Development of Temperature Monitoring System for Drying of Red Chillies

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Abstract. Red chili has a very low shelf life because it is easy to spoil. Storage at low temperatures is one of the best ways to preserve chili freshness. Drying at high temperatures is another best way to maintain chili quality. One way to maintain and maintain the quality of chili is by using a peltier. Peltier is an environmentally friendly cooling component because it does not produce harmful substances such as Freon or CFCs. Peltier has 2 sides, namely the side that has the writing TEC issuing cold temperatures and the other side issuing hot temperatures with storage (cooling) and drying (heating) methods to maintain the quality of red chili according to the characteristics of red chili. The DHT11 sensor will be turned on with the Arduino Mega which is used to measure the temperature in the storage room and drying room so that the temperature obtained is read and does not exceed the temperature required for red chili.

Keywords: Red chili · Drying · Storage · Peltier · Arduino Mega · DHT11 sensor

1 Introduction

Red chili is one type of vegetable that has a fairly high water content (55–85%) at harvest. Red chili has a very low shelf life because it is easy to spoil and the production of red chili every year is not all consumed by consumers so that there is an abundance that causes post-harvest spoilage. This low durability of fresh red chili causes the price of red chili in the market to fluctuate greatly. Storage at low temperatures is the best way to preserve chili freshness. The optimal cooling temperature depends on the chili variety and the degree of maturity.

Post-harvest handling of red chili in Indonesia is generally still simple so that the level of damage is very high ranging from 0.8–10.6%. Packaging aims to protect the quality of chili before being marketed. Good packaging can prevent yield loss, maintain quality and appearance, and extend the shelf life of materials. The use of Thermo electric cooler (TEC) is expected to be an alternative because TEC is a semi-conductor technology that has the ability to convert between 2 forms of energy, namely electrical energy and heat energy. TEC can not only cool, but can heat at the same time. The nature of this TEC can be used for refrigerator temperature control systems. TC can be controlled with

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a microcontroller which is a family of small microprocessors. In this study, using the Peltier effect which produces a temperature difference on the sides (cold side and hot side). The Peltier effect used can be combined with Arduino to regulate the temperature and humidity in the chili storage area. Chili storage places that have used the Peltier and Arduino effects as temperature and humidity controllers can be monitored to maintain the quality of the chili.

2 Research Methodology

A. *Research Methods*

The following is a description of the problem solving of this research which has been described in the Fig. 1.

- Start.
  The start of a research.
- Tool preparation and design.
  Hardware. This research consists of several stages:

  - Body and tool frame construction,
  - Preparation and installation of TEC, Humidifier installation,
  - Installation of components.

  Software :
  In this research, the software design consists of coding the Arduino program to support the working system of the tool
- Testing
  In the TEC test and the humidifier is tested to determine its working performance
- Data Analysis
  After testing and obtaining data from the test results and analyzing the test results, then applying it by testing the object
  Conclusion
  After the research is completed, make conclusions from the research process that has been carried out.
- End.
  Research completed

B. *Research Tool Design*

In this research, this is the process for displaying the heart signal through the stages with the following block diagram see Fig. 2.

In the design of cooling and heating equipment using 10 pieces of Peltier. The peltier is assisted by the coldsink and the fan will absorb the cold thereby lowering the temperature in the cooling room, while the heatsink will receive the heat and release it to the other room (the heater) so that the temperature in the room rises. Besides that, the heater also helps increase the temperature of the room.

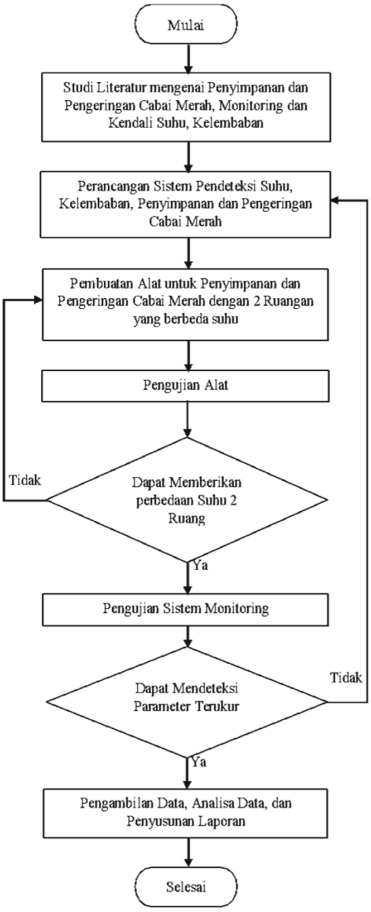

Fig. 1. Research Flowchart

Humidity or humidity in each room will decrease while the tool is working, so to increase the amount of humidity again assisted by a humidifier and blower.

While the Arduino component will be in charge of controlling every connected component. In this system the DHT11 sensor will read the temperature and humidity in each room so that Arduino can provide further action by controlling the relays connected to the TEC, incandescent lamps, and humidifiers (Fig. 3).

C. *Thermo Electric Cooler (TEC)*

The working principle of thermoelectric is based on the Peltier effect, i.e. when DC current is applied to a Peltier element consisting of several pairs of P-type semiconductors (i.e. semiconductors with lower energy levels) and N-type (i.e. semiconductors with higher energy levels) it will cause one side of the peltier element becomes cold (heat is

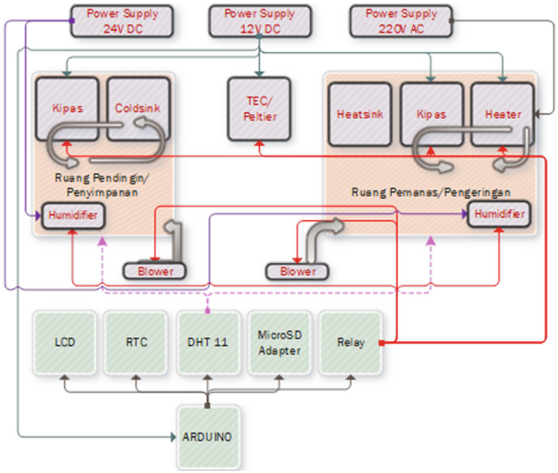

Fig. 2. Research Block Diagram

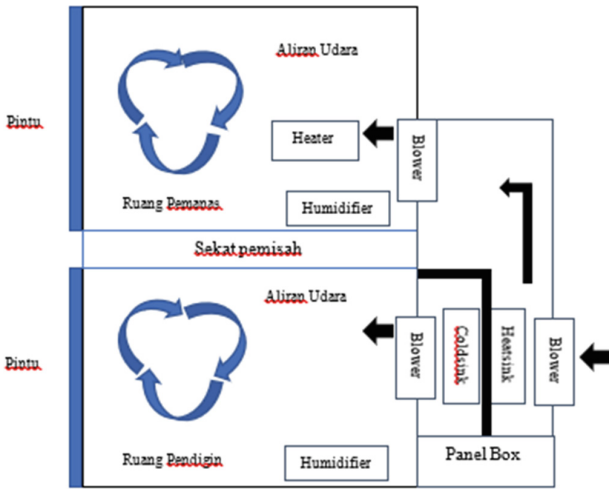

Fig. 3. Tool Design

absorbed) and the other side becomes hot (heat is released) and vice versa if the direction of the current is reversed (Fig. 4).

D. *Humidifier*

Humidifier is a mist maker or mist maker that works at high frequency to produce water droplets in the air like white mist and creates a humidity in the air (Fig. 5).

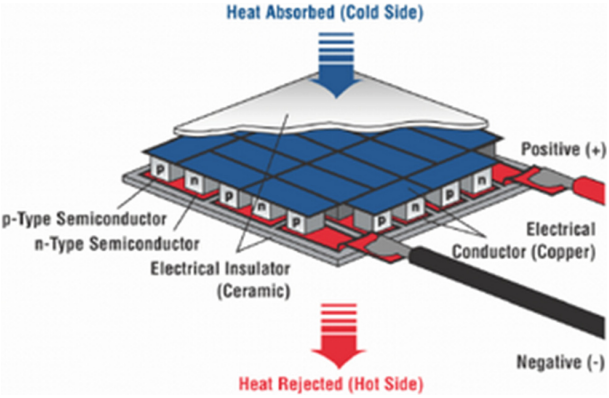

Fig. 4. TEC Working Principle

Fig. 5. Humidifier

Fig. 6. Result of Frame

E. *Tool Making*

The design of this tool consists of several parts, namely: making the body frame as a protector and making a frame for the separation or insulation between the two rooms (Fig. 6).

3 Results and Discussions

The test is carried out using a heating room, a cooling room, and no load. To compared between the three tests the advantages and disadvantages of each test.

A. *No-load Temperature Test*

The testing of the cooling chamber and heating chamber is carried out using several series of TEC preparations, which consist of power supply, relay, TEC (peltier) (Figs. 7, 8 and 9 and Table 1).

B. *No-load Humidity Test*

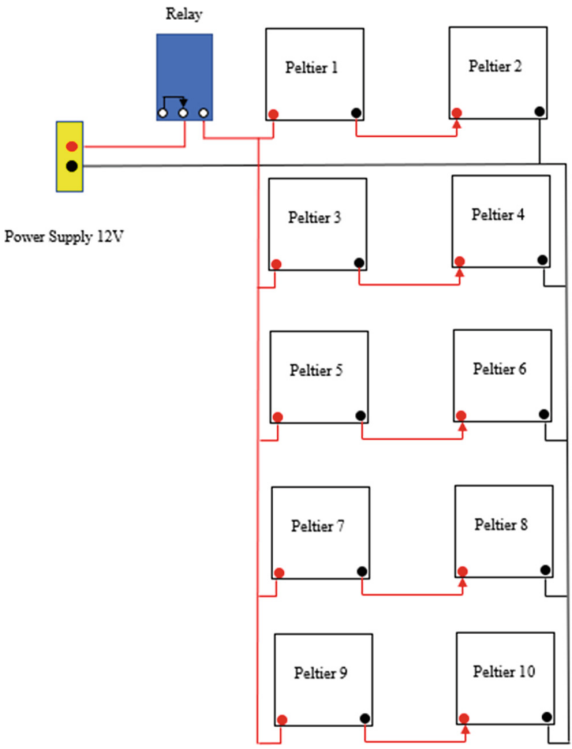

Fig. 7. TEC line

Table 1. NO-LOAD COOLING AND HEATING SYSTEM TEMPERATURE TEST

Time (Minute)	Heating (°C)	Cooling (°C)
0	30	29
1	31	28,6
2	31,8	28,1
3	32,7	27,7
4	33,7	27,3
5	34,4	26,9
6	34,9	26,4
7	35,5	26
8	36	25,5
9	36,6	25,2
10	37	24,9
15	38	24,5
20	39,1	24
25	40,1	23,5
30	41	23
ΔT	11	9

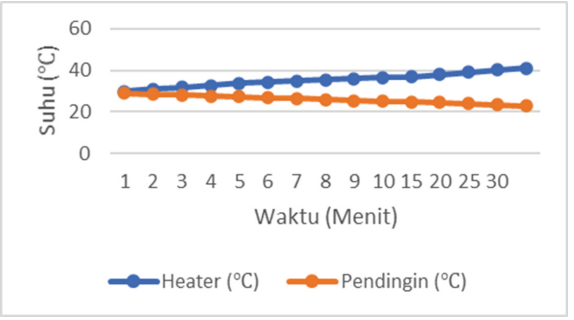

Fig. 8. Cooling Room and Heating Room Temperature Chart No Load

Humidity testing for heating and heating rooms is carried out using a humidifier.

C. *Testing Red Chili With Heating*
See Table 3, 4 and Fig. 10.

D. *Testing Red Chilli With Cooling*
See Table 5, 6 and Fig. 11.

Table 2. HEATING SYSTEM AND COOLING SYSTEM HUMIDITY TEST

Time (Minute)	Heating Humidity (%)	Cooling Humidity (%)
0	90	90
1	90	90
2	55	90
3	52	88
4	50	88
5	49	87
6	49	87
7	48	86
8	48	86
9	47	85
10	47	85
15	46	84
20	45	83
25	44	82
30	44	81
Δ T	46	9

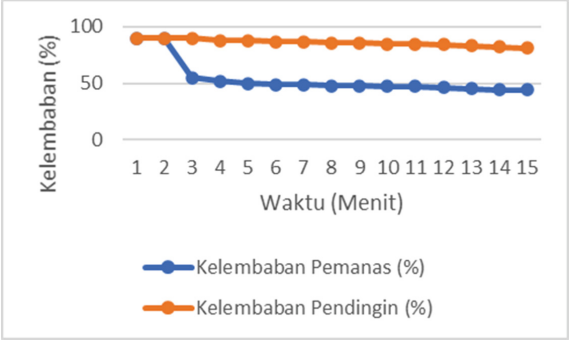

Fig. 9. No-load Heating and Cooling Chamber Humidity Chart

E. *Overall Comparison of Red Chili Tests*
See Table 7 and Fig. 12.

Table 3. RED CHILI TEST WITHOUT HEATING

Day	Red Chili Mass (grams)	Weight Loss
1	300	-
2	274	-26
3	255	-19
4	241	-14
5	231	-10

Table 4. RED CHILI TEST WITH HEATING

Day	Red Chili Mass (grams)	Weight Loss
1	300	-
2	280	-20
3	269	-11
4	260	-9
5	252	-8

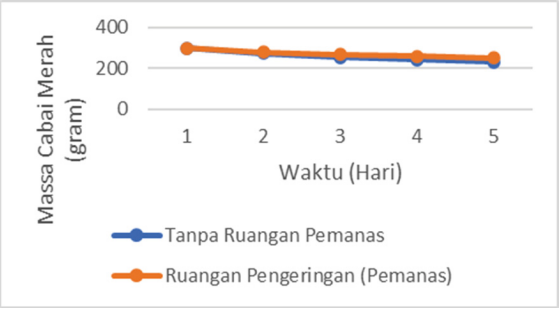

Fig. 10. Comparison Graph of Testing Without Heating and Using Heating

F. *Comparison of Previous Tool With Current Tool*

Comparison of previous research tools and current research tools is carried out to show the differences obtained and to find out the advantages and disadvantages (Table 8).

The data obtained are then compared with the current research data. The results of the previous researchers that there was a decrease in weight loss by 40 g, 48 g, and 51 g in 3 experiments and the results were 13% carried out for 3 days. The results of the current researchers are experiencing a decrease in weight loss of 31 g which is carried out for 3 days, and get results of and 10% weight loss in the current researcher (Table 9).

Table 5. RED CHILI TEST WITHOUT COOLING

Day	Red Chili Mass (grams)	Weight Loss
1	300	-
2	274	-26
3	255	-19
4	241	-14
5	231	-10

Table 6. RED CHILI TEST WITH COOLING

Day	Red Chili Mass (grams)	Weight Loss
1	300	-
2	290	-10
3	280	-10
4	273	-7
5	268	-5

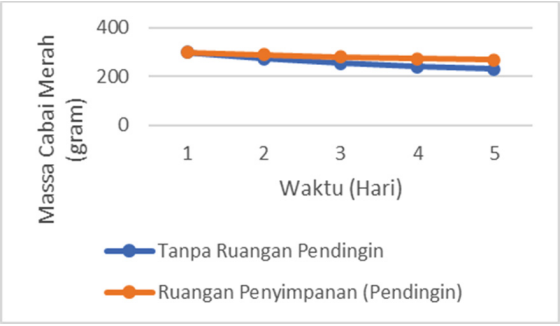

Fig. 11. Comparison Graph of Testing Without Cooling and Using Cooling

The data obtained are then compared with the current research data. The results of the previous researchers that experienced a decrease in weight loss by 22 g, which was 4.4% which was carried out for 5 days. The result of the current researcher is that there is a decrease in weight loss of 32 g, which is 10.67% which is carried out for 5 days.

Table 7. OVERALL COMPARISON OF RED CHILI TEST

Day	No Heating and Cooling Room (grams)	Heating (grams)	Cooling (grams)
1	300	300	300
2	274	280	290
3	255	269	280
4	241	260	273
5	231	252	268

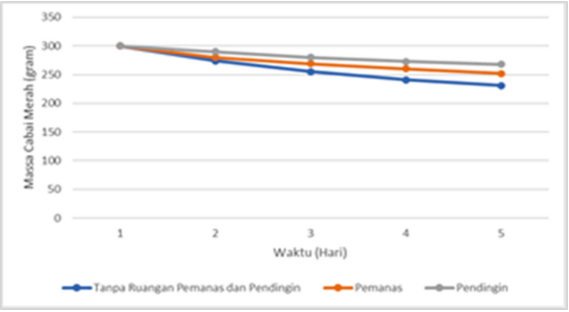

Fig. 12. Overall Comparison Graph of Red Chili Test

Table 8. PREVIOUS HEATING ROOM TEST

No	H	H + 1		H + 2	
		Mass	Shrink	Mass	Shrink
1	300	268	-32	260	-8
2	300	262	-38	252	-10
3	300	260	-40	249	-11

Table 9. PREVIOUS COOLING ROOM TEST

Day	Mass (grams)	Depreciation (grams)
H	500	-
H + 1	493	-7
H + 2	488	-5
H + 3	483	-5
H + 4	478	-5
H + 5	474	-4

4 Conclusions

From the results of research that has been carried out, the following conclusions are obtained:

- Monitoring system for temperature and humidity of red chili which functions to maintain chili quality based on Arduino MEGA microcontroller
- The data obtained are that the drying room reaches a temperature of 41 °C and a humidity of 44% has a weight loss of 48 g, a storage room reaches a temperature of 23 °C and a humidity of 81% experiences a weight loss of 32 g, and without a drying room and a storage room it reaches temperature 29 °C and humidity 77% experienced a weight loss of 69 g in a period of 5 days.
- The percentage of the three data, namely the drying room is 16%, the storage room is 10.67%, and without the drying and storage room it is worth 23% weight loss for 5 days.

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