# Health Costs for Detoxification Benzene Exposure Workers in the Mining Oil and Gas Pt. A Balikpapan

**Farhana Syahrotun NS[1], Suherdin[1], Tedi Levinrarian[1], Bella Oktavia[1], Abdul Rohim Tualeka[1]**

*[1]Department of Occupational Health and Safety, Public Health Faculty, Airlangga University, Surabaya*

## Abstract

Benzene (C6H6) is a liquid aromatic hydrocarbon volatile, colorless, flammable. Benzene is a carcinogen nature makes very harmful for health. The purpose of this study was to calculate and determine the cost of detoxification due to exposure to benzene in the Mining and Oil and gas workers Earth PT. A Balikpapan. Based on the consumption of foods rich in enzyme CYP2E1, Sulfation, and Glutathione. The variable in this study is the intake of the effective dose required by each individual to calculate the weight, length of employment (years), worked on average each day (hour), and the working time in a week (days) of the respondents, as well as the measurement of the concentration benzene. The highest food costs to be paid by the respondent for liver detoxification use is 883,872.51 IDR, using egg 3,513.18 £, and use avocado Rp3,475.01 S. Every individual has a number of different costs. It's dependent on the characteristics of workers, the concentration of benzene in the work environment, and the intake of benzene by workers.

***Keywords:*** *Benzene, Detoxification, CYP2E1, Glutathione, Sulfation*

## Introduction

Benzene is known as carcinogen compound, with physical and chemical properties sweet-smelling, volatile and slightly soluble in water. According to the Agency for Toxic Substances and Disease Registry (ATSDR), dangerous chemicals and toxic contained in the oil content is Benzene, Toluene, Ethylene, Xylene (BTEX), TPH (Total Petroleum Hydrocarbon) and Polycyclic Aromatic Hydrocarbon (PAHs). Of the six chemicals benzene exposure is very serious impact on health[1],

Exposure to Benzene is one of the causes of disease aplastic anemia. The incidence of this disease varies between 2 to 6 cases per 1 million population depends on the risk of occupational, geographic variation and environmental influences[2], According to Aksoy (1991) Benzene exposure of the body can result in depression of the bone marrow (bone marrow) there by inhibiting the production of blood cells causing anemia (a decrease in red cells), leukopenia (decreased WBCs), and thrombocytopenia or decreased platelets[3],

If the exposure benzene cannot be controlled by way of the elimination of the working environment, it takes an effort to eliminate or reduce the effects of benzene exposure at the worker's body. In order to reduce or eliminate the concentration of toxins in the body needed workers exposed to benzene biotransformation process.The purpose of the biotransformation is to transform toxic non-polar (soluble in fats) into polar (solvent-soluble compounds). Then, was changed to the hydrophilic (soluble in water) that can be excreted from the body. Biotrasforms substances or chemicals in the body can occur with the help of enzymes that are specific to a particular compound participate[4],

Process biotrasforms benzene phase 2 involves a variety of enzymes, such as CYP2E1, Glutathione and Sulfation. The enzyme-enzym many times in many different types of food. CYP2E1 enzyme-rich foods are beef liver, cow's brain, and salmon. Foods that are rich in content sulfation are eggs, chicken, beef and tuna. While diet foods rich in glutathione are avocado, asparagus, carrots, tomatoes, oranges, and broccoli[5],

**Corresponding author:**
**Abdul Rohim Tualeka**
Department of Occupational Health and Safety, Public Health Faculty, Airlangga University Campus C, Jalan Mulyorejo, Surabaya, 60115, Indonesia
Tel: +62 81,333,519 73,
E-mail: abdul-rt@fkm.unair.ac.id

Enzyme-rich food source for benzene detoxification in the body is widely recognized. But in fact obstacles, one of which is the assumption that states bring managerial providing food for detoxification benzene exposure is relatively expensive.

Based on the exposure, the study aims to calculate the cost required for detoxification purposes of benzene exposure for each worker in Mining and Oil and Gas PT. A Balikpapan.

## Methods and Materials

This research is an observational descriptive with quantitative approach[6], To calculate and illustrate the data collected. The calculations in this research are done by using the application number crunchers.

The research location is in mining Oil and Gas PT. A Balipapan. The study population was all employees of chemicals totaling 22. Sampling technique using the total sample[7], The variable in this study was effective dose intake needed by each individual to calculate the weight, length of employment (years), worked on average each day (hour), and the working time in a week (days) of the respondents, as well as the measurement of the concentration benzene. Measurement of weight using the weighing scale manual method body. Working length measurement, the average work every day, and time work week obtained through in-depth interviews with respondents. As for the measurement of benzene in the work environment using NIOSH 1501 method of measurement with activated carbon charcoal pipe using gas chromatographic techniques[8],

The formula for calculating the intake of benzene to the worker:

Information:

| | | |
|---|---|---|
| **C** | **:** | **Benzene concentration (mg / ml)** |
| R | : | Benzene reaction rate (m3 / hour) |
| TE | : | Work time / day (hours) |
| fe | : | Work time / week (days) |
| dt | : | Working time (years) |
| wb | : | Weight (kg) |

Then calculate the effective dose per day with the calculation results of non-carcinogen intake (intake) above, using the formula below:

The last part is to calculate the cost of each food intake using the following formula:

Cost of intake = Effective dose x price

per Kg of food

Price information (in Indonesia):

1 Kg liver = £ 50,000

1 Kg egg = £ 24,000

1 Kg avocado = £ 45,000

Food prices above are approximate prices beef liver, eggs and

avocado per kilogram on the market, so: BP benzene = (m liver x USD / kg liver) + (m eggs x £ / kg eggs) + (m avocado x Rp / Kg avocado).

## Findings

Based on the results of measurements of the concentration of benzene in the mining Oil and Gas PT. A as follows:

**Table 1. Concentrations of Benzene**

| **Location Measurement** | **Concentration** | |
|---|---|---|
| | **ppm** | **mg / m3** |
| Processing Facility B | 1:35 | 4:30 |
| Processing Facility C | 2:31 | 7:35 |

Tabel Based on the above, the concentration of benzene in the processing facility B is 1:35 ppm and processing facilities c is 2:31 ppm.

**Table 2. Ratio Effective in dose of each Foodstuffs (n = 22)**

| Benzene Concentration (mg / m3) | Dose-effective and CYP2E1 (Cow Liver) | Dose-effectiveness Sulfation (Egg) | Dose-effective and glutathione (Avocado) |
|---|---|---|---|
| 4.3 | 6.371592941 | 0.056853317 | 0.034444305 |
| 4.3 | 10.26755654 | 0.091616752 | 0.055505563 |
| 4.3 | 8.117506233 | 0.07243199 | 0.043882568 |
| 4.3 | 8.92894381 | 0.079672396 | 0.048269133 |
| 7:35 | 4.958570373 | 0.044245007 | 0.026805622 |
| 7:35 | 12.86690181 | 0.114810544 | 0.069557409 |
| 7:35 | 14.51566946 | 0.129522393 | 0.078470511 |
| 7:35 | 9.916701576 | 0.088486095 | 0.05360887 |
| 7:35 | 13.35928221 | 0.119204023 | 0.072219177 |
| 7:35 | 9.120958982 | 0.081385735 | 0.049307151 |
| 4.3 | 0.515614775 | 0.004600798 | 0.002787371 |
| 4.3 | 0.38643994 | 0.003448179 | 0.002089062 |
| 7:35 | 14.17289791 | 0.126463864 | 0.076617516 |
| 7:35 | 9.897811056 | 0.088317537 | 0.053506749 |
| 7:35 | 14.21485412 | 0.126838236 | 0.076844328 |
| 7:35 | 16.07040935 | 0.143395237 | 0.086875306 |
| 7:35 | 13.90576739 | 0.124080275 | 0.07517343 |
| 7:35 | 10.21268527 | 0.091127139 | 0.055208933 |
| 4.3 | 4.310092549 | 0.038458681 | 0.023300004 |
| 4.3 | 3.550583928 | 0.031681634 | 0.019194164 |
| 4.3 | 7.471714547 | 0.066669632 | 0.040391472 |
| 4.3 | 5.071398166 | 0.045251762 | 0.02741556 |

The calculation results illustrated in the following graph:

**Chart. 1 Ratio Effective in Dose of Each Raw Meal (n = 22)**

Based on table 2 and graph 1 shows that the average concentration of benzene in the workplace is 5.82 mg / m3. The highest dose effects which should be consumed by the respondent for beef liver is 16.07040935 Kg (rounding = 16:07 kg), eggs and avocado 0.086875306 0.143395237 kg.

**Table 3. Comparison of Benzene Concentrations in Liver Cost Beef, Egg and Avocado (n = 22)**

| Benzene Concentration (mg / m3) | Cose of Cow Liver (S) | Cose of Egg (S) | Cose of Aocado (S) |
|---|---|---|---|
| 4.3 | 350437.6118 | 1392.906274 | 1377.772214 |
| 4.3 | 564715.6098 | 2244.610423 | 2220.222515 |
| 4.3 | 446462.8428 | 1774.58376 | 1755.302737 |
| 4.3 | 491091.9096 | 1951.973701 | 1930.765319 |
| 7:35 | 272721.3705 | 1084.002673 | 1072.22488 |
| 7:35 | 707679.5997 | 2812.858327 | 2782.296351 |
| 7:35 | 798361.8205 | 3173.298617 | 3138.820423 |
| 7:35 | 545418.5867 | 2167.909339 | 2144.354796 |
| 7:35 | 734760.5214 | 2920.498559 | 2888.767062 |
| 7:35 | 501652.744 | 1993.950509 | 1972.286046 |
| 4.3 | 28358.81264 | 112.7195447 | 111.494836 |
| 4.3 | 21254.19671 | 84.48038379 | 83.56249632 |
| 7:35 | 779509.3852 | 3098.364664 | 3064.700634 |
| 7:35 | 544379.6081 | 2163.779646 | 2140.269972 |
| 7:35 | 781816.9764 | 3107.536791 | 3073.773106 |
| 7:35 | 883872.5141 | 3513.183314 | 3475.01224 |
| 7:35 | 764817.2062 | 3039.966742 | 3006.937212 |
| 7:35 | 561697.6898 | 2232.614908 | 2208.357332 |
| 4.3 | 237055.0902 | 942.2376802 | 932.0001774 |
| 4.3 | 195282.116 | 776.2000295 | 767.7665417 |
| 4.3 | 410944.3001 | 1633.405989 | 1615.658876 |
| 4.3 | 278926.8991 | 1108.668176 | 1096.62239 |

In Table 3, the highest food costs to be paid by the respondent for liver detoxification use is 883,872.51 IDR, using egg 3,513.18 £, and use avocado 3,475.01 £.

## Discussion

Enzymes are proteins that function as catalysts (plunger) all metabolic activity of chemicals in the body, nothing is done without the use of enzymes as the body of vital elements. There are thousands of enzymes that humans need to survive. One of the activities of the body is known most often spend reserves are detoxification enzymes. Detoxification is the process of draining piles of toxins in the body[9],

Toxic fat-soluble cannot be excreted without metabolic transformation (detoxification) in the liver so it can be dissolved in water. Liver cells have sophisticated mechanisms to break down toxic substances. These include endogenous substances (produced by the body) and exogenous (obtained from the environment; for example xenobiotics). Each chemical is broken down or metabolized via detoxification pathways in the liver called "phase 1" and "Phase 2[10],

An enzyme that plays a role in metabolic transformation (detoxification) of them were CYP2E1, Sulfation and Glutathione. CYP2E1 in this study obtained from beef liver, Sulfation obtained from the eggs and Glutathione obtained from avocado.

CYP2E1 plays an important role in the metabolic activation of chemicals such as acetaminophen (APAP), acetone, halothane, ethanol, including benzene. Benzene is metabolized into epoxy benzene by CYP2E1, which spontaneously formed phenol. Phenol later becomes hydroquinone and catechol catalyzed by CYP2E1, which is more toxic than phenol. Oxidation of benzene by CYP2E1 become reactive intermediates is a prerequisite cellular toxicity. Sheets and Carlson observed a decrease in CYP2E1 activity and reduced risk of benzene-induced hematotoksisitas[11],

Sulfation one liver detoxification pathways, especially the phase II detoxification. Sulfation system is important in detoxifying several drugs, food additives, and environmental contaminants[12],

Glutathione is the most powerful antioxidant in the body and is the most abundant antioxidant in the liver and is also the main detoxifying agent in the body. If the body does not have enough amino acids and cofactors required to produce glutathione, the toxins accumulate in the fatty tissues, brain and nerve sheaths[13],

Glutathione is also needed in many complex steps required to perform the immune response, with reserves that reduced glutathione, the liver cannot effectively detoxify toxins. If you have a low glutathione levels, we do not have cysteine containing sulfur that is adequate for the sulfation process[13],

Based on the calculation shows that each individual has a different spending. This is because each individual has a different dose food effect. The effective dose can also be dependent on the amount of inhaled benzene concentration, weight, and length of work. The higher the concentration of benzene in the body, the greater the mass of detoxification for the food it needs. It is in line with previous research which states that the greater the concentration of benzene and duration of exposure, the greater the period of detoxifying substances. This means that the greater the expenditure required to buy food containing the enzyme CYP2E1, Sulfation, and Glutathionin[14],

## Conclution

The researcher concludes that the average concentration of benzene in the workplace is 5.82 mg / m3. The highest dose effects which should be consumed by the respondent for beef liver is 16.07040935 Kg (rounding = 16:07 kg), eggs and avocado 0.086875306 0.143395237 kg kg.

The highest food costs to be paid by the respondent for liver detoxification use is 883,872.51 IDR, using egg 3,513.18 £, and use avocado 3,475.01 £.

Consumption of foods containing enzymes CYP2E1, Sulfation, and Glutathione with the right dose is expected to reduce or even eliminate benzene compounds into the worker's body.

Every individual has a number of different costs. Case It depends on the characteristics of workers, the concentration of benzene in the work environment, and the intake of benzene by workers[15],

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**Ethical Clearance:** The study was approved by the institutional Ethical Board of the Public Health, Airlangga University.

All subjects were fully informed about the procedures and objectives of this study each subject prior to the study signed an informed consent form.

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