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Analysis Based on Arduino Uno Producing a Baracuda Smoking Tool With a Smoke Concentration and Temperature Monitoring System

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ABSTRACT

A smoked barracuda fish product smoking device with closed circulation using a temperature monitoring system and smoke concentration based on Arduino Uno has been created. The design of the cold smoking device is divided into three parts, namely the combustion area, the smoke pipe, and the smoking chamber. Smoke drift of (25.53%-32.45)%. The average length of the fish was 16.7 cm and the average weight of the barracuda fish was 192.3 grams. 10 barracuda fish were put into the smoking room. The lowest water content value for smoked barracuda fish, namely 25.53%, occurred at a smoking time of 6 hours and the highest water content for smoked barracuda fish, namely 32.45%, occurred at a smoking time of 3 hours. The efficiency of the time needed to smoke mackerel on the water content was 6 hours compared to a smoking time of 3 hours. This means that the longer the smoking, the lower the water content value in smoked mackerel.

I. Introduction

Fish processed by smoking can last longer due to several factors, including reducing the water content of the fish to below 40 percent, the presence of compounds in wood acid which inhibit the growth of spoilage microorganisms and the coagulation of proteins on the surface of the fish which results in the connective tissue becoming stronger and more compact so that it is resistant to attack by microorganisms. [1] The antimicrobial compounds contained in wood smoke include various types of aldehydes, alcohols, acids and so on. Smoked fish must be stored in a dry place and tightly closed. [2] Mold growth in smoked fish causes the smell to become rancid and changes the texture. Smoking can also improve the appearance of fish because the fish becomes shiny. [3] Apart from the advantages mentioned above, smoking fish has several disadvantages because the texture of the fish becomes hard, especially if smoking is carried out at low temperatures for a long time and it takes a long time to smoke the fish completely.

II. The Proposed Method/Algorithm

A. Arduino Uno

Arduino is an open source micro-single-board controller. The hardware has an Atmel AVR processor and the software has its own programming language. The meaning of a micro-single-board controller is that an Arduino is a special device in the form of an electronic module whose shape and components are ready-made and ready to be used. However, there are still standards for manufacturing. The open source electronics platform consists of three components, namely programming language, IDE (Integrated Development Environment) software and a microcontroller device. Arduino has 14 digital input or output pins and 6 analog inputs. Arduino can work by connecting to a computer via a USB cable. Arduino Uno has 6 analog inputs, namely labeled A0-A5. Each pin provides a resolution of 10 bits (1024 different values). Voltage value d Arduino has 14 digital input or output pins and 6 analog inputs.

B. Analysis fungtions

Power consumption is around 3-4.2 watts, the fan is placed at the bottom of the smoking chamber. The lower fan draws smoke from the combustion chamber into the smoking chamber to produce optimal temperature evenness. [1] The use of the 7809 regulator on the transformer functions to reduce the voltage from 12V to 9 V, this regulator only transmits the voltage in accordance with the specifications listed on the regulator. This voltage is positive while the diode functions to rectify the current. [2] Real time clock (RTC DS3231) uses DC communication with Arduino. On port A pin 4 as SDA and port A pin 5 as SCL. The RTC requires two 4.7 kΩ pull-up resistors. This resistor functions to adjust the voltage level of the digital sensor with the Arduino microcontroller, due to the difference in current between the two. The power supply required by the DS3231 is around 2.3-5.5 V. The DS3231 real time clock also requires a backup voltage source so that the set date and time data continues to run when the main power supply is turned off. The output from the DS3231 RTC is the current time in the format day/month/year-hour: minutes: seconds. [3] Liquid crystal display (LCD) is a component that can display text. One type has two lines with each line consisting of sixteen characters. Such an LCD is usually called a 16 x 2 LCD. [4] The micro SD adapter module is a MicroSD card reader module, through the file system and serial peripheral interface driver interface. Micro SD can generally be used as data storage from the Arduino Uno where the data is in large quantities or large in size. This research project uses a micro SD module as a data logger. Where in the process of recording data from sensors, every change that occurs to the sensor will be recorded in memory. Here are some images that can be quoted from the reference :

Fig 1. 12 Volt AC Fan

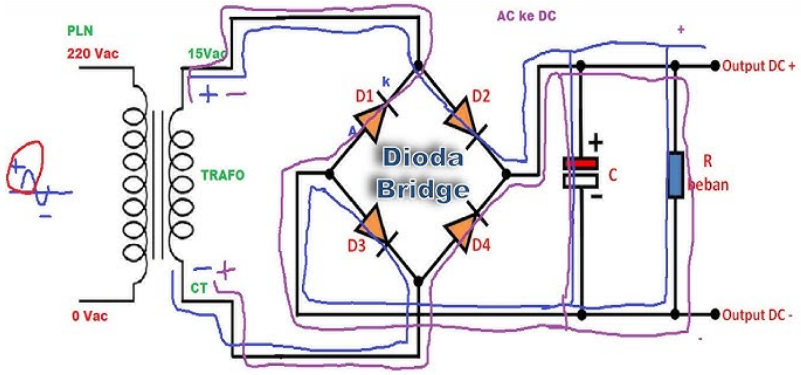

Figure 2. Power Supplies

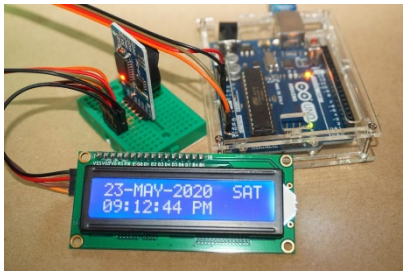

Figure 3. Real Time Clock (RTC DS3231)

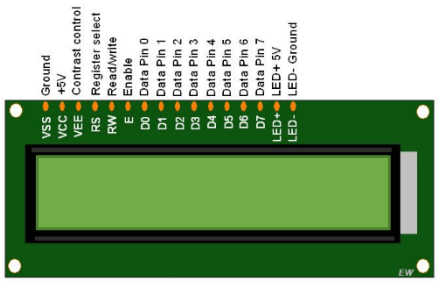

Figure 4. Liquid Crystal Display (LCD)

III. Method

This research is directed at creating a new consentrations the 12 volt fan is a temperature and smoke concentration control device controlled by Arduino as a microcontroller. The two fans under the smoking room will all turn on if the temperature in the smoking room is <15°C and one of the fans will turn off when the temperature in the smoking room is >45°C. The 12 volt AC fan is controlled

by a relay which works according to the temperature data input to the Arduino Uno via the display. The display is a temperature and smoke concentration monitoring device which is read by the DS18b20 sensor and MQ-2 sensor. This display uses a Liquid Crystal Display (LCD) and the data will be stored on the micro SD. The overall working system of the cold smoking device for smoked fish products is described in the flowchart as follows figure 5

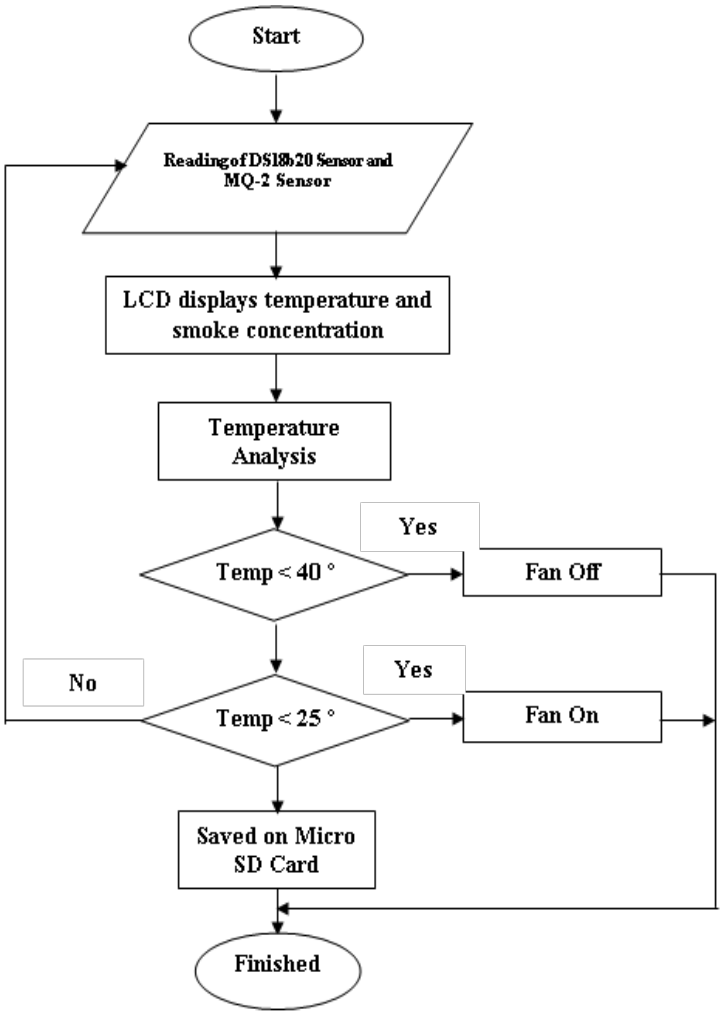

Fig 5 Tool Design Flowchart

Explanation of the cold smoking system workflow. The process begins by burning coconut shells in a kiln. This process will produce smoke which then enters through the smoke pipe and will go to the smoking room because it is sucked in by the fan in the smoking room. The DS18b20 temperature sensor and MQ-2 sensor will detect the temperature and concentration of smoke in the smoking chamber. LCD displays temperature and smoke concentration. Then analyze if the temperature in the smoking area is less than 25°C. The 2 bottom fans will work optimally. If the temperature in the smoking room is 45°C, then a fan below will stop working, and the smoke hole above the smoking room will be opened. Smoke will come out of the smoking cupboard. The data recorded from the temperature sensor and smoke sensor is then stored on the micro SD, then the process will be complete. The data is stored on the micro SD card.

A. Tool Sketch

Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

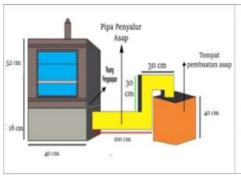

Fig 6. Tool Sketch

Fig 7. Location of the fan

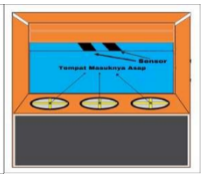

Fig 8. Sensor Location and smoking rack

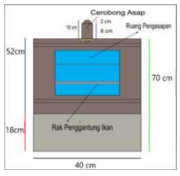

Fig 9. Fumigation Room Design

Fig 10. Design of Box Component and Glass

B. Programme

Design and Construction of a Catfish Smoking Device Using an Arduino Uno-Based Temperature and Smoke Concentration Monitoring System requires hardware and software that are used, including: Avoid combining SI and CGS units, such as current in amperes and magnetic field in oersteds. This often leads to confusion because equations do not balance dimensionally. If you must use mixed units, clearly state the units for each quantity that you use in an equation.

A. Tools Used:

1 Cutting Pliers Cutting cables, 2 Laptop Designing hardware and recording data, 3 Soldering Soldering between components, 4 Digital multimeter Measuring voltage, resistance and component connections, 5 AVR USB ISP Downloading firmware from Arduino to microcontroller board, 6 Electric grinder Cutting aluminum, 7 Screwdriver Opening and installing bolts, 8 Eagle Making circuit schematics, 9 Small electric drill Drilling holes in PCB, 10 Arduino IDE Making firmware, 11 Google sketch Up Making tool designs and dimensions, 12 Microsoft Excel 2010 Processing dataEquations.

B. Materials Used:

Microcontroller board 1 piece, Temperature sensor 1 piece, Smoke sensor 1 piece, LCD 1 piece, Resistor 6 pieces, PCB 1 piece, Coconut shell 1 sack, Scad fish 10 pieces, RTC 1 piece, Adapter 1 piece, AC (Air Conditioning) fan 2 pieces, Arduino Uno kit 1 piece, Smoking chamber 1 piece and Burning place 1 piece

C. Block Diagram

The hardware for measuring temperature and smoke concentration is divided into 9 parts, namely 12 volt power supply, DS18b20 digital temperature sensor, MQ-2 gas sensor, Arduino Uno, Real Time Clock, relay, micro SD Card, and 16 x 2 character LCD and 2 AC fans. The hardware scheme on the cold smoking device for fish products can be seen in Figure 11

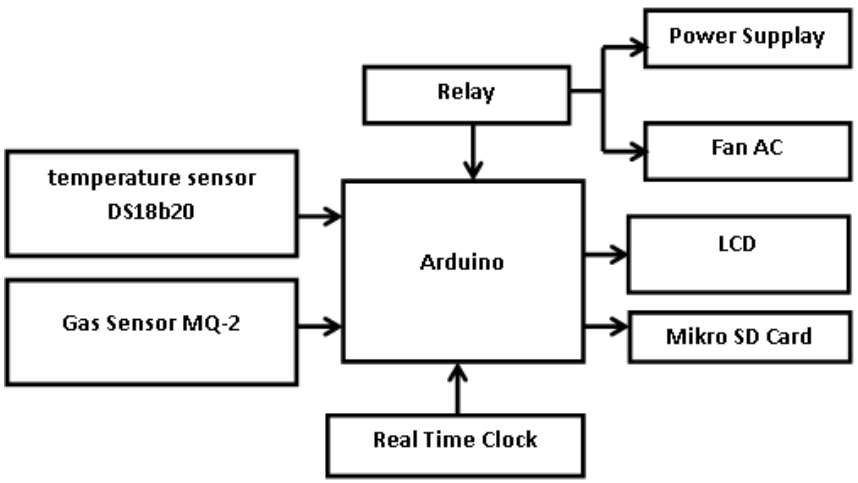

Fig 11. Block Diagram

Each device is connected to an Arduino Uno microcontroller. The system block consists of a power supply that functions to provide voltage to the Arduino Uno microcontroller.

Relay as a switch, an AC fan functions to draw smoke, a temperature sensor functions to measure the temperature value in the smoking room. The MQ-2 sensor is an analog sensor used to measure smoke concentration. Arduino Uno functions as a data processor. LCD functions as a data display, micro SD card functions as data storage. Data from the DS18b20 sensor and the MQ-2 sensor are stored in the Micro SD.

Testing the MQ-2 sensor can be done by looking at the output value of the MQ-2 sensor. This value can be converted into a smoke density value in ppm units. The equation used to convert digital values to parts per million (ppm) values is as follows:

a. $$Vout = \frac{digital\ Number\ ADC}{1024}\ x\ Vc \quad (1)$$

Information:
- ADC = Analog Digital Converter
- 1024 = Constant Value
- Vc = Circuit Voltage

b. $$Rs = 1 + \frac{Vc - Vout}{Vout}\ x\ RL \quad (2)$$

Information :
- Vout = Output Voltage
- Rs = Sensor resistance
- RL= Indicator resistance (standard value RL=10KΩ)

c. $$\frac{Rs}{Ro} = \frac{Rs}{RL} \quad (3)$$

The values obtained are then converted to the gas concentration graph contained in the sensor data sheet MQ-2. The equation used to convert the Analog Digital Converter (ADC) in Parts Per Million (Ppm) units is as follows:

$$Ppm = 322{,}39x\ ((Rs/Ro)^2) - (573{,}12\ x\ (Rs/Ro)) + 256{,}7 \quad (4)$$

$$\text{Water Content} = \frac{(A-B)}{C}\ X\ 100\% \quad (5)$$

Information:
- a = mass of initial sample (grams)
- b = mass of sample after smoking (grams)
- c = initial mass of sample (grams).

IV. Results and Discussion

Testing of the tool was carried out in Warureja Village, Tegal Sari District, Tegal City, Central Java Province. Cold smoking equipment trials were carried out to determine the stability of temperature and smoke concentration in the smoking room. The DS18b20 sensor and MQ-2 sensor have been coated with aluminum and are waterproof, safe to use in the smoking room, the sensitivity level of the DS18b20 sensor and MQ-2 sensor is high. The DS18b20 sensor and MQ-2 sensor function to record the temperature and concentration of smoke in the smoking chamber. Recorded data from the sensor will be stored on micro SD. Then the data is processed using Microsoft Excel.

A. Temperature in the Smoking Room

While recording the temperature sensor data, leave it alone without any special handling, The results of the temperature test in the smoking room are presented and The smoke sensor is placed in the smoking room, namely between shelf 1 and shelf 2 in Table 1.

Table 1. Temperature in the Smoking Room and Smoke Concentration Data

Time	Temperature in the Smoking Room and Smoke Concentration Data									
	Tamp (Celcius)	***Time***	***Tamp (Celcius)***	***ADC***	***Constant Value***	***VC***	***VOUT***	***RL-RO***	***Rs***	***Smoke Concentration***
09:05:03	23,38	11:25:02	42,17	36	1024	5	0,175	10 KΩ	276,7	241,17
09:10:02	26,23	11:30:22	40,98	37	1024	5	0,181	10 KΩ	276,2	241,78
09:15:05	26,35	11:35:11	40,01	39	1024	5	0,191	10 KΩ	252,78	242,55
09:20:02	27,65	11:40:23	39,15	40	1024	5	0,195	10 KΩ	247,4	242,8
09:25:35	27,93	11:45:02	38,11	42	1024	5	0,205	10 KΩ	234,9	243,5
09:30:25	28,77	11:50:05	36,07	43	1024	5	0,209	10 KΩ	230,2	243,76
09:35:22	29,31	11:55:11	33,87	46	1024	5	0,224	10 KΩ	214,2	244,76
09:40:12	30,25	11:00:02	30,25	48	1024	5	0,234	10 KΩ	204,6	245,19
09:45:11	30,67	12:05:11	30,67	50	1024	5	0,244	10 KΩ	195,9	245,68
09:50:01	30,78	12:10:12	30,78	55	1024	5	0,268	10 KΩ	177,5	246,71
09:55:23	31,93	12:15:23	31,43	66	1024	5	0,322	10 KΩ	141,6	248,73
10:00:01	31,22	12:20:35	32,17	72	1024	5	0,351	10 KΩ	133,4	249,2
10:05:05	31,43	12:25:02	33,79	74	1024	5	0,361	10 KΩ	129,5	249,42
10:10:02	32,17	12:30:22	32,12	79	1024	5	0,385	10 KΩ	120,8	249,91
10:15:11	33,79	12:35:11	32,17	87	1024	5	0,424	10 KΩ	108,9	250,58
10:20:13	32,12	12:40:23	32,22	127	1024	5	0,62	10 KΩ	71,6	252,7
10:25:23	32,17	12:45:02	34,01	129	1024	5	0,629	10 KΩ	70,4	252,76
10:30:01	32,22	12:50:05	36,19	131	1024	5	0,639	10 KΩ	69,2	252,83
10:35:12	34,01	12:55:11	37,91	93	1024	5	0,454	10 KΩ	101,1	251,02
10:40:05	36,19	13:00:02	39,15	96	1024	5	0,468	10 KΩ	97,8	251,8
10:45:01	41,65	13:05:11	38,11	97	1024	5	0,473	10 KΩ	96.7	251,27
10:50:31	43,81	13:10:12	41,65	103	1024	5	0,502	10 KΩ	90,6	251,62
10:55:23	44,81	13:15:23	44,81	113	1024	5	0,551	10 KΩ	81,7	252,12
11:00:02	44,72	13:20:35	44,82	119	1024	5	0,581	10 KΩ	77	252,39
11:05:11	44,59	13:25:02	44,72	127	1024	5	0,62	10 KΩ	71,6	252,7
11:10:12	44,56	13:30:22	44,59	129	1024	5	0,629	10 KΩ	70,4	252,76
11:15:23	43,69	13:35:11	44,56	72	1024	5	0,351	10 KΩ	133,4	249,2
11:20:35	43,31	13:40:23	43,69	74	1024	5	0,361	10 KΩ	129,5	249,42
13:45:02	43,31	14:45:02	31,25	79	1024	5	0,385	10 KΩ	120,8	249,91
13:50:05	42,17	14:50:05	30,17	66	1024	5	0,322	10 KΩ	141,6	248,73
13:55:11	40,98	14:55:11	30,12	74	1024	5	0,361	10 KΩ	129,5	249,42
13:00:02	40,01	14:00:02	29,77	79	1024	5	0,385	10 KΩ	120,8	249,91
14:05:11	39,15	15:05:11	29,62	66	1024	5	0,268	10 KΩ	177,5	246,71
14:10:12	38,11	15:10:12	29,59	74	1024	5	0,181	10 KΩ	276,2	241,78
14:15:23	37,91	15:15:23	29,56	79	1024	5	0,191	10 KΩ	252,78	242,55
14:20:35	33,87	15:20:35	29,34	55	1024	5	0,175	10 KΩ	276,7	241,17
14:25:02	31,76	15:25:02	28,48	37	1024	5	0,181	10 KΩ	276,2	241,78
		15:30:22	27,56	39	1024	5	0,191	10 KΩ	252,78	242,55
		15:35:11	27,44	36	1024	5	0,195	10 KΩ	247,4	242,8
		15:40:23	27,44	37	1024	5	0,205	10 KΩ	234,9	243,5
		15:45:02	26,89		1024	5	0,209	10 KΩ	230,2	243,76

B. Temperature and Smoke Concentration Test Results

While recording the temperature sensor data, leave it alone without any special handling, to avoid sensor readings other than the temperature in the smoking room. The MQ-2 in Figure 12-13

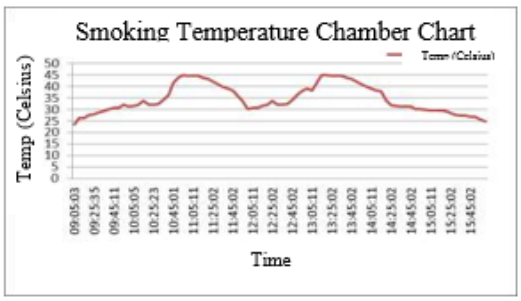

Fig 12. Fumigation Room Temperature Graph

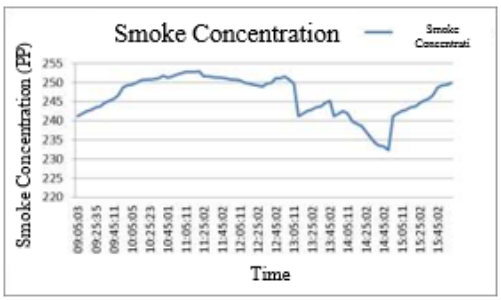

Fig 13. Graph of Smoke Concentration Test Results

Data retrieval. Meanwhile, the y axis is the Analog Digital Converter (ADC) value which is converted in parts per million (ppm) from the MQ-2 sensor using equation 3. Based on the observation results, it can be seen that the smoke concentration in the fumigation room is (230-252) ppm. Moderate smoke in the smoking room for 6 hours is caused by the low temperature in the smoking room, around (23.18^{o}C- 44.81)°C. The density of the smoke can affect the results of the cold smoking method of fish. So, fumigation is expected to be above 200 ppm for optimal results.

C. Product Results Analysis

The analysis used in this research is the water content of smoked fish. The durability of food ingredients is closely related to water content. The lower the water content in food, it is hoped that the food will last longer. The water content in food affects the food's resistance to microbial attack. Water is a medium for microorganisms to grow, To analyze the water content of barracuda fish, use equation (5). The results of the water content of cold smoking barracuda fish are presented in figure 14

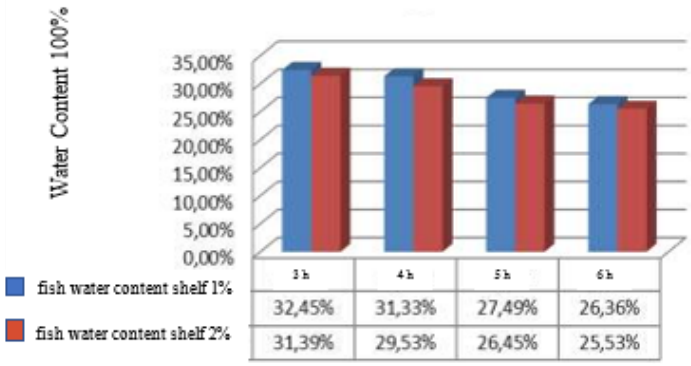

Fig 14. Graph of Water Content of Smoked Barracuda Fish

Smoke drift of (25.53%-32.45)%. The average length of the fish was 16.7 cm and the average weight of the barracuda fish was 192.3 grams. 10 barracuda fish were put into the smoking room. The lowest water content value for smoked barracuda fish, namely 25.53%, occurred at a smoking time of 6 hours and the highest water content for smoked barracuda fish, namely 32.45%, occurred at a smoking time of 3 hours. The efficiency of the time needed to smoke barracuda fish for water content is 6 hours compared to the smoking time of 3 hours. This means that the longer the smoking, the lower the water content in smoked barracuda fish.

V. Conclusion

A smoked barracuda fish product smoking device with closed circulation using a temperature monitoring system and smoke concentration based on Arduino Uno has been created. The design of the cold smoking device is divided into three parts, namely the combustion area, the smoke pipe, and the smoking chamber. The temperature results in the smoking chamber were the lowest temperature of 23.18°C and the highest temperature was 44.81°C. The smoke concentration in the smoking chamber was (230-252) ppm. The temperature recording data was stored on a micro SD card. Average results The lowest water content value of smoked mackerel was 25.53% at a smoking time of 6 hours and the highest water content of smoked mackerel was 32.45% at a smoking time of 3 hours. The efficiency of the time needed to smoke mackerel on the water content was 6 hours compared to a smoking time of 3 hours. This means that the longer the smoking, the lower the water content value in smoked mackerel.

Acknowledgment

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