

The Design of Goldfish Hatchery Equipments for Sex Manipulation

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ABSTRACT

One way to seed goldfishes (*cyprinus carpio*) is called *gynogenesis*, an egg cell insemination process without any male genetic contribution, so the produced hatches are all female. One way to get seed with much superiority is by using sex manipulation method. It is expected that from this breeding seed with good genetic quality can be obtained. One type of sex manipulation is *Gynogenesis*. It is a process called heat shock of the inseminated eggs. During shocking process, it needs some water with certain temperature with highly stability. Another process UV irradiation is the process of UV radiation with certain intensity in sperm by using mutagenic substances; in gynogenesis aims to weaken the fish sperm are genetically for the number of chromosomes in the eggs remain 2N (diploid). The purpose of this research is to design a prototype equipment in the form of goldfish hatcheries Mechatronics control circuit and software for the process of gynogenesis. The success of gynogenesis process not only determined by heat shocking process, but also determined by eggs quality and sperm quality are chosen from ripe mothers. The results of this experiment are a prototype equipment goldfish hatchery in an effort to increase the rate of fish breeding process faster with better quality.

KEYWORDS: gynogenesis, male genetic, UV irradiation, heat shock, hatch rate, mechatronics

INTRODUCTION

Many fish species that are cultivated in nearly all the territory of Indonesia is carp (*Cyprinus carpio*) and tilapia (*Oreochromis niloticus*). The advantages of both types of fish are able to live in lowland ecosystems as well as high society as well as preferences of both types of fish are high enough[1]. The potential of common carp as fish cultivation is big enough where this fish has several advantages are: easy to breed, can be maintained with high density; to receive the feed ranging from natural and artificial feed; tolerant of changes in heat-tolerant state of oxygen in their environment; relatively rapid growth.

The process of seeding to be able to produce quality seeds can not be done naturally, although the natural way would be quite easy to get a lot of quantity, but for terms of quality and variety of species would be better if it is obtained by means of genetic manipulation. Need to do a particular effort in which one of them is the manipulation of sex as gynogenesis. Breeding with the modern way is by way of manipulation of sex that one of them is gynogenesis, i.e. the production of embryos from eggs fertilized by sperm without the contribution of male genetic material so that the results only female offspring and have the same nature as female parent. In gynogenesis process must be selected female parent who has the superior characteristics such as its large, disease resistant, easy to adapt to the environment and rapid growth.

There are several levels of perform gynogenesis process in one of the important process of gynogenesis is irradiating fish sperm with mutagens such as ultraviolet light materials with strength and a certain time [13]. Sperm irradiation intended to disable a genetic male, medium heat staggering aims to be able to prevent polar body II jump [2]. To implement the necessary equipment that form ultraviolet lamps irradiation, timers, regulators intensity, where the sperm, magnetic stirrer. Another important process is staggering (shocking) that can be done with Staggering cold (cold shock), Staggering heat (heat shock) and shock pressure (pressure shock). The main problem faced by farmers in the development of fish farming is to maintain continuity of production, stem and seed quality.

Goldfish purification program carried out to obtain a superior parent. Breeding with the modern way is by manipulating the sex of the embryo production from eggs fertilized by sperm without the contribution of male genetic material so that the results are genital only female offspring and have the same nature as female parent. Goldfish purification program with the modern way is to use the method of gynogenesis. This method is the production of embryos from eggs fertilized by sperm without the contribution of male genetic material. How to eliminate genetic sperm is by irradiating sperm cells with mutagenic substances like gamma rays, X rays and ultraviolet light [13]. Results gynogenesis is a female fish only. Gynogenesis process fluid temperature is affected by the timorous, radiation intensity, duration of radiation treatment on the eggs, medium and long time breeder of Staggering [7].

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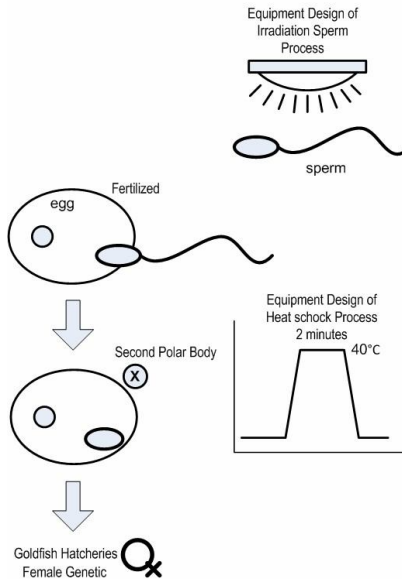


Figure 1 Process of gynogenesis

Gynogenesis zygote is the process of egg formation in the absence of male gametes contributed genetic material so that an individual or population that forms only inherited genetic traits female parent only. Gynogenesis program is also more efficient when compared to with program selection in generating individual homozygote and can produce true-breed populations [12].

Gynogenesis program there are two types of meiotic and mitotic gynogenesis. Both types of programs are distinguished by the treatment time of conception is the time when eggs mixed with sperm, given a solution of fertilizer until shortly before the heat shock. In meiosis, this time is 3 minutes while mitosis is 29 minutes.

- a. Gynogenesis Meiosis, which is normally a fertilized egg (fertilization) with sperm that has been irradiated so that the number of chromosomes in the eggs remain 2N (diploid) and prior to the occurrence of jumping polar body II made a surprise (shocking) in the egg. The result of this process is the fish "Meiotic diploid Heterozygote" which according to comments in [5] the nature of fish produced from this process depends on the nature of its parent.
- b. Gynogenesis Mitosis, which is a normal egg is fertilized by sperm irradiation so that the number of chromosomes in the eggs remain 2N (diploid) and allowed the occurrence of jumping polar body II. After jumping the second polar body just done Staggering. The result of this process is to fish with "diploid mitotic Gynogenetic Homozygote" and the nature of these fish are all full homozygous.

There are two important steps in the process of gynogenesis, the first is irradiating sperm and Staggering (shocking) in the egg after fertilization. Irradiating (irradiation) is the process of irradiating sperm with mutagenic substances to generate mutants

MATERIALS AND METHODS

Gynogenesis process can be done at cold temperatures (cold shock) or in hot temperatures (heat shock), which both have advantages and disadvantages. Especially in the heat shock, the process is easier in a practical arena more easily keep the temperature in hot conditions and can use simple tools. The temperature of heat shock on Staggering varies between 26°C to 42°C depending on the type of fish, the length of time Staggering and also the type of treatment. For one type of fish, shock temperature 42°C within 1 minute is sufficient time for the gyno. However, if the desired temperature is lower shock can be done at a temperature of 32°C for 3 to 5 minutes after fertilization 12 to 16 minutes [4].

Temperature settings to select the desired temperature during the process of gynogenesis. Provided four options i.e. temperature 38, 39, 40 and 41 ° C. Given the carp gynogenesis to be in that temperature range. Setting a long time to choose sstaggering's time, provided a choice of 1, 1.5, 2 and 2.5 minutes long remember Staggering in the range of time. Temperature sensors to detect changes in water temperature, two temperature sensors mounted on the hottest point (close to the heater) and the coldest point (farthest) from the heater. Function signal conditioner to condition the output from the sensor to fit the needs of the signal at the next level, given the output from temperature sensor (LM35) is still quite small. Indicator, LED light that will light up if the water temperature

has reached the value in accordance with the set point (temperature option). Buzzer will provide a sound signal when time sstaggering finished.

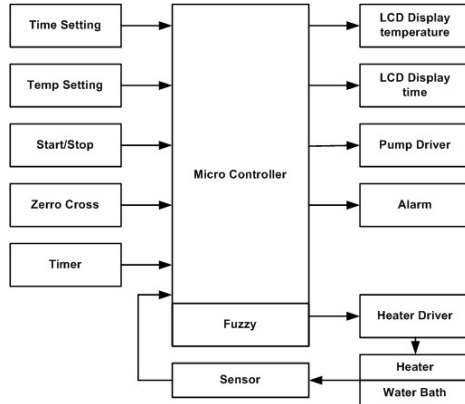


Figure 2. Heat Shock Diagram

UV irradiation is the process of UV radiation with certain intensity in sperm by using mutagenic substances; in gynogenesis aims to weaken the fish sperm are genetically for the number of chromosomes in the eggs remain 2N (diploid). Ultraviolet has a distribution of wave spectrum (320 nm - 400 nm) UVA, (280 nm - 320 nm) and UVB (200 nm - 280 nm) is called UVC which is often used in the medical field. In the process of germicidal UVC type used for irradiation with 200nm wavelength - 280 nm.

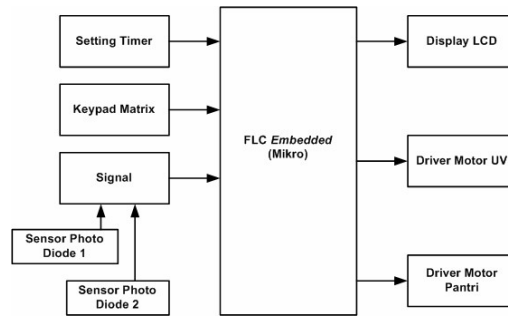


Figure 3. UVc Irradiation Diagram

The research used UVC with a wavelength fixed, then by adjusting the distance of irradiation will be obtained by changing the intensity of radiation (irradiation). Irradiation is the change of power / energy of light that occurs in the change of surface area, to determine the dose of irradiation used spectrometry unit. In order to obtain an optimal UV irradiation, can be done by placing the UV sensor on petri disk and perform an experiment measuring the intensity of UV for any changes in the distance so that, UV rays produced by fluorescent lamps UV-C Germicidal level of the irradiation can be observed by comparing with the standard gauge . TL Lamp UV-C Germicidal has a fixed wavelength so that the pattern used in measuring non-exponentially in the wavelength region of UV-C, but only set the dose of UV irradiation. UV photo diode sensor placement is directly above and the middle of petri disk with a distance of approximately 2 cm, which does not interfere with the process of irradiation because of petri disk in a rotating condition.

For data collection performed by UV Irradiation testing procedure as follows: Long-wave UV-C germicidal lamp TI 10 Watt (TUV 10W/uv-c, G13 Base 8FC11004, Safer Electric) refers to a tool used in the Fish Seed (BBI) with setting of irradiation and 0.32 mW/cm² minutes, just 9 minutes and a distance of 15 cm then the setting made in the research intensity of 0.426 mW/cm² irradiation was made with the same distance of 18 cm, 7.5 minutes of time will be obtained by 1920 J/m² irradiation dose. Mutagen solution concentration and keep the room temperature, the dose would be selected during the process the best gyno. The above process is repeated again in the setting of fixed intensity with time of irradiation process was made 5 minutes and 6 minutes.

RESULTS AND DISCUSSION

Truth on the vessel water temperature is very dependent timorous temperature sensor capability to read the temperature and provide a report in the form of output. Temperature sensor to be used and tested is LM 35, where this sensor converts the temperature into the output directly from the form of voltage changes linearly with temperature which, according to data sheet changes the output voltage is 10 mV / ° C. Tests carried out a series of temperature sensors to determine whether a series of temperature sensors that are designed and implemented to the system can work and in accordance with the planned research. Tests were also performed to determine the amount of membership in a control system and controller response.

The temperature setting on water bath with fuzzy logic controller gives a pretty good temperature stability with no overshoot occurs, the percentage of error is quite low (0.6%) and fast enough to respond to disturbances although it is quite slow to reach the set point. It took 18 to 19 minutes to reach the set point compared with 11 minutes when performed in open loop.

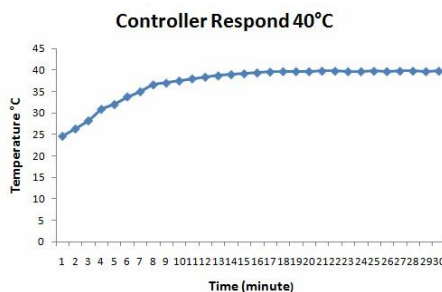


Figure 4. Controller Respond 40°C

Temperature stability 40°C is quite good and the time of shocking is 2 minutes. The ratio of gynogenesis results in terms of number of eggs fertilized, showed an increase of about 5% while the number of dead has decreased although the percentage small enough (5%). From the statistical test showed that shocking with fuzzy logic temperature control gives better results with higher percentage fertilization and percentage of egg mortality is lower.

The level of truth in the irradiation of UV irradiation depends on the ability of light sensors in the reading light intensity changes and provide results in the form of output. Light sensor that will be used and tested is photodiode G5842 (Hamamatsu), where this sensor converts light into output directly from the form of flow changes linearly against certain wavelengths where the output changes according to the data sheet is 1 mA / W at (λ_p) The test circuit light sensor conducted to determine whether the series light sensor designed and implemented to the system can work and in accordance with the plan. Tests were also performed to determine the amount of membership in a control system and controller response.

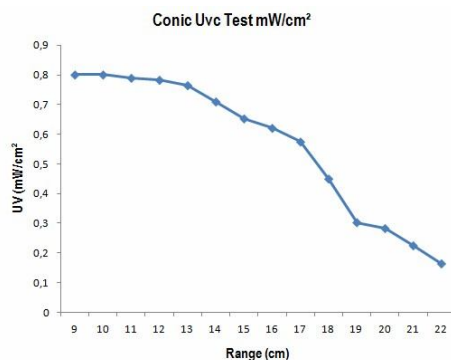


Figure 5 Conic Uvc test (mW/cm²)

Settings irradiation with fuzzy logic controller gives fairly good intensity stability and also has a fast response to reach set point. It took 19 to 20 seconds to reach the set point with a value of PWM 80% of its maximum. The statistical test is expected that the dose of irradiation with fuzzy logic control provides a better outcome.

CONCLUSION

The result is a prototype equipment goldfish hatchery, which the ratio of gynogenesis results in terms of the produced female hatches and of eggs fertilized, carp seed showed an increase while the number of dead has decreased. The irradiation is done by setting the intensity through the changing distance of the ultraviolet source toward the object in this case the fish sperm. The dose of irradiation is determined to the amount of 1920J/m² (4,5W/m²) the time option is 7.5 minutes, and temperature head shock 40°C the time of shocking is 2 minutes. Using fuzzy logic controller, the water temperature stability can be well maintained with 0.6% error rate from set point value. Quantitatively, water bath with fuzzy logic controllers results fertilization and better for the heat shock gynogenesis

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