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Article Review

Effects of Japan's Nuclear Waste on Invertebrate Fetuses

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Abstract

The study is aimed at knowing the nuclear impact of an intervetebrate fetus. The study used a study of literature acquired from Google scholar for collecting data on the effects of radiation on marine populations of organisms in the sea. Research shows that tritium content of nuclear waste air could lead to genetic infections, tissue damage, reproductive disorders, immune system and physiological changes in fetal invertebrates. Moreover, nuclear waste can also cause mutations in DNA, damage to reproductive genes and can have a long-term effect on marine life.

Keywords: *Nuclear, effect on an intervetebrate fetus*

INTRODUCTION

Nuclear power plants are a type of power plant that uses nuclear reactions in nuclear reactors to generate electricity. It is an efficient way to generate electricity as it produces energy with low greenhouse gas emissions, but the radioactive waste produced can be a serious problem for the environment.

On March 11, 2011, there was an earthquake in Japan with a magnitude of 9.0 followed by a tsunami. This event caused damage to the entire Fukushima nuclear power plant. As a result, uncontrolled residual heat led to the melting of nuclear fuel and the release of explosive hydrogen gas (Sari et al., 2023) . These events resulted in a drastic rise in temperature. As a result, water is used to cool the reactor and control radiation. Electric Power Company Holdings (TEPCO) Fukushima Daiichi Nuclear Power Station (Basic Policy) submitted a plan to discharge more than 1 million tons of Fukushima nuclear plant wastewater into the sea by 2023 (Mawaddah et al., n.d.) . This is as a result of thousands of temporary storage tanks for liquid nuclear waste having reached full capacity. The Japanese government's decision to dump liquid nuclear waste into the sea raises many pros and cons from various parties.

The disposal of nuclear waste into the ocean can trigger concerns for the survival of marine organisms. One important aspect of this is its effect on the fetal development of marine invertebrates. Invertebrates play an important role in the marine food chain and maintain the balance of the ecosystem. In a study conducted by (Sari et al., 2023) , it was found that the disposal of nuclear waste at sea can harm marine organisms. The heated water can accelerate the metabolism of aquatic animals such as fish, causing malnutrition due to lack of food sources because the environment is unfit for them. Although research conducted by (Sari et al., 2023) has provided insight into the impact of radiation by nuclear power plants on marine populations, there are still some unanswered specifications. In-depth understanding of how nuclear waste contamination specifically affects invertebrate fetal development is limited. This study aims to delve deeper by investigating the effect of Japanese nuclear waste on fetal development of invertebrates in the sea. The results of this study are expected to provide better insight into the effects of nuclear waste on marine ecosystems, especially on marine invertebrate fetuses.

IMPLEMENTATION METHOD

The method used is the literature study method by utilizing google scholar which is obtained from the article Analysis of the Impact of Radiation by NPP on Marine Organization Populations. Literature studies are used to identify the effect of tritium content in nuclear wastewater can cause disturbances in invertebrate fetuses.

RESULTS AND DISCUSSION

Most anthropogenic radionuclides in the environment come from three main sources: nuclear weapons testing, nuclear disasters, and permitted discharges from nuclear reprocessing plants (Fuller et al., 2015).

Nuclear power is always associated with contamination issues and the risk of nuclear waste is very real. In 2017, exactly six years after the nuclear accident in Fukushima, Japan still cannot solve the problems caused by the accident, namely, where to put the nuclear waste that continues to accumulate. Until now, TEPCO (Tokyo Electric Power Company) is still trying to filter water contaminated with the waste but it cannot disappear completely. "We can't keep making barrels to store this nuclear waste" said Shigenori Hata who was the Minister of Economy, Trade and Industry at the time. Therefore, Electric Power Company Holdings (TEPCO) Fukushima Daiichi Nuclear Power Station (Basic Policy) submitted a plan to discharge more than 1 million tons of Fukushima nuclear plant wastewater into the sea by 2023. (Mawaddah et al., n.d.) .

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The Fukushima accident is considered to be the largest radioactive release into the ocean ever by humans, although the source of this flow is not fully known (Lu et al., 2021).

The Fukushima Daichi nuclear reactor explosion is one of the worst nuclear disasters in history. The Fukushima Daiichi nuclear reactor is located in Fukushima Prefecture, Japan. Construction of the reactor began in 1967 and the first reactor became operational in 1971. The reactor is part of a complex of six nuclear reactors operated by the Tokyo Electric Power Company (TEPCO). On March 11, 2011, Japan was struck by a magnitude 9.0 earthquake off the northeast coast. This earthquake caused a tsunami with waves as high as 15 meters that hit the coast. The tsunami hit the area around the Fukushima Daiichi nuclear reactors, causing significant damage to the power plant and reactor cooling systems.

Some of the victims of this disaster were Hisashi Ouchi (35), Masato Shinohara (39), and Yutaka Yokokawa (54), who suffered an explosion inside the Tokai-Mura Nuclear Power Plant. At the time Hisashi was mixing uranium-containing fuel into a stainless steel pan while his colleague Yutaka was standing 4 meters away from him. Surprisingly there was a sudden blue flash that was eventually referred to as Cherenkov radiation, when the mixture underwent a nuclear reaction that emitted neutron radiation and gamma rays. The incident then made the three of them suddenly get a very high dose of radiation Hisashi Ouchi received 17 Sv (sievert) and Masato Shinohara received 10 Sv. While Yutaka Yokawa was irradiated with 3 Sv. For comparison, according to the Regulation of the Head of the Nuclear Energy Regulatory Agency Number 4 of 2013, the dose limit value for the public is 1 mSv (millisievert) per year, while for radiation workers it is 20 mSv for five years. After the explosion, Hisashi was immediately rushed to the hospital and immediately received medical treatment. Hisashi died after 83 days of treatment.

The next nuclear radiation exposure case comes from Eben Byers. Byers was a golfer who was born on April 12, 1880, he won the golf championship in 1906. But his life changed when he returned from a match at Harvard Yale, he fell from his bed. Long story short he went to a doctor and the doctor recommended "Radithor" to Byers. Miraculously

Byers no longer felt the pain he had been feeling which eventually Byers began to continue taking Radhitor. Byers stopped taking radhitor in 1930 after drinking over 1400 bottles of Radhitor and Byers' body began to decay the deteriorating tissue was surgically removed, leaving him with a gaping hole where his mouth was without a lower jaw. Byers eventually died at the age of 51 on March 31, 1932. He was sealed inside a lead-lined coffin designed to absorb radiation that would continue to emanate from his remains for centuries to come. She was exhumed for testing in 1965. The study found that the radiation levels were still very dangerous.

Based on the two cases above, we can analogize how dangerous it is to be exposed to excessive nuclear radiation. Nuclear wastewater contains a number of radioctive materials that have the potential to harm marine ecosystems if they cannot be managed properly. In the context of nuclear waste disposal from Fukushima Daiichi, the main radioactive material found was tritium. Tritium, as an isotope of radioactive hydrogen, releases weak beta radiation. Although tritium has lower radiation levels compared to some other radioactive isotopes, its impact on marine ecosystems can still be significant depending on its concentration and how the waste affects organisms and food chains in the ocean. In high amounts, tritium can damage the tissues of marine organisms, affecting their development, reproduction and health.

The formation of the organs of the invertebrate fetus comes from the layers of the embryonic body wall. One of the deepest layers in the embryo wall is the endoderm layer. The endoderm layer in the embryo will grow epitellium cells which will then differentiate into several organs such as digestive organs and glands and pulmo (respiratory organs) . The plan to dump nuclear waste into the sea can also be a new problem in the marine ecosystem, especially in the development of invertebrate fetuses. The tritium content in it can affect the development of invertebrate fetuses. Here are some potential side effects of tritium on invertebrate fetal development:

1. Genetic Mutations: Beta radiation released by tritium can damage genetic material in the cells of invertebrate fetuses. This can cause genetic mutations that can affect normal development. Genetic mutations can interfere with the functioning of the organism and can even be passed on to offspring.
2. Tissue Damage: Beta radiation can also damage invertebrate fetal body tissues. It can affect the development of the organism by disrupting the growth of healthy cells and tissues.

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3. Reproductive Disruption: Exposure of invertebrate fetuses to tritium may interfere with their reproductive processes. It may inhibit the development of adult organisms or interfere with their ability to reproduce.
4. Immune System Impairment: Beta radiation can affect the immune system of invertebrate fetuses, making them more susceptible to disease and environmental stress.
5. Physiological Changes: Tritium can also affect physiological functions in invertebrate fetuses, such as metabolic processes and changes in growth rates.

The next possible problem that will occur is genetic mutation in marine biota due to exposure to nuclear waste. This would be a serious problem in the context of environmental protection. Nuclear radiation can cause various types of genetic mutations in marine organisms, including fish, crustaceans and microorganisms. Some of the effects of genetic mutations due to nuclear waste include:

1. Mutations in DNA: Nuclear radiation can damage the DNA structure in the cells of marine organisms. This DNA damage can result in genetic mutations that cause changes in the makeup of genes, which in turn can alter the traits of the organism.
2. Damage to Reproductive Genes: Genetic mutations that occur in genes involved in reproduction can disrupt an organism's ability to reproduce. This can negatively affect the population and sustainability of the species.
3. Long-term Effects: Some genetic mutations may not have an immediate impact, but they can accumulate and become a serious problem in the long run. It can reduce genetic diversity in the population, which makes the population more vulnerable to environmental stresses and changes.
4. Decreased Quality of Life: Significant genetic mutations can disrupt the functioning of organisms, reducing their resistance to disease, temperature changes, and other environmental conditions. This can lead to a decrease in the organism's quality of life.
5. Potential Effects on the Food Chain: Genetic mutations in basic organisms in the marine food chain can have cascading effects on organisms higher up the food chain, including humans who consume fish and other marine life.

Impacts from exposure to tritium and other radioactive materials generated from nuclear wastewater will vary depending on a number of factors, including the level of exposure, duration of exposure, and tolerance of certain species to radiation. Therefore, careful scientific research and rigorous environmental monitoring are essential to understand the exact impacts on invertebrates and the marine ecosystem as a whole. Efforts to minimize exposure to marine organisms and protect the marine environment should be a priority in the handling of nuclear waste. It is important to continuously monitor and assess the impacts of nuclear waste on marine ecosystems, and implement appropriate mitigation measures. These measures are necessary to protect biodiversity in marine ecosystems.

Congenital anomalies can occur in all animal species, even in the absence of external radiation. Congenital anomalies are abnormalities that occur due to processes that take place before or during birth. Congenital anomalies can vary depending on the time of year when they are examined. Some problems may be seen while the animal is still in the mother's womb, while others may appear after the animal is born.

The period of total development in the womb is divided into 3 periods, namely:

1. **Oreimplantation,** from fertilization to when the embryo attaches to the uterine wall;
2. **Organogenesis** (the period when major organs develop;
3. **The fetal period**, when the growth of structures has been established.

The preimplantation stage is the most sensitive to the lethal effects of radiation. In this case, a "yes, or no" system will apply. That is, if the embryo exposed to radiation survives, it will grow normally in the uterus and develop. However, if the number of cells in the conceptus is small and they are not yet specialized, the damaging effects on the cells are likely to cause implantation failure or undetected death of the conceptus.

Embryos exposed to radiation during early organogenesis will show the greatest intauterine growth delay. The growth of the embryo in the womb will be inhibited or slower than normal in general. There will be a reduction in body weight at birth caused by cell depletion. Embryos exposed to radiation early in organogenesis show the most severe intrauterine growth retardation, which may recover later in life (i.e. temporary growth retardation).

In the fetal period, the effects of radiation have no major effect on cellular and functional damage. When it enters the fetal period, the organism will be stronger and less vulnerable in the pre-implantation and organogenesis stages. Only exposure to high doses of radiation will cause death. Exposure to high doses of radiation in the fetal period

causes the highest rate of permanent growth retardation. If exposed to radiation in this period, it is likely that fetal growth will be permanently inhibited. This makes it likely that the organism will be born with growth problems from which it cannot fully recover.

The effects of radiation on embryos and fetuses in animals can cause embryonic death, intrauterine growth retardation (fetal growth in the womb is stunted or slower than normal), and a wide variety of malformations affecting various limbs and organs.

The effects of radiation exposure depend on the level of exposure, duration of exposure, tolerance of the particular species to radiation and the developmental level of the organism.

CONCLUSIONS

The effects of Japanese nuclear waste on the fetal development of invertebrates and organisms in the sea will vary depending on a number of factors, including the level of exposure, duration of exposure, and tolerance of certain species to radiation. Tritium content in nuclear wastewater can cause genetic mutations, tissue damage, reproductive disorders, immune system disorders and physiological changes in invertebrate fetuses. In addition, nuclear wastewater can also cause mutations in DNA, damage to reproductive genes and can have long-term effects on the sustainability of marine biota.

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