Influence of Benzene Exposure on Hematological Variables in the Workers of the Fuel Filling Station

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Abstract. The purpose of the present study is to find the impact of benzene and its components on some aspects of hematological parameters in the blood of workers in the filling stations as blood samples were collected, studied and synthesized from (60 people) of people working in filling stations in Kirkuk and in direct contact with gasoline and (60 people) of people who do not work in gas stations and considered as a control group. The laboratory tests were conducted and included: blood tests include a Complete Blood Count, WBC, RBC, Hb, ESR, Plat. count and the biochemical test (T.S.P). The results of the study showed a little difference in the levels of the CBC, ESR as well as measure total serum protein in the blood of workers, compared with the control group. Non-significant differences in the values of white blood cell count, erythrocyte sedimentation rate, and hemoglobin.

Keywords: Benzene exposure, blood count, RBC, WBC, hematology.

1. Introduction

Benzene: is an important component of petrol, is a widely distributed environmental contaminant. It is a mixture derived from crude oil which is a hydrocarbon net and its chemical formula C6H6 and its molecular weight (78.12 g/mmol) the physical properties and under standard conditions, it is a colorless liquid or a pale yellow which is fast evaporation, fast ignition in the air and its melting rate in water reaches (1.8 g/L)Boiling point (80.1) Celsius and steam density 2.77 and rather pleasant odor [1]. Today, about 98% [2] of the benzene is derived from the petrochemical and petroleum refining industries. Therefore, occupational exposure to benzene in humans generally takes place in factories, refineries, and other industrial settings. Moreover, the general population is exposed to benzene contained in petrol, vehicle exhaust, and diesel fuel and cigarette Smoke. Occupational exposure to benzene has mainly been associated with increased incidences of blood disorders such as aplastic anemia, leukemia, lymphoma, and myelodysplastic syndrome (MDS) chronic myeloid and acute lymphoid leukemia and non-Hodgkin's lymphomas [1]. Gasoline enters into the manufacture of many needs, including plastics, nylon, and synthetic fibers and enters into the manufacture of certain types of oils, greases, rubber, dyes, detergents, medicines and pesticides in addition to fuel, humans nowadays exposed to quantities of gasoline daily because of its presence in the air And water and the soil is considered to be natural and industrial sources [3].

IMDC-SDSP 2020, June 28-30, Cyberspace

DOI 10.4108/eai.28-6-2020.2298212

The gasoline ring was first discovered in 1825 by the English world Faradi Micheal, when it was isolated from gas oil and in 1833 the German scientist Alhard Metsherlitshis produced it by distillation of benzoic acid and lime and then the English Sharolen masphild in 1845 isolated gasoline from Coal tar in 1948 he produced gasoline from the coal mine[4]. In the United state, for example, the average individual gasoline is exposed to smoking tobacco cigarettes by 50% and the car exhaust by 20% [5]. The first human infection with white blood cell cancer was in 1928 as a result of the exposure to gasoline, and this case was called poison gas, and it was caused by the bone marrow [6].

Exposure to gasoline fumes leads to a defect in the manufacture of hymochlorin, with a noticeable decrease in the concentration of Haemopenia in the blood of workers exposed to gasoline, as well as the decrease in the number of erythrocytes and the concentration of hymoclloben in male guinea pigs when exposed to the same human exposure conditions [7-8]. Studies have shown that there is a great correlation between the exposure to gasoline and the white blood cell carcinoma as the cells originate from the bone marrow so that when the infection occurs, the cells will accumulate in the bone marrow, causing the state of leukemia, as it does not leave its maturity and thus leads to a small number of pellets Red blood and white blood cells in the body add to it the thrombocytopenia and the incidence of anemia [7]. In another study, it was noted that a deficiency in the concentration of Hemoglobin had been recorded as a result of exposure to leaded gasoline and other compounds, as well as for erythrocytes and erythrocyte deposition rate, but noted that there had been a noticeable increase in the number of white blood cells and the number of platelets [9].

Inhalation of very high rates of gasoline can cause death, While only high proportions may cause dizziness, drowsiness, and acceleration heartbeats, headaches, dislocations, disorder, absence from consciousness. Eating foods with high proportions can also cause of gasoline or drank in the occurrence of vomiting, stomach irritation, dizziness, drowsiness, and violent convulsions, accelerated heartbeat, and finally death. The main effect of long-term exposure to gasoline is limited to blood [10]. Gasoline causes harmful effects on the bone marrow and can cause a decrease in red blood, leading to anemia [11].

It can also cause severe bleeding and affect the immune system, which increases the chance of infection. Some women who inhale high rates of gasoline for many months have suffered Irregular menstrual periods and a decrease in the size of the ovaries [12].

2. Materials and methods

Venous blood samples have been collected from people working in six fuel stations distributed in the governorate of Kirkuk, which numbered 60 samples ranging in age from 20 to 40 years old and their working periods ranged from 6 to 10 hours. The other 60 samples have been collected from people who did not work at stations, from students in age from 20 to 26 years old. The necessary analyzes have been conducted, including part of the public health laboratory for the analysis of c.b.c in the complete blood count device. A section of the analysis was conducted at the laboratories of the Technical Institute and under supervision to conduct the rest of the analyzes (t.s.p ... esr) were analyzed the total blood proteins, adding solutions to the sample of the serum and wait for the wavelength reading and then calculate the outputs according to the law and according to the table.

Table 1. Data for calculating the total blood protein

Add	T	S
R1	1 ml	1 ml
Serum	20 uL	----------
Standard	----------	20 uL

Mix at 5 min for 37c°
W.L = 550 nm
N.V=6.2 – 8.2 g
Aan . Con 6g/dl
As = 0.420 nm
Result= At/As × 6g/dl

The ESR test has been done using Routine methods using prefabricated pipes "Westergreen Method", wait an hour and then record the results as follows:

1. Add the blood sample to the ESR tube containing sodium citrate and then mix carefully.
2. Keep it vertically to avoid any mistakes.
3. Wait an hour to see the changes.

A blood sample of 5 ml was withdrawn from each person and distributed as follows:
1. A small amount for the c.b.c device.
2. 1.6 ml for ESR analysis.

3. Results and discussion

The effect of exposure to benzene on hematological variables:

The results of this study showed that there are significant differences in red blood cell count, the mean of red blood cells for the workers and the control groups was (5.6 and $5.3*10^6$ cell/mm^3 respectively) figure (1). The percentage of red blood cells in the workers was greater than the percentage of the control group, note that it is still in the normal range which agrees with the study of (12,13,14,15 and 16).

The study showed significant differences in the number of white blood cells, the mean of white blood cells for the workers and the control groups was (7.12 and $7.8*\ 10^3$ cell/mm^3 respectively) figure (2). The percentage of white blood cells in the workers was greater than the percentage of the control group because the main function of white blood cells is to act as one of the body's defenses from the exposure to the gasoline and its component which are very harmful to the cells and tissues which is agreed with the study of (17, 18, 19).

The study showed significant differences in the concentration of blood hemoglobin, the mean of hemoglobin concentration for the workers and for the control groups was (14.3 and 13.78 g/100 ml respectively) figure (3). The concentration of hemoglobin in the workers was greater than the control group, there is a positive relationship between red blood cells and hemoglobin concentration, whereas that the hemoglobin concentration increase when the percentage of red blood cells increases.

The study also showed significant differences in the volume ratio of the packed blood cells for the workers and for the control groups which was (45.43 and 40.2 % respectively) figure (4). The volume ratio of the packed blood cells for the workers was greater than the control

group. Since the red blood cells and the hemoglobin concentration was high in the workers' group so it is obvious that the volume ratio of the compressed blood cells must be high too because it represents the accumulation and adhesion of red blood cells (20).

The study showed significant differences in the platelets percentage, the mean of the platelets for the workers and the control groups was (230.35 and 117.3 x 10^3/ mm^3 respectively). Figure (5). The platelet number for the workers was greater than the control group, it could be because the gasoline has a stimulation effect on the bone marrow which causes increasing in megakaryocytes formation. The study showed no significant differences in the red blood cell deposition rate, the red blood cells deposition rate for the workers and for the control groups was (14.38 and 13.6 mm/h respectively). Figure (6). The study showed no significant differences in the neutrophils percentage, the mean of neutrophils percentage in the workers and for the control groups was (65.45 and 75.92 % respectively). Figure (7). The study showed significant differences in the lymphocyte percentage, the mean of neutrophils percentage in the workers and for the control groups was (27.4 and 18.3 % respectively). The results showed that the lymphocyte was greater in the workers' blood than in the control group, it could be because of the defensive role of the lymphocyte against diseases and inflammations that could happen in the workers' bodies because of exposing to gasoline always. The study showed no significant differences in the monocytes percentage, the mean of monocytes percentage in the workers and for the control groups was (8.75 and 7.65 % respectively). Figure (9). As we can see the results showed a trace increase of the workers' monocytes than in the control group.

The study showed significant differences in the eosinophils percentage, the mean of eosinophils percentage in the workers and for the control groups was (2.25 and 1.23 % respectively). Figure (10). The eosinophils were greater in the workers' blood than in the control group, it could be because they may get allergy and inflammations especially skin allergy. The study showed significant differences in the basophils percentage, the mean of basophils percentage in the workers and for the control groups was (0.41 and 0.15 % respectively). Figure (11). The basophils were greater in the worker's blood because of the allergy and the inflammations, so this increasingly considered a defensive way from the body caused by long exposure to benzene.

The study showed significant differences in the mean corpuscular volume of red blood cells, the mean corpuscular volume of red blood cells in the workers and for the control groups was (78.2 and 75.9 VIM respectively). Figure (12). The mean corpuscular volume of red blood cells in the workers was greater than in the control group, it could be because of the increase of red blood cell number in the workers' blood. The study showed significant differences in the mean corpuscular hemoglobin concentration, the mean corpuscular hemoglobin concentration in the workers and for the control groups was (34.48 and 32.23 % respectively) as shown in Figure (13).

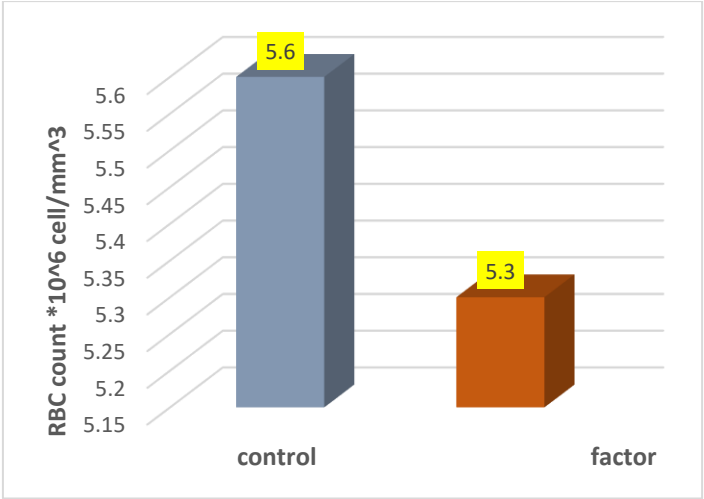

Fig. 1. The average of RBC count in the blood of workers and control group.

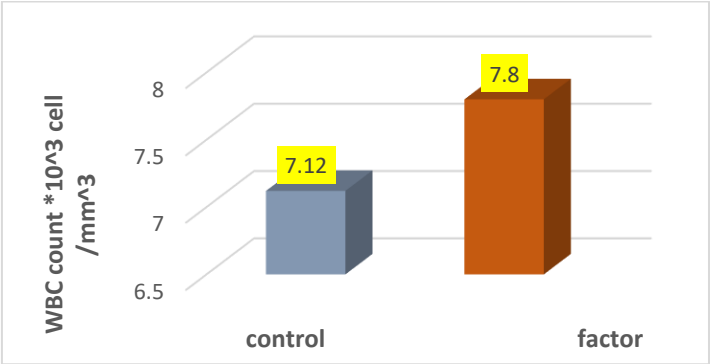

Fig. 2. The average of WBC count in the blood of workers and control group.

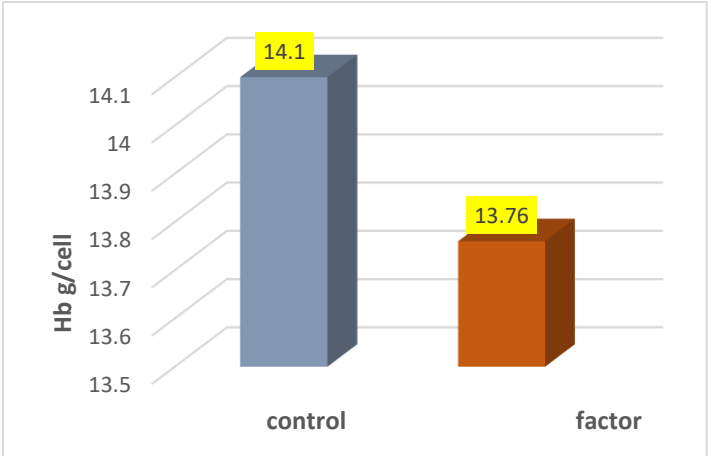

Fig. 3. The concentration of blood hemoglobin of workers and control group.

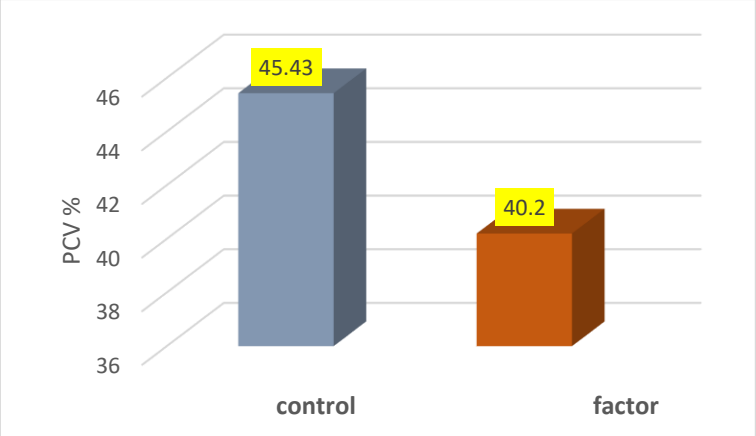

Fig. 4. The ratio of packed blood cell volume of workers and control group.

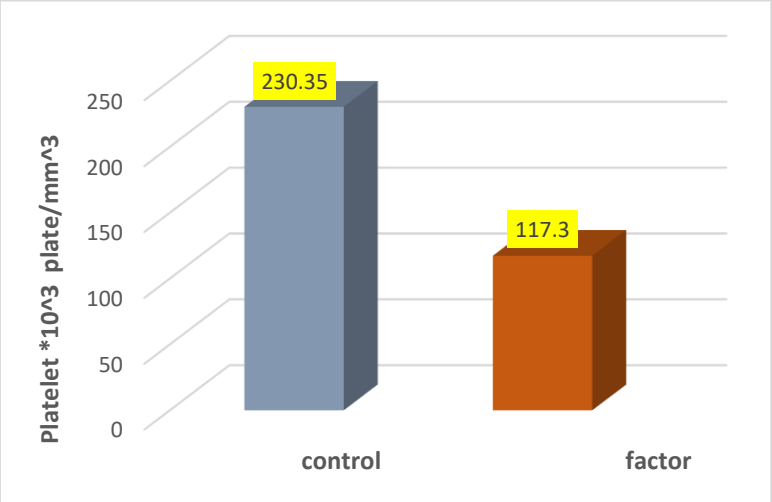

Fig. 5. The average platelets count in the blood of workers and the control group.

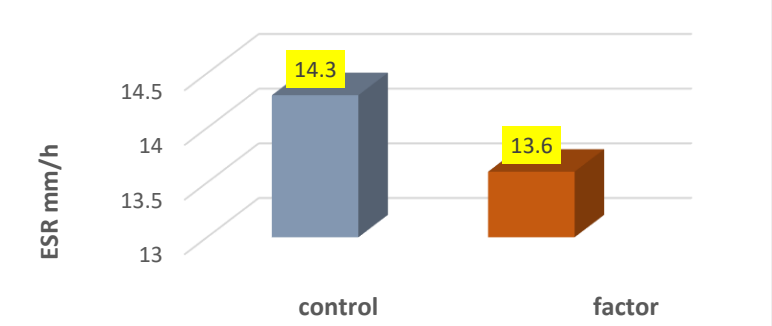

Fig. 6. The red blood cells deposition rate of workers and control group.

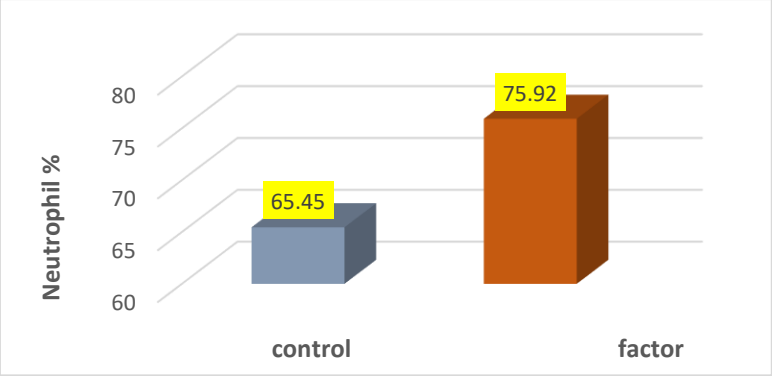

Fig. 7. The neutrophils percentage of workers and control group.

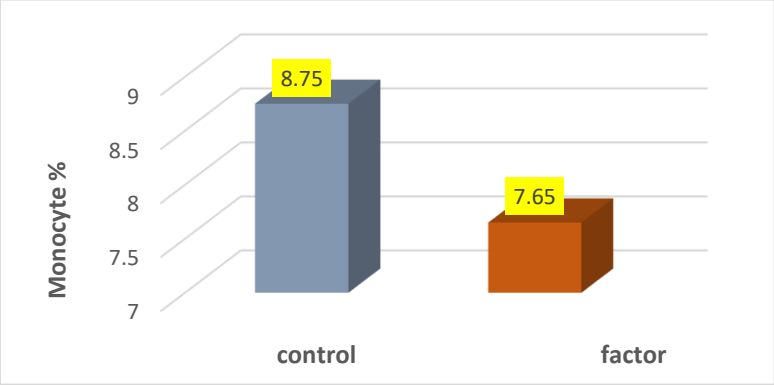

Fig. 9. The monocytes percentage of workers and control group.

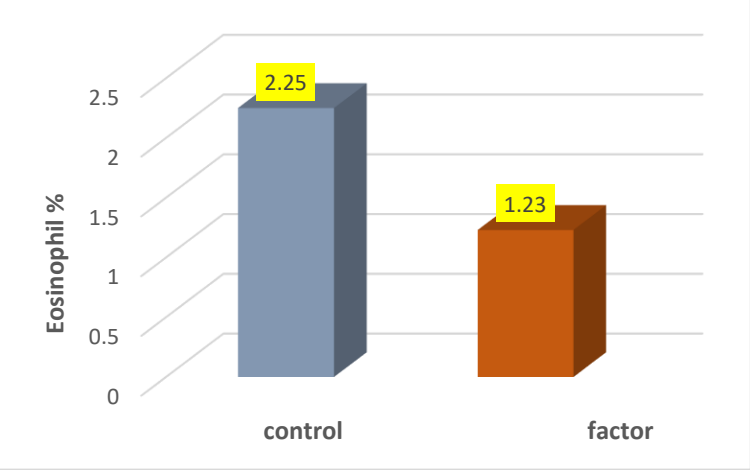

Fig. 10. The esinophils percentage of workers and control group.

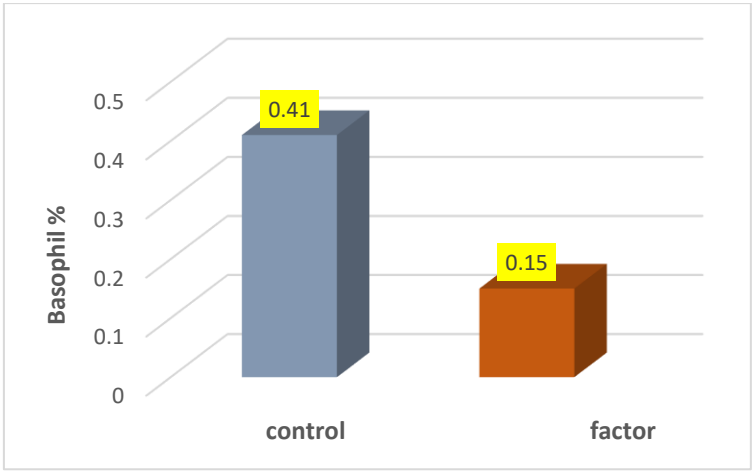

Fig. 11. The basophils percentage of workers and control group.

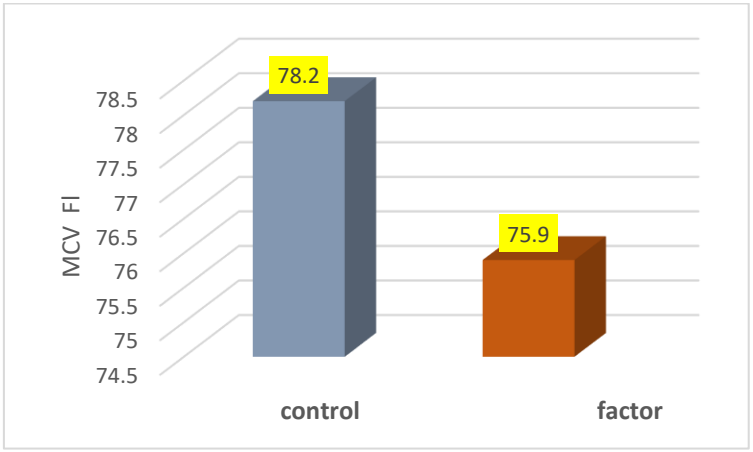

Fig. 12. The mean corpuscular volume of red blood cells of workers and control group.

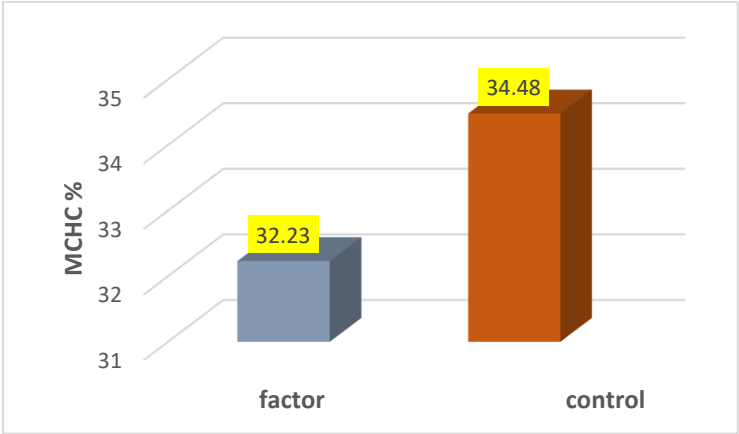

Fig. 13. The mean corpuscular hemoglobin concentration of workers and control group.

4. Conclusions

In general, the finding of our study lead us to conclude that the hematological indices may be useful in detection early hematological changes among workers exposed to benzene vapor after reviewing the results above and after discussing the people of experience. We found the number of results:

1. There are no significant changes observed, the reason for the strict control and compliance with safety directives
2. High efficiency and modern technologies used by companies and fuel stations
3. A slight increase in the values of white blood cells, because gasoline with a pungent odor can cause an allergic reaction in the body
4. A relative increase in red blood cells due to aromatic sensation and increase the times of inhalation and exhalation and therefore, the increase of red blood cells similar to the effect of smoking in addition to the smoke of exhaust cars in the station. This is the result of increased HB according to the triple rule that collects (pcv HB RBC)
5. Elevation in WBC ESR TSP may be interpreted as inflammatory in persons under study.

References

[1] Castellote L., Soriano Y.: Clinical and microbiological diagnosis of oral candidiasis. J Clin Exp Dent. 5(5):279-286 (2013)

[2] Weast , R. C., Lide , D. R., Astle , M. J., and Beyer, W. H.: Handbook of Chemistry and Physics, 70th ed. CRC Press , Boca Raton . FL. (1965)

[3] Mackay, D. and Leinonen, P. J.: The Rate of Evaporation of Low Solubility Contaminants from Water Bodies to atmosphere . Environmental Sci. and Technol. 9: 1178-1180 Cal report series 289, National Toxology Program , Triangle Park , NC. (1986)

[4] Abdel Aziz, I., Salam, Z., and Ossama, A.: Hematological and Biochemical Studies for Gasoline ToxicityAmong Gasoline Workers In Gaza Strip . Hematological And Biochemical Studies (2016)

[5] Yaris, F., Dikici, M., Akbulut, T., Yaris, E., and Sabuncu, H.: Story of benzene and leukemia:epidemiologic approach of Muzaffer Aksoy. J. Occup Health.;46(3):244-247 (2014)

[6] Carletti. R., and Romano.: Assessing health risk from benzene pollution in an urban area. Environ (2012)

[7] Darrell, W., Winsett. W., Judy, H., Donald , L., and Costa, D. L.: Partitioning of benzene in blood: influence of hemoglobin type in humans and animals. Environ Health Perspect; 110 (3): 255–261 (2015)

[8] Delore, P., and Borgornano, C.: Leuccmic aique au cours de I'intoxication benzenique. Sur I'origine toxique de certaines leucemies aigues et leurs relations avec les anomies graves. J. Med. Lyon.; 9:227-33 (2018)

[9] Cronkite, E.P., Drew, R.T., lnoue, T., Hirabayashi, Y., and Bullis, J.E.: Hematotoxocity and carcinogenicity of inhaled benzene. Environ. Health perspect. 82 97-108. (2015)

[10] Ward, E., Horning, R., Morris, J., Rinsky, R., Wild, D,. Halperin, W.: Risk of low red or white blood cell count related to estimated benzene exposure in a rubber worker cohort (1940-1975). Am. J. Ind. Med. 29 (3) 247-257. Story of benzene and leukemia:epidemiologic approach of Muzaffer Aksoy. J. Occup 1 (2018)

[11] Lan, Q., Zhang, L., Li, G., et al.: Hematotoxicity in workers exposed to low levels of benzene. Science.306:1774-104 (2014(

[12] Lan, Q., Zhang, L., Shen, M., et al.: Polymorphisms in cytokine and cellular adhesion molecule genes and susceptibility to hematotoxicity among workers exposed to benzene. Cancer Res.65: 9574-9581 (2015)

[13] Carletti, R., and Romano, D.: Assessing health risk from benzene pollution in an urban area. Environ. Monit. Assess. 80, 135–148. (2013)

[14] Ireland, B., Collins, J.J., Buckley, C.F., and Riordan, S.G.: Cancer mortality among workers with benzene exposure. Epidemiology, 8, 318–320 (2017)

[15] Verma, D.K., des Tombe. K.: Benzene in gasoline and crude oil: occupational and environmental implications. AIHA J. 63: 225-230 (2016)
[16] Brautbar, N., et al.: Leukaemia and low level benzene concentration: revisited. European Journal of Oncology, 11(1): in-press (2016)
[17] Browne, M.: A guide to reference ranges used in pathology. In: Hutchison's clinical methods 22nd ed. London-Sanders Elsevier publishers. pp.509-513 (2017)
[18] Agency for Toxic Substances and Disease Registry. Toxicological Profile for Benzene . Update (final report). NTIS accession no. PB98101157. Atlanta, Georgia: Agency for Toxic Substances and Disease Registry (1997)
[19] Hayes, R.B., Yin, S., Rothman, N., Dosemeci, M., Li, G.-L., Travis, L.T., Smith, M.T:. and Linet, M.S.: Benzene and lymphohematopoietic malignancies in China..J. Toxicol. Environ. Health;–432 (2018)
[20] Nieters, A., et al.:Tobacco and alcohol consumption and risk of lymphoma: results of a population-based case-control study in Germany, International Journal of Cancer,118(2):422-430 (2016)
[21] Iwuanyanwu, P. Onyemaenu, K.C., Wegwu, C.C., M..O and Ayalogu. E.O.: Haematotoxic Effects of Diets Contaminatedwith Petroleum Products (Kerosene and petrol) in Wistar Albino Rats. Research. Jornal ofEnvironmental Toxicology, 4:134-140 (2010).
[22] Gonick, H.C., Nephrotoxicity of cadmium & lead. Indian Journal of Medical Research. Vol. 128 (2018)
[23] Farmand, F., Ehdaie, A., Roberts, C.K., Sindhu, R.K.: Lead-induced deregulation of superoxidedismutases, catalase, glutathione peroxidase,and guanylate cyclase. Environ Res 98: 33-39 (2005)