

## A Review on Health Effects of Phenol

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### Abstract:

*Treatment of domestic and industrial wastewater by efficient and economical method can be facilitated by application of physical, biological and chemical routes. Organic matter (COD), phenol and heavy metals are important pollutants which can cause health problems in living organisms. It is very important to study the effect of pollutants on man and environment. Phenol can affect human being and other animals and affect the ecosystem adversely. It has different long term and short term effects on skin, respiratory system and reproductively. In this review, studies carried out by investigators to study effect of phenol and its derivatives on living organisms are summarized.*

### Keywords:

Phenol; diseases; exposure; growth; metabolism

### Introduction

Environmental pollution is major reason for many diseases in human being. The pollutants are adversely affecting the ecosystem. Recycle and reuse of wastewater has become important aspect of environment friendly industrial and social growth [1]. The major pollutants that are cause of concern for aquatic life and human being are chemical oxygen demand COD, phenols and heavy metals [2,3]. COD level, if high may affect the water quality[4,5]. The organic demands consumes dissolved oxygen and so damages aquatic life[6,7]. Many chemical, biological and advanced treatment methods are investigated for COD removal[8,9,10,11,12]. Heavy metals also affect the ecosystem and living

organism[13,14,15]. They have the tendency to bioaccumulate. Removal of heavy metals can be carried out by adsorption, ion exchange, electro coagulation, reverse osmosis etc[16,17,18,19,20,21]. It is very important to study the effects of these pollutants on man, environment and property. Phenol is one pollutant which can cause taste and odor problems in drinking water even lower concentrations. It can affect nervous system, hormonal activities, digestive system eyes, and different metabolisms adversely [22,23,24,25,26]. Sources of phenol include petroleum and petrochemical, fertilizer, insecticide, wood preservative, pharmaceutical and many other industries[27,28,29]. Phenol can be removed by various chemical, physical and biological methods from water [30,31,32,33,34]. In order to realize the gravity of phenolic pollution, it is important to understand and study effects of phenol and potential risks of phenolic pollution. The present review summarizes the research carried out to study effect of phenolic pollution on man, environment, aquatic and animal life.

### Research on Effects of Phenolic Compounds

Sandau studied toxicological effects and environmental levels of halogenated phenolic compounds (HPCs)[35]. They are metabolites of persistent organic pollutants (POPs). They explained the fact that biotransformation

products of POPs by the enzyme cytochrome P450 (CYP P450) system are the source of HPCs. Fish do not possess the enzyme system necessary to metabolize persistent PCB. Kayama et al. investigated potential health effects of alkyl phenols in Japan[36]. Some forms of alkyl phenols are reported to induce endocrine disruption especially in fish species. Their study revealed that the current environmental concentrations in the sites in Japan influence reproduction in fish species. They recommended to curb emissions of alkyl phenols and its ethoxylates into the aquatic environment. Batarfi carried out investigation on effect of maternal exposure to octylphenol(4-tert-octylphenol) on the growth of the adrenal gland in male albino rats[37].They treated pregnant females of albino rats were orally during pregnancy and until 21 days after birth (the period of lactation)with octylphenol (OP).They observed that there was increase in mortality rate of newborn rats of the pregnant female treatment with dose low-and high-octylphenol compared to the control group. There was increase in the average body weight. Also it was observed that there was increase in percentage of gain in body weight of male rats from mothers of small treatment and the control group for 12 weeks of age. According to the studies carried out by Khleifat, phenol inhibit the growth rate with a maximum concentration of 1100 ppm, beyond which no growth occurred[38].They used The Haldane model to predict the specific growth rate-concentration data. They also observed that only fructose as the carbon source showed catabolic repression of the degradation activity. According to these investigations, carbon-starvation minimized the acclimation period. It also accelerated the complete degradation achievement of phenol and affected the growth of cells differently based on the data obtained for growth phases.An investigation on effect of phenolic aldehydes and flavonoids on growth and inactivation of

oenococcus oeni and lactobacillus hilgardii was carried out by Figueiredo et.al.[39]. They investigated the effect of wine phenolic aldehydes, flavonoids and tannins on growth and viability of strains of Oenococcus oeni and Lactobacillus hilgardii. According to them , different classes of wine phenolic compounds interact with wine lactic acid bacteria.Fatoki and Opeolu reviewed the occurrence and quantification of phenolic endocrine disruptors in water[40]. According to them, population growth, urbanization, industrial development and associated changes in agricultural and other land use practices are inevitable activities for economic growth. Phthalates, phenols and some metals constitute significant class of pollutants which affects man and environment. According to their discussion in the said work, phenols (and other EDCs) exhibit disruption activities by either of three ways. They may bind to hormone receptors thereby mimicking or antago-nising the action of the natural ligand by virtue of molecular structure. They may alter synthesis or metabolism by indirectly affecting concentrations of hormones. Also, they may interfere with signals between different components of the hypothalamus-pituitary-endocrine gland axes. Li et.al. carried out investigation on effect of nonyl phenol (NP)and di-n-butyl phthalate(BBP) on rat sertoli cells in vitro[41].They inferred that the combined effect of the two substances on Sertoli cell toxicity had an additive effect.Also it was concluded that the induction of apoptosis may play an important role. According to report by Philippat et.al. for National Institutes of Health , the effects of prenatal exposures to phthalates and phenols on fetal growth are limited[42].They assessed the relationships between prenatal exposures to phthalates and phenols and fetal growth among male newborns. They observed an inverse association of 2,4-dichlorophenol (2,5-DCP ) and a positive association of Benzophenone-3(BP3 ) with male birth



weight. According to Metzler and Pfeiffer, the number of Endocrine active compounds, EAC must be expected to further increase when the metabolites of natural and anthropogenic chemicals are taken into account[43]. Their paper was focused on the chemical structures of typical compounds known today to exert sex-hormone-like activity. They concluded that it is important to study the activity of the parent substance and its metabolites in order to assess the potential of a compound to affect the endocrine system. According to Tejaswini et.al., Inhalation and dermal contact of phenol causes cardiovascular diseases and severe skin damage[44]. Also ingestion can cause serious gastrointestinal damage and oral administration into laboratory animals. It has also induced muscle tremors and death. Khan studied effect of phenol with other compounds on nasal mucosa of albino rat [45]. For 1% nasal dose, phenol affected respiratory epithelium more than the olfactory epithelium. Phenol was harmful to the nasal mucosa. Mahgiubi investigated the effect of octylphenol (OP) on zebra fish with emphasis on sexual development and reproduction[46]. They observed that there was change in sex ratio due to exposure to OP. Also ovarian development was observed. They concluded that OP has a negative impact on sexual development and maturation as well as reproduction in zebra fish. A review was carried out on polychlorinated phenols (PCP) by McLellan et.al[47]. PCP and its derivatives sodium pentachlorophenate (NaPCP) and pentachlorophenyl laurate (PCPL) have been used worldwide as herbicides, biocides, pesticides and wood preservatives. According to them, depending on the experimental and environmental conditions, PCP can degrade into as many as 30 different products. It was reiterated that chlorophenols are bioaccumulative in humans. Their review highlights the need for a 'multipurpose' monitoring strategy, linking urban, rural and

global sites to systematically examine chlorophenol contamination within cork forests and the transfer between trophic levels. Mpofo et al. carried out an investigation aimed at the effects of genotype and growing environment on the phenolic contents and antioxidant activities of alcohol-soluble extracts from commercial wheat cultivars[48]. According to the studies genotype versus environment interaction was small for all parameters compared with genotype and location effects and was significant only for TPC.

## Conclusion

Phenolic pollution is very important study area in toxicological and environmental researches and surveys. Many studies carried out on toxicological aspects indicate adverse effects of phenol on metabolism, reproduction, skin and other organs. In detail study is important to decide the exposure time limit and limit for its concentration in water. As it is not possible to completely stop the phenolic pollution, it is important to know its effects, exposure limits in order to create awareness regarding toxicological factors. Also it helps in deciding the removal target of phenol in treatment facility.

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