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Effectiveness of Ozone Plasma Technology in Enhancing the Survival of Gourami (*Osphronemus goramy*) Fish Eggs

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ABSTRACT

The gourami (*Osphronemus goramy*) fish is a freshwater fish commonly found in Asia and widely cultivated by fish farmers or local inhabitants. The survival rate of gourami fish from egg to larva and juvenile stages is very low, at approximately 50%. Several factors, such as unstable environmental conditions, poor water quality, and fungal growth on the eggs, cause this. Typically, synthetic medications or natural materials such as betel leaves and others are used to improve gourami fry's survival rate. In this study, the researchers attempted to apply ozone plasma technology dissolved in water to observe the egg hatchability of gourami fish. This study aims to apply technology in fisheries and aquatic sciences. The results of the study show that ozone technology can be applied to observe larval survival, with the highest survival rates found in the 10-minute and 15-minute ozone treatments, both achieving 100% hatchability, with larval survival rates of 86.67% and 96.66%, respectively.

Keywords: Gourami (Osphronemus goramy), Egg Survival Rate, Plasma Ozone Treatment.

ABSTRAK

Ikan gurami (*Osphronemus goramy*) adalah ikan air tawar yang umum ditemukan di Asia dan banyak dibudidayakan oleh para peternak ikan atau penduduk setempat. Tingkat kelangsungan hidup ikan gurami dari tahap telur hingga larva dan juvenil sangat rendah, sekitar 50%. Beberapa faktor yang menyebabkan hal ini antara lain kondisi lingkungan yang tidak stabil, kualitas air yang buruk, serta pertumbuhan jamur pada telur. Biasanya, salah satu metode yang digunakan untuk meningkatkan tingkat kelangsungan hidup benih gurami adalah penggunaan obat-obatan sintetis atau bahan alami seperti daun sirih dan lainnya. Dalam penelitian ini, para peneliti mencoba menerapkan teknologi plasma ozon yang dilarutkan dalam air untuk mengamati daya tetas telur ikan gurami. Tujuan penelitian ini adalah menerapkan teknologi dalam bidang perikanan dan ilmu akuatik. Hasil penelitian menunjukkan bahwa teknologi ozon dapat diterapkan untuk mengamati kelangsungan hidup larva, dengan tingkat kelangsungan hidup tertinggi ditemukan pada perlakuan ozon selama 10 menit dan 15 menit, yang keduanya mencapai tingkat daya tetas 100%, dengan tingkat kelangsungan hidup larva masing-masing 86,67% dan 96,66%.

Kata kunci: Gurami (*Osphronemus goramy*), Tingkat Kelangsungan Hidup Telur, Perlakuan Plasma Ozon.

1. Introduction

The gourami (*Osphronemus goramy*) fish is a freshwater fish commonly found in Asia and is often farmed by fish farmers or local residents [1]. The mortality rate in gourami fish farming is very high, reaching 50% to 70%, accompanied by slow growth [2]. Factors such as environmental instability, declining water quality, and fungal growth on eggs often hinder the proper development of fish eggs. One way to improve the survival and growth of gourami larvae is by using synthetic drugs and natural feed. Synthetic drugs are generally used to prevent and treat protozoa and fungi on fish eggs, fish seeds, and adult fish. However, the use of synthetic drugs is not yet optimal, as it can lead to resistance in eggs, increase costs, and, with long-term use, potentially harm the environment [3][4].

Some researchers have conducted studies using ozone technology. Ozone is a triatomic compound (O_3) recognized as safe and environmentally friendly in its application. Ozone is highly reactive and less stable compared to oxygen. Ozone is a powerful oxidizing agent with an oxidation strength six times greater than that of chlorine. Due to this property, ozone is widely used for water sterilization, removal of organic waste and color, disinfection, and virus elimination. It also enhances water supplementation, as the final reaction product is oxygen [5]. The ozonization process is cleaner for wastewater treatment, breaking down into water and oxygen. Ozone is the most efficient method for degradation through oxidation, with an oxidation potential of 2.7 V [6]. Research conducted by [7] demonstrated that the effect of ozonization on the hatching percentage of Kuruma shrimp embryos, Penaeus (Marsupenaeus) japonicus, varies depending on the duration of ozone exposure to the eggs. One technique for generating ozone is using dielectric barrier discharge (DBD), which utilizes high voltage [8][9]. DBD is an ozone generator reactor that utilizes plasma discharge produced in the gap between two electrodes: a wire electrode as the active electrode on the inside and an outer electrode as the passive electrode, which uses aluminum foil. A Pyrex glass tube serves as the dielectric material to prevent arc discharge. When ambient air or pure oxygen at atmospheric pressure is passed through the gap between the two electrodes, an ionization process occurs, producing ozone [10].

The research will examine and analyze the potential of Plasma Ozone Technology in improving the hatching rate of gourami fish eggs while minimizing the growth of fungi such as Saprolegnia sp. This study is part of an effort by Asahan University to apply technology to address community issues, such as the suboptimal hatching rate of gourami fish eggs due to fungal attacks.

2. Methods

2.1. Tools and Materials

In this study, the equipment used is the D'Ozone machine from PT. Dipo Technology Company, Semarang. This machine utilizes DBD technology, which can generate a concentration of 150 ppm. The materials used are gourami fish eggs, which are immersed in water dissolved with ozone for 5, 10, and 15 minutes. The study is conducted with three repetitions. A total of 60 gourami fish eggs are treated with ozone, after which the eggs are transferred to the rearing media.

2.2. Research procedures

The research method is conducted in three stages. First, ozone is generated using a reactor powered by high voltage, with a reactor length of 10 cm and an airflow rate of 5 L/min. The reactor is supplied with high voltage. Second, the gourami fish eggs are immersed in water dissolved with ozone for 5, 10, 15, and 20 minutes. Third, the eggs that have been immersed are observed for embryo development. The observation times are 1 hour, 2 hours, 3 hours, 12 hours, and 31 hours. Observations are made under a microscope. Next, the survival rate of the gourami larvae is calculated using Equation (1).

$$S = \frac{N_t}{N_0} \quad (1)$$

Where S (Survival Rate): The proportion of individuals that survive over a given period, often expressed as a percentage, N_0 is the initial number of fertilized eggs; N_t is the number of eggs that successfully hatched or larvae that survived after a certain period.

3. Result and Discussion

3.1. Characteristics of the Ozone Generator

The ozone generator is generated using dielectric barrier discharge plasma (DBDP). The DBDP reactor comprises two stainless steel wires wrapped with a Pyrex tube. The measurement of ozone concentration in relation to voltage variation can be seen in Figure 1.

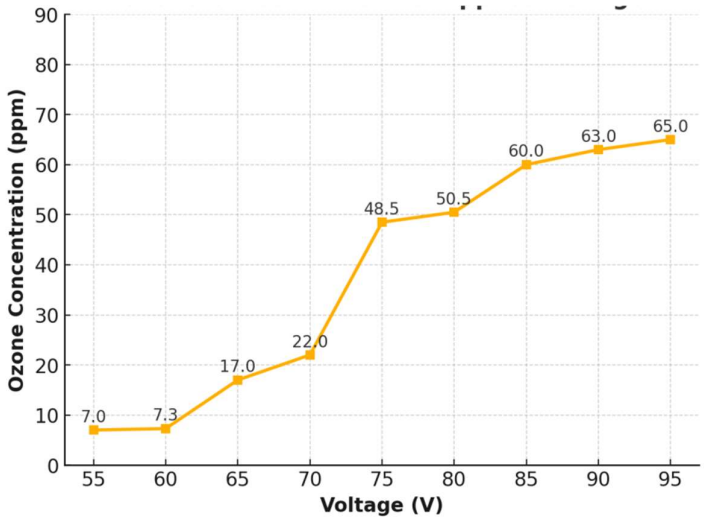


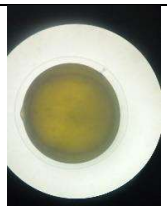
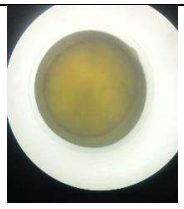
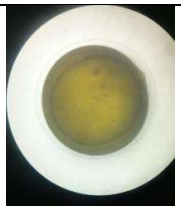
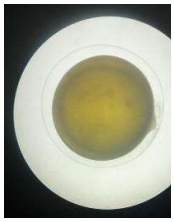
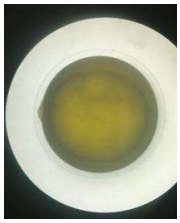
Figure 1. Voltage vs. concentration graph

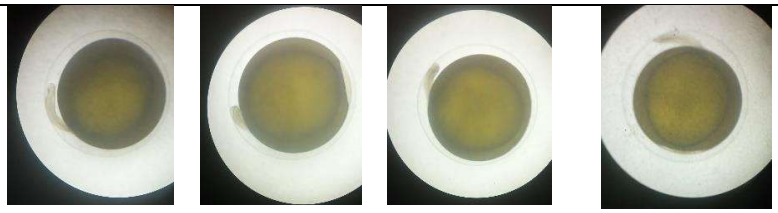
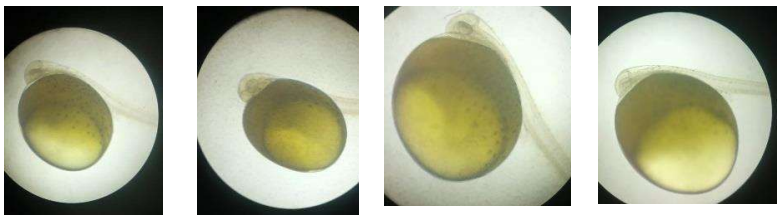
Figure 1 shows the relationship between voltage and ozone concentration. The applied voltage ranges from 55 V to 95 V. The results indicate that the maximum ozone concentration of 65 ppm occurs at 95 V. The ozone concentration values between 85 V and 95 V do not differ significantly, remaining between 60 ppm and 65 ppm. The trend suggests that ozone concentration increases with voltage; however, beyond 85 V, the increase becomes less pronounced, indicating a possible saturation effect.

3.2. Egg Hatching Rate

The egg hatching rate was observed up to day 6. The first data collected were the eggs' embryogenesis and the gourami fish's larvae, which were monitored from 12 hours to 50 hours under both the control and the ozone treatments (5, 10, and 15 minutes). The research data is shown in Table 1.

Table 1. Embryo and larvae development of gourami fish.

Time	Treatment				Notes
	Control	5 Minutes O_3	10 Minutes O_3	15 Minutes O_3	
12 hours					Gastrula stage
21 hours					The embryo begins to form.

Time	Treatment				Notes
	Control	5 Minutes O_3	10 Minutes O_3	15 Minutes O_3	
31 hours					The black color and the tail bud are clearly visible.
40 hours					The black color and tail become more distinct.
50 hours					The eye organs have formed, and the heartbeat is clearly visible

Each treatment, namely the control and ozone treatments (5, 10, and 15 minutes), showed embryonic development in the gourami fish eggs. Table 1 shows that the larval growth in the 15-minute ozone treatment is faster compared to the control treatment.

3.3. Larval Survival

The survival of the larvae of gourami fish is observed around 2 to 3 days after hatching. At this age, the larvae of gourami fish begin to show signs of active life, such as moving and searching for food. Initially, the gourami larvae will use the yolk sac reserves to survive, and after that, they begin to search for tiny plankton and other microscopic organisms as their primary food source.

Table 2. Hatchability of Eggs

Treatment	Hatchability of Eggs (%)	Larval Survival (%)
Control	97.78	62.22
5 Minutes O_3	86.67	73.33
10 Minutes O_3	100	86.67
15 Minutes O_3	100	96.66

The data on egg hatchability and larval survival are presented in Table 2. The highest egg hatchability occurred in the treatments with 10-minute and 15-minute ozone exposure, achieving 100% hatchability, with larval survival rates of 86.67% and 96.66%, respectively. The lowest larval survival rate was observed in the control treatment, with a survival rate of 62.22% and an egg hatchability of 97.78%. This indicates that the administration of ozone for 15 minutes affects egg hatchability and larval survival in gourami fish. When ozone is dissolved in water, it produces O_2 (oxygen), providing sufficient oxygen to the fish eggs.

4. Conclusion

Ozone technology generated using a DBD (Dielectric Barrier Discharge Plasma) reactor with an applied voltage ranging from 55 V to 95 V produced a maximum ozone concentration of 65 ppm at 95 V. The results indicate that ozone treatment can be effectively applied to observe egg survival rates. The highest survival rates were observed in the 10-minute and 15-minute ozone treatments, achieving 100% hatchability, with larval survival rates of 86.67% and 96.66%, respectively. The findings suggest that increasing ozone exposure up to an optimal level enhances egg viability and larval survival, demonstrating the potential application of ozone technology in aquaculture.

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