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PID-CONTROLLED HEAT EXTRACTION FOR HIGH-YIELD BOTTLE SHARK LIVER OIL PRODUCTION

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Article Info
Keywords: Traditional medicines, bottle shark liver oil, Centrophorus atromarginatus, squalene

Abstract
Traditional medicines, comprising plant, animal, mineral ingredients, and galenic preparations, have been employed for generations in various societies for therapeutic purposes. Ensuring access to balanced and reliable health information and education is a fundamental right of every individual, and it is the government's responsibility to facilitate such access and improve overall healthcare services. The bottle shark (Centrophorus atromarginatus) presents a promising source of liver oil due to its abundance in Indonesian waters and ease of capture, with the current catch rate reaching only 39% of its sustainable potential. The bottle shark in Indonesian seas has a length of 1.5 meters, weighing 50 kilograms, and an impressive 85% oil content in its liver. However, despite its potential and high production in Cilacap Regency, its utilization remains largely untapped. The liver oil of bottle sharks is rich in squalene, a compound known for reducing blood cholesterol levels by enhancing the liver's filtering capacity. This beneficial mechanism arises from squalene's ability to regulate HMG Co-A reductase, leading to improved cholesterol filtration in the liver. Furthermore, the liver oil contains approximately 90% squalene, along with Vitamin A and Omega, making it a valuable supplement for heart disease and stomach ulcers, while also enhancing stamina and cognitive function. This study aims to explore the potential of bottle shark liver oil as a natural remedy for various health conditions, focusing on its cholesterol-lowering effects, benefits for heart health and gastric health, and its potential to enhance overall vitality and cognitive performance. Through a comprehensive review of existing literature and experimental investigations, the bioactive compounds in bottle shark liver oil and their potential health applications will be elucidated. Moreover, sustainable and responsible utilization of this resource will be emphasized, taking into consideration the ecological impact and conservation of bottle shark populations.

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1. Introduction

Traditional medicines are ingredients or ingredients in the form of plant ingredients, animal ingredients, mineral ingredients, galenic preparations, or mixtures of these materials, which have been used for generations for treatment. They can be applied according to the norms in force in society [1]. Everyone has the right to receive balanced and responsible information and education about health. The government is responsible for the availability of access to information, education, and health service facilities to improve and maintain the highest degree of health [2].

Bottle shark (Centrophorus atromarginatus) has good prospects as a producer of liver oil. This fish is easy to catch and occurs in relatively large numbers in Indonesian waters; the catch rate until now is only 39% of its sustainable potential [3]. The bottle shark found in Indonesian seas has a body length of 1.5 meters, weighs 50 kilograms, and the oil content in its liver reaches 85% [4]. Sharks' potential and production in Cilacap Regency are pretty high, but their utilization has not been developed much. Squalene found in fish can reduce blood cholesterol levels by increasing the filtering capacity of the liver [5]. This mechanism stems from its ability to regulate HMG Co-A reductase, which increases the liver's ability to filter lousy cholesterol [6]. Bottled shark liver oil contains 90% squalene, Vitamin A, and Omega, which are very useful for the human body as a supplement for heart disease and stomach ulcers, and increase stamina and brain intelligence.

2. Literature Review

2.1. General Environmental Conditions

People generally use modern medicine, but few people still use health services from traditional medicine [8]. In 2003, 30.67% of Indonesia's population used alternative medicine [9]. Behavior is an activity or activity of the organism (living thing) concerned. Therefore, from a biological point of view, all living things, from plants to animals to humans, behave because they have their activities. The 2007 Susenas showed that 30.90% of the Indonesian population complained of being sick within a month before the survey. Of the residents who complained of being sick, 65.01% chose self-medication using drugs or traditional medicines[10]. Conventional medicines are ingredients in the form of plant ingredients, animal ingredients, mineral ingredients, herbal preparations, or mixtures of these ingredients, which have been used for generations for treatment based on experience[11]. One of the traditional medicines often used is bottled shark liver oil[12]. Shark oil is a medicine to reduce burns, heart disease, cancer, and infertility. In shark oil, there are substances such as alkylglycerol, squalene, and omega-3 polyunsaturated fatty acids[13]

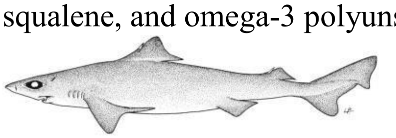

Fig 1. Bottle Shark (Centrophorus Atromarginatus)

2.2. Proportional Integral Derivative (PID)

The PID control system consists of three control methods, namely P (Proportional), D (Derivative), and I (Integral) controls, with each having advantages and disadvantages. In its implementation, each method can work alone or in combination. In designing a PID control system, what needs to be done is to set the P, I, or D parameters so that the response of the system output signal to certain inputs is as desired. Proportional Integral Derivative (PID) controller is one of the controllers that aims to improve the performance of a system, including the dc motor rotation control system. Response speed and steady-state error are parameters that are measured to assess the performance of a control system. PID control in this paper is implemented through personal computer (PC) based software which is also used to monitor the resulting response curve through an interactive graphical display [14].

2.3. Microcontroller

A microcontroller is a complete microprocessor system contained on a chip. Microcontrollers differ from multipurpose microprocessors used in a PC because a microcontroller generally includes components that support a minimal microprocessor system, namely memory and Input-Output programming. Microcontrollers are also called digital electronic devices with input/output and control using programs that can be written and erased in a particular way. In a microcontroller application, power is used on automatically controlled products or devices such as machine control systems, electrical appliances, remote controls, and devices that use other embedded systems [15].

Fig 2. Arduino Uno **2.4. Relay**

Relay is electrically and magnetically designed to detect abnormal conditions in unwanted electric power system equipment. If this abnormal condition occurs, the safety relay will automatically give a signal or command to open the circuit breaker so that the disturbed part can be separated from the standard system [16].

Fig 3. Relay

2.5. DS18B20 Temperature sensor

The DS18B20 Temperature Sensor is a one-wire digital temperature sensor or only requires one communication data line pin. Each DS18B20 sensor has a unique 64-bit serial number meaning it can use multiple sensors on the same power bus (multiple sensors connected to the same GPIO). This sensor has a digital output, so it does not need an ADC circuit; the level and speed of measuring temperature have better stability than other temperature sensors. The following is the specifications of the DS18B20 sensor [17].

The specifications of the DHT-11 sensor are as follows: The specifications of the DS18B20 sensor are: a. Temperature range: -55 - 125˚C.

b. Temperature Sensor Accuracy: -10˚C - +85˚C

c. Sensor power supply: 3.0 V - 5.5 V

Fig 4. DS18B20 Temperature sensor

2.6. LCD (Liquid crystal display)

LCD is a layer of organic mixture between a layer of clear glass with transparent indium oxide electrodes in the form of a seven-segment display and a layer of electrodes on the glass back. When the electrodes are activated by an electric field (voltage), the long, cylindrical organic molecules align themselves with the electrodes from the segments. The sandwich layer has a front vertical light polarizer and a rear horizontal light polarizer followed by a reflector layer. The reflected light cannot pass through the adapted molecules, and the activated segment appears to darken and forms the character of the data to be displayed [18].

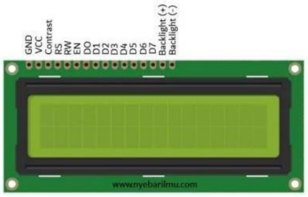

Fig 5. LCD

2.7. Saklar Switch

A switch is an electronic component that connects (ON) and disconnects (OFF) electric current from two or more points in electronics. The buttons are operated directly by electricity. The controller is an Electromechanical component that has two main parts, namely, the Electromagnet (Coil) and the Mechanical (a set of Switch Contacts/Switches) [19].

Fig 6. Saklar Switch

2.8. Power Supply

An electronic circuit converts alternating electric current into direct electric current. A power Supply is a device that functions as a power provider for other equipment. In general, power supplies still use analog power supplies, which still use analog dials, so it is not easy to get the output directly according to the wishes of the user. In addition, the stability that is still not good and the amount of power dissipation that occurs in analog power supplies is the background, so Development is needed. Along with developing digital technology, a Power Supply device was designed that uses digital control techniques [20].

Fig 7. Power Supply

2.9. Heat Element

Heating Elements (electric heating elements) are widely used in everyday life, households, industrial equipment, and machinery. A heating element is a tool that functions as one of the work activities to get the temperature from the low temperature of a substance to a high temperature. As a source of heat generated by this electric heating element, it comes from a wire or tape with high electrical resistance (Resistance Wire); usually, the material used is a nice wire which is rolled up to resemble a spiral and inserted in a sleeve/pipe as a protector, then electrified at both ends. And covered by an electrical insulator that can transmit heat properly so that it is safe to use. The shape and type of the Electrical Heating Element vary depending on the function, place of installation, and the media to be heated [21].

Fig 8. Heat Element

2.10. DC Fan

DC fan is an electromagnetic device that converts electrical energy into mechanical energy. This mechanical energy is used to drive a fan or blower. A fan usually has an electric motor where the electric motor will convert electrical power into kinetic energy. An electric motor has iron on the moving part (rotor) and a pair of flat U-shaped magnets on the stationary part (stator). When an electric current flows through a coil of wire in an iron coil, this will make the iron coil become a magnet. Due to the nature of the interests that repel each other at the two poles, when the magnet repels between the iron coils and a pair of magnets, it causes the force to rotate periodically on the iron coils [22].

Fig 9. DC Fan

3. Method

3.1. Research Stage

The first research stage was carried out to present the activities used by the author so that the research was better conceptualized and structured. The writer made a flowchart which can be seen in Figure 10. Below.

1. Identifying problems related to the review process of the Bottle Shark Heart Heating Tool, it is found that if the temperature is higher, the oil produced from the shark liver heating process is faster.
2. Literature study, after identifying the problem, the next step is to conduct a literature review concerned with the problem to be discussed and ensure that the research can be carried out.
3. Observation of tool components, namely conducting and determining component problems and the needs of the research to be carried out, aims to determine the basic needs of the investigation.
4. System design, namely designing and assembling a planning picture of the system, consists of mechanical, electronic, and program designs.
5. Functional testing and system performance are carried out in two stages. The first testing stage was carried out on the components forming the tool from installing the system circuit. The second testing stage is carried out on the Arduino control system connected to each sensor, which tests the DS18B20 sensor, Ceramic Heater Element, and LCD.
6. Testing the entire system after functional testing has been carried out; testing is carried out by running the system that has been made with specific scenario guidelines to see the success rate of the entire system design. If an error occurs or the results of the system's work are not as expected, corrections and improvements are made to achieve the research objectives.
7. Implementation of the Bottle Shark Liver Heater, namely after the design goes as expected, the next step is to apply the system design to the Bottle Shark Liver Heater that has been prepared.
8. Results and discussion, namely the presentation and discussion of the results obtained during the testing and implementation of the system design in the Bottle Shark Liver Heater.
9. Conclusion, namely concluding the results of research that has been done.

3.2. System Requirements Analysis

In assembling the "Design of a Bottle Shark Liver Heating Device (Centrophorus atromarginatus)" components or equipment are needed to facilitate the assembly process later. Some of the required tools and materials are shown in table 1 below:

Table 1. Equipment and Material Needs

NO	Material	Amount	Equipment	Amount
1	Arduino Uno	1	Wood	2

2	*Power Supply*	1	Plywood	1
3	DC Fan	1	Nail	50
4	DS18B20 Temperature sensor	1	Aluminum container	2
5	Ceramic Heater Elements	1	Whipsaw	1
6	Saklar Switch	1	Hammer	1
7	LCD	1	Filter	1
8	BTA41	1	Solder	1
9	MOC3021	1	Paint	2

3.3. System Block Diagram

The block diagram is one of the essential parts in the design of electronic equipment because, from the block diagram, it can be seen the overall working principle of the electronic circuit is made so that the entire block diagram of the tool that is created can form a system that works according to the design. Figure 11. is a block diagram of the Bottle Shark liver heating system.

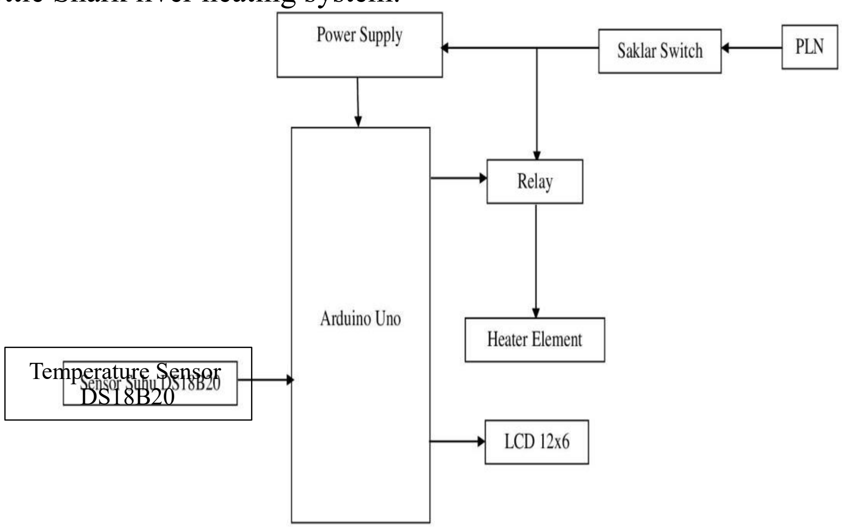

Fig 10. Blog Diagram

Based on the block diagram in Figure 10, we can describe it as follows:

1. The block diagram in Figure 10 explains the system configuration ratio between input, output, and the main components used.
2. The block diagram of the system gets power input from PLN 220 Volt AC, and then it is forwarded to the Switch Switch.
3. Then the output from the power button is connected to the power supply and Relay. In the 220 Volt power supply, the voltage is lowered to 12 Volts to supply the Arduino Uno. At the same time, the Relay is connected to the Heater Element and Arduino Uno, where the Arduino Uno functions as a signal to the Relay to disconnect and link between the Relay and the Heater Element.
4. The DS18B20 temperature sensor uses power from the Microcontroller converted from 220 to 12 Volts.
5. The DS18B20 sensor will give the output value of each sensor work to the Microcontroller, and then the Microcontroller will identify the sensor value and process it.
6. After getting the input value from the sensor, the Microcontroller will send information to the LCD to find out the temperature of the heating element container that is attached to the container.

4. Results and Discussion

4.1. Mechanical Design

The mechanical design is in the form of a heating container, where the container functions as a heating place for the bottle of shark liver, then a filter box, which works as a filter for shark liver oil which is still mixed with the dregs of the shark liver. Then the reservoir design serves as a reservoir for the oil produced from the bottle shark's liver. The results of the mechanical design of the Bottle Shark liver heater can be seen in Figureure 11 below.

Fig 11. Bottle Shark Heart Heater Mechanical Design Information:

1. Bottled Shark Liver Heater
2. Strainer Bottled Shark Liver Oil
3. Container for Bottled Shark Liver Oil

4.2. Electrical Design

The electric design is specifically designed according to the invention of the Bottle Shark (Centrophorus Atromarginatus) liver heater. The electrical design is divided into the sensor design for the bottle shark heart heater, the fan design, and the LCD for the system circuit design. Design a Sensor on a Heating Container In the heating container series, the sensor used is the DS18B20 sensor. The purpose of this sensor is to find the temperature of the container where the ceramic heater element is attached.

Fig 12. Bottle Shark Heart Heater Electrical Design Information:

1. Arduino Uno
2. Power Supply
3. Step Down Buck Converter
4. Ceramic Heater Elements
5. DC Fan
6. DS18B20 Temperature Sensor
7. LCD

4.3. Programs Design

The program's design is made according to the workings of a Bottle Shark liver heater. The program or command used to run the component uses one piece of software, the Arduino IDE software. The following is a picture of the Arduino IDE software.

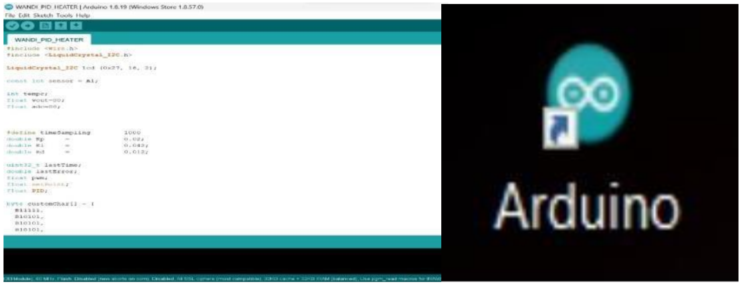

Fig 13. Bottle Shark Heart Heater Programs Design

4.4. Testing of Bottle Shark Liver Heating System

This power supply test requires an input voltage from PLN of 220 Volts AC with an output voltage of 12 and 9 Volts DC. In this test, it is hoped that the output results from the power supply match the output values required for all modules and sensors used in this study. Following are the results of the power supply test carried out:

Table 2. Power Supply Test Results

No	Input	Output	Statuses
1	220 Volt AC	224 AC	Good
2	12 Volt DC	11.98 Volt DC	Good
3	9 Volt DC	09.02 Volt DC	Good

In this test, what will be tested is the LCD. This LCD test aims to determine the temperature resulting from the bottle shark liver heating container. Then simultaneously test the Function of the DC Fan.

Table 3. LCD Test Result

No	Temperature	Statuses
1	31˚	Good
2	32˚	Good
3	33˚	Good
4	34˚	Good
5	35˚	Good

Tabel 4. Fan Test Results

No	Command	Statuses
1	On	Good

Sensor testing was carried out to determine the temperature generated from the bottle shark liver heating container. In this test using the DS18B20 temperature sensor.

Table 5. DS18B20 Temperature Sensor Test Results

No	Temperature	The resulting oil	Statuses
1	31˚	3 Ons	Good
2	32˚	3 Ons	Good
3	33˚	3 Ons	Good
4	34˚	3 Ons	Good
5	35˚	3 Ons	Good

5. Conclusion

After testing and analyzing the above, it can be concluded:

1. Design of a Box-Shaped Bottle Shark liver heater with a height of 80 cm and a width of 37 cm. Inside the box is a heating container, a bottle shark liver filter, and a bottle of shark liver oil reservoir.

2. The working system of the Bottle Shark liver heater works with temperatures of 31˚, 32˚, 33˚, 34˚, and 35˚. And using PID control to control the temperature stability of the bottle shark liver heating container.

3. The amount of oil produced is between a low temperature of 31˚ and a high temperature of 35˚. The amount is 3 ounces.

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