavy Metals In The Various Branded Face Wash Available In The Bangladeshi Markets.

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**Abstract:** The current study has played an important role for the determination of heavy metals in the different types of face wash. In this study, 32 samples of 15 branded face wash were gathered from the local market in Bangladesh. The analysis of these samples has performed using Atomic Absorption Spectrophotometer (AAS). A total of 16 samples are herbal and also 16 are synthetic out of 32 samples. The range of heavy metal concentration for synthetic face wash was obtained (0.55 – 11.35)ppm for iron followed by BDL for cobalt, (BDL – 0.50)ppm for nickel, (BDL – 0.66)ppm for copper, (0.28 – 10.92)ppm for zinc, (BDL – 0.21)ppm for lead, BDL for cadmium, (BDL – 0.51)ppm for manganese and (BDL – 7.19)ppm for chromium. On the other hand herbal face wash samples contain the range of heavy metals as (0.80 – 1358.46)ppm for iron followed by BDL for cobalt, (BDL – 0.43)ppm for nickel, (BDL – 1.85)ppm for copper, (0.37 – 136.77)ppm for zinc, (BDL – 28.13)ppm for lead, (BDL – 0.02)ppm for cadmium, (BDL – 32.17)ppm for manganese and (BDL – 14.95)ppm for chromium. It was referred that very high concentration of iron has found in three herbal samples. One herbal product also contains high concentration of lead. The excess range of chromium has found in one synthetic and two herbal products. It was observed that four herbal samples hold the high concentration of zinc and also two herbal products contain excess amount of manganese. The high mean value of iron was obtained from both synthetic (as 5.58ppm) and herbal (as 166.42ppm) face washes. It was noted that the low mean value was found for both cobalt and cadmium in synthetic samples where only the cobalt has shown low mean value in herbal samples.

**Keywords:** Heavy metals, face wash, synthetic, herbal, diseases and Bangladesh.

## 1. Introduction

Cosmetics are well known substances applied to increase beauty of the different parts of human body like skin, hair, nails, eyes, teeth, lips, face etc. Various types of cosmetics including face wash, soap lipstick, talcum and face powder, shampoo, shaving cream, mascara, lip liner, eye liner, skin cream, body lotion, nail polish etc. are available in the world made by a large number of worldwide branded companies. In present, depending on the public demand these cosmetics are produced in both herbal and synthetic forms. The individual item of cosmetics is utilized in the specific field. Face wash is an important substance used to wash our face for removing natural oil from our skin. It is also more essential for keeping the skin supple as well as smooth by removing dust and moisture. Cosmetics may be contaminated with heavy metals such as Pb, Cd, Mn, Co, Ni, Fe, Zn, Cr, and Cu etc. from different sources. These are very hazardous pollutants persist in the environment due to unlawful use of pesticides and fertilizer. The other sources of heavy metal are included disposal of industrial waste in open place without pretreatment, through the domestic waste here and there, use of adulterated fuel in the vehicle etc. Heavy metals are un-biodegradable having long half lives. Lead is a very dangerous toxic metal and is also common pollutant in different types of cosmetic products [1]. The main sources of lead are metal pipes and wires, lead-acid batteries, paint chips, fertilizer and other industrial wastes. Renal diseases, weakness of nervous system, deficiency of intelligence may arise in human body cause of harmful effect of lead [2]. Cadmium is appeared due to burning of coal and the incineration of municipal waste. It is accountable for heart disease, liver disease, bone degradation, hypertension etc [3]. Zinc is a very important in human diet. In the absence of zinc, human can suffer skin sores, decreasing sense of taste and odor, loss of appetite and sexual weakness. But over doses of zinc must be harmful to health. Nevertheless, both zinc and copper are very essential to maintain the nutritional value of skin [4], [5]. Chromium is a toxic metal released from

industrial sources such as tanneries, chrome pigment production, metal processing etc. Two forms of chromium viz. trivalent and hexavalent are available in the nature. Though trivalent chromium is beneficial for human body but the hexavalent chromium is deadly injurious and liable to cancer, cell damage, eczema and other skin diseases [6]. A common element named nickel is usually obtained from food, water, plant etc [7]. Other sources of nickel are coins, glass frames, and different domestic items. Nickel is responsible for skin diseases including allergic skin reaction [8], [9], [10]. Eczema, erythema and lichenification of the hand as well as other area of the skin are appeared by nickel dermatitis [6]. Manganese is generally found in food, air, ground and surface water. It is very helpful for human body to check anemia and osteoporosis. But it should be remember that, manganese is beneficial to human body in amount up to 11 mg per day. It is therefore, excess amount of manganese can cause liver disease. Iron is an element which occurs in nature from different sources such as iron industries, ore, various types of food and water. It is an important nutrient able to hemoglobin formation, build up healthy muscle and prevent anemia. But over doses of iron may cause constipation, stomach pain and upset as well as vomiting and diarrhea.

## 2. Materials and Methods

**2.1 Sampling:** Various branded face wash were collected from market situated in the different zone of Bangladesh. These were prepared as samples for analysis by following a method named AOAC Official Method (2005). Weighed almost 5g of each sample in an evaporating dish and transferred to the electrical oven. The samples were dried in the oven at (100±5) °C for about thirty minutes. Then the sample containing dishes were placed in a furnace and ignited at 525°C temperature for five hours. The ashes were obtained in white color and these were also free from carbon. Each evaporating dish having white ash was contacted to 5ml of 1M HNO<sub>3</sub> and warmed up on a hot plate

for five minutes. Then allowed to cool for a few moments and filtered into 100ml of volumetric flask using filter paper (Whatman No 42). The samples were diluted to the mark with deionized water.

**2.2 Analysis of samples:** The prepared samples were running through Atomic Absorption Spectrophotometer (Thermo Scientific, iCE-3000, USA) to detect the concentration of heavy metals viz. iron, cobalt, nickel, copper, zinc, lead, cadmium, manganese and chromium. After every six samples were analyzed, the first sample was further run through AAS for assessment of accuracy.

**3. Result and Discussion**

The present study was carried out to quantify the heavy metals in both synthetic and herbal face wash samples originated from different countries with different brands. A total of 32 samples of 15 brands were included in these research activities [Table 1 & 2]. It was mentioned that, in synthetic face wash samples, the lowest amount of iron was found in F<sub>13</sub> as 0.55ppm and the highest concentration was found in F<sub>11</sub> as 11.35ppm. Nickel was obtained as 0.50ppm in only one sample named F<sub>3</sub>. The concentration of copper was found from five samples such as F<sub>2</sub>, F<sub>3</sub>, F<sub>4</sub>, F<sub>8</sub> and F<sub>9</sub> in the amount of 0.18ppm, 0.08ppm, 0.04ppm, 0.11ppm and 0.66ppm respectively. The highest quantity of zinc (as 10.92ppm) was found in F<sub>11</sub> and also the lowest concentration (as 0.28ppm) was observed in F<sub>13</sub>. Lead was found in ten samples like F<sub>1</sub>, F<sub>2</sub>, F<sub>3</sub>, F<sub>5</sub>, F<sub>7</sub>, F<sub>8</sub>, F<sub>9</sub>, F<sub>10</sub>, F<sub>11</sub> and F<sub>12</sub> as 0.06ppm, 0.21ppm, 0.18ppm, 0.11ppm, 0.09ppm, 0.14ppm, 0.15ppm, 0.08ppm, 0.14ppm and 0.18ppm respectively. The concentration of cobalt and cadmium has nothing found [Table 1]. The highest quantity of manganese was 0.51ppm obtained from F<sub>3</sub> where the samples named F<sub>13</sub> and F<sub>15</sub> have shown the concentration in Below Detection Level (BDL). According to World Health Organization (WHO) guidelines the concentration level of heavy metal in synthetic face wash did not exceed the permissible limit [11]. But it was mentioned that according to European Union law chromium was found in only one sample named F<sub>2</sub> (7.19ppm) above the acceptable limit (1.0µg/g) [1] [Table 1]. The order of mean value of heavy metals concentration in synthetic face wash has shown as follows [Table 1]:

$$Fe > Zn > Cr > Mn > Pb > Cu > Ni$$

Further, the current study also represented that, in herbal face wash samples, the amount of iron was obtained in the range of (0.80 – 1358.46)ppm. The highest concentration of iron was found in HF<sub>2</sub> where the lowest one was found in HF<sub>4</sub>. Cobalt has nothing found and nickel has found in just one herbal sample like HF<sub>10</sub> (as 0.43ppm). Three samples viz. HF<sub>2</sub>, HF<sub>9</sub> and HF<sub>10</sub> have shown the concentration of copper as 0.61ppm, 1.52ppm and 1.85ppm respectively. The high quantity (as 136.77ppm) of zinc was found in HF<sub>5</sub> and the poor amount (as 0.37ppm) was found in HF<sub>8</sub>. Lead was obtained from eight samples viz. HF<sub>1</sub> (as 0.06ppm), HF<sub>2</sub> (as 0.32ppm), HF<sub>3</sub> (as 0.07ppm), HF<sub>5</sub> (as 28.13ppm), HF<sub>7</sub> (as 0.25ppm), HF<sub>9</sub> (as 4.17ppm), HF<sub>10</sub> (as 3.77ppm) and HF<sub>11</sub> (as 0.15ppm). According to WHO guidelines, one sample named HF<sub>5</sub> has extremely crossed the permissible limit (as 10ppm) of lead [11]. Cadmium was obtained from

only one sample (HF<sub>9</sub>) in a trace amount as 0.02ppm which is negligible. Manganese was found in the amount of 32.17ppm for HF<sub>9</sub> as the highest concentration and also found as BDL in HF<sub>6</sub>. Chromium was obtained from four herbal face wash samples such as HF<sub>2</sub>, HF<sub>9</sub>, HF<sub>10</sub> and HF<sub>13</sub> in the quantity of 2.63ppm, 11.48ppm, 14.95ppm and 0.46ppm correspondingly. It was noted that two samples named HF<sub>9</sub> and HF<sub>10</sub> were exceeded the acceptable limit (10µg/g) according to European Union law [1]. The mean value of iron, cobalt, nickel, copper, zinc, lead, cadmium, manganese and chromium was observed as 166.42ppm, BDL, 0.03ppm, 0.25ppm, 17.53ppm, 2.31ppm, 0.001ppm, 4.85ppm and 1.85ppm respectively [Table 2]. The order of mean value for heavy metal in herbal face wash samples has given below [Table 2]:

$$Fe > Zn > Mn > Pb > Cr > Cu > Ni > Cd > Co$$

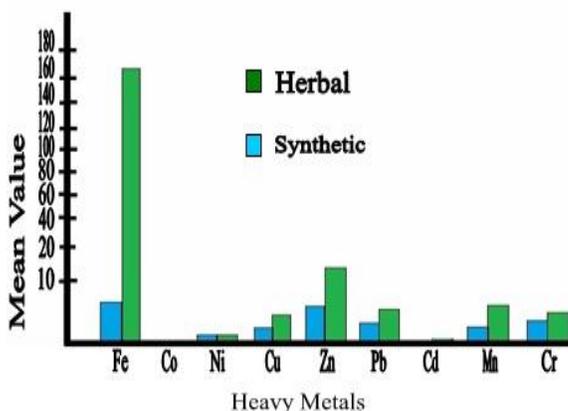


Fig 1: Comparison of the mean values for heavy metals between synthetic and herbal face wash (ppm)

Table 1: Heavy metal concentration (ppm) in synthetic face wash.

Brands	Sample ID	Origin	Concentration of heavy metals (ppm)								
			Fe	Co	Ni	Cu	Zn	Pb	Cd	Mn	Cr
I	F <sub>1</sub>	India	3.46	BDL	BDL	BDL	2.23	0.06	BDL	0.11	BDL
	F <sub>2</sub>	India	2.52	BDL	BDL	0.18	1.69	0.21	BDL	0.11	7.19
	F <sub>3</sub>	Indonesia	9.29	BDL	0.50	0.08	4.10	0.18	BDL	0.51	BDL
	F <sub>4</sub>	Indonesia	2.82	BDL	BDL	0.04	1.22	BDL	BDL	0.12	BDL
	F <sub>5</sub>	Thailand	4.67	BDL	BDL	BDL	7.18	0.11	BDL	0.17	BDL
III	F <sub>6</sub>	England	2.06	BDL	BDL	BDL	1.14	BDL	BDL	0.26	BDL
	F <sub>7</sub>	India	1.79	BDL	BDL	BDL	0.49	0.09	BDL	0.13	BDL
IV	F <sub>8</sub>	India	9.44	BDL	BDL	0.11	8.50	0.14	BDL	0.47	BDL
	F <sub>9</sub>	India	9.56	BDL	BDL	0.66	1.40	0.15	BDL	0.16	BDL
	F <sub>10</sub>	India	4.19	BDL	BDL	BDL	4.38	0.08	BDL	0.11	BDL
	F <sub>11</sub>	India	11.35	BDL	BDL	BDL	10.92	0.14	BDL	0.40	BDL
V	F <sub>12</sub>	Thailand	8.15	BDL	BDL	BDL	2.66	0.18	BDL	0.44	BDL
VII	F <sub>13</sub>	Thailand	0.55	BDL	BDL	BDL	0.28	BDL	BDL	BDL	BDL
	F <sub>14</sub>	Ireland	1.54	BDL	BDL	BDL	0.80	BDL	BDL	0.07	BDL
IX	F <sub>15</sub>	India	8.81	BDL	BDL	BDL	1.08	BDL	BDL	BDL	BDL
	F <sub>16</sub>	India	9.13	BDL	BDL	BDL	1.12	BDL	BDL	0.08	BDL
Mean			5.58	BDL	0.03	0.07	3.07	0.08	BDL	0.20	0.45

\*BDL: Below Detection Limit

Table 2: Heavy metal concentration (ppm) in herbal face wash.

Brands	Sample ID	Origin	Concentration of heavy metals (ppm)								
			Fe	Co	Ni	Cu	Zn	Pb	Cd	Mn	Cr
II	HF <sub>1</sub>	India	8.05	BDL	BDL	BDL	5.20	0.06	BDL	0.68	BDL
	HF <sub>2</sub>	India	1358.46	BDL	BDL	0.61	10.87	0.32	BDL	13.95	2.63
	HF <sub>3</sub>	India	4.38	BDL	BDL	BDL	0.83	0.07	BDL	0.07	BDL
IV	HF <sub>4</sub>	England	0.80	BDL	BDL	BDL	1.58	BDL	BDL	0.07	BDL
	HF <sub>5</sub>	India	1.98	BDL	BDL	BDL	136.77	28.13	BDL	0.09	BDL
V	HF <sub>6</sub>	USA	1.02	BDL	BDL	BDL	0.70	BDL	BDL	BDL	BDL
VI	HF <sub>7</sub>	USA	19.94	BDL	BDL	BDL	0.50	0.25	BDL	0.35	BDL
	HF <sub>8</sub>	USA	1.39	BDL	BDL	BDL	0.37	BDL	BDL	0.03	BDL
VIII	HF <sub>9</sub>	India	599.12	BDL	BDL	1.52	49.93	4.17	0.02	32.17	11.48
	HF <sub>10</sub>	India	632.98	BDL	0.43	1.85	28.33	3.77	BDL	29.17	14.95
X	HF <sub>11</sub>	China	6.39	BDL	BDL	BDL	3.51	0.15	BDL	0.16	BDL
XI	HF <sub>12</sub>	Malaysia	1.06	BDL	BDL	BDL	1.10	BDL	BDL	0.04	BDL
XII	HF <sub>13</sub>	England	2.95	BDL	BDL	BDL	23.67	BDL	BDL	0.15	0.46
XIII	HF <sub>14</sub>	Bangladesh	6.41	BDL	BDL	BDL	6.68	BDL	BDL	0.19	BDL
XIV	HF <sub>15</sub>	Bangladesh	14.57	BDL	BDL	BDL	6.60	BDL	BDL	0.46	BDL
XV	HF <sub>16</sub>	India	3.34	BDL	BDL	BDL	3.91	BDL	BDL	0.06	BDL
Mean			166.42	BDL	0.03	0.25	17.53	2.31	0.001	4.85	1.85

\*BDL: Below Detection Limit

#### 4. Conclusion

The study has performed to determine the concentration of heavy metals such as chromium, manganese, iron, cobalt, nickel, copper, zinc, lead and cadmium in fifteen branded face wash samples. These products were manufactured by different companies from nine countries like Bangladesh, India, Indonesia, Thailand, England, USA, China, Ireland and Malaysia. From this study it was finally observed that synthetic samples did not contain excess amount of heavy metals except F<sub>2</sub> which was contained 7.19ppm of chromium. Conversely one herbal face wash sample like HF<sub>5</sub> has exceeded the permissible level of lead. Moreover two herbal samples such as HF<sub>9</sub> and HF<sub>10</sub> have crossed the acceptable limit of chromium. From overall assessment it was determined that in both synthetic and herbal face wash samples altogether four samples out of thirty two have contained the excess amount of different heavy metals. Though it is impossible to produce absolutely heavy metals free cosmetic products but it is very necessary to control the concentration level of heavy metals in cosmetics for the sake of reducing public health risk.

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