

# Correlation Between The Novel Biomarker For Benzene Aromatic Hydrocarbon Exposure, Urine Trans, Trans Muconic Acid And Urine Phenol

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## Abstract

Volatile aromatic hydrocarbons become an important group of toxic substance at present. Benzene is a colorless poisonous liquid with a sweet - odor. Breathing extremely high level of benzene can result in death while exposure to high level can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion, and unconsciousness. Long-term benzene exposure mainly affects hematopoietic system. At present, it is documented as a known inducer of leukemia (Rinsky et al, 1987). At present, work with benzene is subject to the Control of Substances Hazardous to Health (COSHH) Regulations 1999. Hence, benzene exposure is of particular concern because of ongoing exposure to thousands of workers in the many occupations.

In developing countries, awareness of the public health impact of exposure to volatile solvents is growing, although few of these countries have introduced policies and regulations that combat the problem effectively. In exposure- and risk- evaluation, the monitoring of benzene by peripheral biomarker has several advantages over technical assessment of exposure. Standard biomarker for benzene exposure at present is urine phenol level. However, there are some other metabolites of benzene in urine that have been studied for its usefulness as biomarker. Here, the author investigated the classical aromatic hydrocarbon urine metabolite "Phenol" and its correlation to the advance biomarker, urine trans, trans muconic acid (ttMA).

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## MATERIALS AND METHODS

Here, we performed additional comparative study between the phenol level and the new marker, urine tt-MA. Urine samples from 39 individual subjects were collected for this comparative study. Urine tt-MA was analyzed by HPLC as described in our previous work (Wiwanitkit et al, 2001). The colorimetric method (with extraction) was used for analysis of urine phenol. The extraction technique help decrease false results.

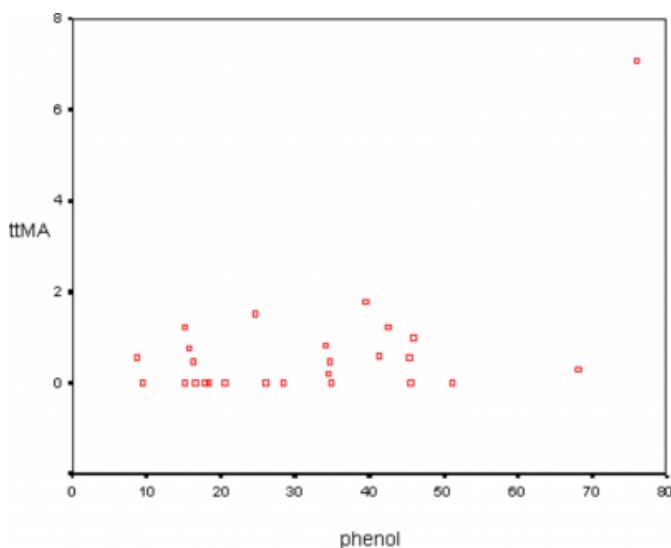
We had the external reference laboratory (Special Lab, Bangkok) to analyze the urine phenol samples.

## RESULTS

We studied 39 pairs of urine phenol and urine ttMA in this study. Concerning the correlation study, the poor ( $r = 0.40$ ) but significant ( $p = 0.04$ ) correlation between urine phenol and urine tt-MA can be observed. Detection rate for subjects with excessive exposure ( $>$  reference limit) of urine phenol and urine ttMA are 68.9 % (31/45) and 69.2 % (27/39). The detection rate of urine ttMA is slightly higher than urine phenol. However, the agreement is not well as shown in the Figure 1.

**Figure 1**

Figure 1: Correlation between urine phenol and urine ttMA



## DISCUSSION

Recent research indicating that benzene exposure can result in chronic toxicity. The toxicity includes genotoxicity, neurotoxicity and hematotoxicity. International organizations such as Agency for Toxic Substances and Disease Registry (ATSDR) have documented benzene toxicity and recommend the monitoring of benzene exposure for groups at risk. Here, we can confirm our previous study (Wiwanitkit et al, 2001) that the urine ttMA is a feasible test for monitoring of benzene exposure. We confirm that both urine phenol and urine ttMA can give good detection rate. But we detected poor agreement. The poor correlation between urine phenol level to the new biomarker might confirm the high interference on the analysis of urine phenol..

Qu et al (2000) noted that all metabolites are good markers for benzene exposure; however, due to the high background,

phenol may not distinguish unexposed subjects from workers exposed to benzene at low ambient levels. Indeed, phenol is not reliable as a biomarker for exposure to benzene at concentrations below 5 ppm. Lee et al (1993) noted that ttMA was far more specific than phenol and could be easily and practically used to estimate with a given probability the lower corresponding benzene concentrations down to around the ppm level. However, in general monitoring for the risk workers with high exposure, the use of urine phenol biomarker is therefore still acceptable and might be more cost effective. Conclusively, the authors recommended the use of the new biomarker, urine trans, trans muconic acid, as the new screening tool in occupational medicine.

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