SPEKTRA: Jurnal Fisika dan Aplikasinya
Volume 6, Issue 3, December 2021
Homepage: doi.org/10.21009/SPEKTRA

DOI: doi.org/10.21009/SPEKTRA.063.04

THE CORRELATION BETWEEN OF TIME AND WATER CONTENT OF FISH DRIED USING SOLAR PANEL-BASED DRYERS

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Received: 8 September 2021
Revised: 26 December 2021
Accepted: 28 December 2021
Online: 29 December 2021
Published: 30 December 2021

SPEKTRA: Jurnal Fisika dan Aplikasinya
p-ISSN: 2541-3384
e-ISSN: 2541-3392

ABSTRACT

Traditional drying of fish, the water content produced is not in accordance with SNI (Indonesian National Standard), which is less than 40%. This research aims to determine the correlation between time and water content of fish dried with an electric-based fish dryer produced from solar panels. The method used is a quantitative method. The solar panel-based electric fish dryer has a maximum capacity of 2237 grams (12 fish) with a temperature above 30°C. Based on the data analysis, the correlation between time and water content was obtained, the results for the 1st, 2nd and 3rd experiments, the average correlation coefficient was $R^2 = 0.99$, and the correlation between the mass of dried fish and the water content of fish, the more mass of fish that is dried the more water content evaporates (dry), To meet the water content of fish that is permitted according to SNI, which is less than 40%, it takes a long time to dry. about 4 days. The heating system in the drying chamber was based on the first experiment until the third experiment, the heat was evenly distributed and quite good in the drying chamber, so that the temperature control system worked well. This solar panel-based fish drying system can be used by fishermen to lighten fish in improving the quality of their products according to SNI.

Keywords: water content of Fish, fish dryer, solar panel

INTRODUCTION

The use of solar energy has been widely used by the community in traditional drying management. Drying is traditionally done by placing the fish on woven bamboo, fishing nets, mats, and placing them in the sun. The fishermen must be vigilant when facing various situations because it is not uncommon during the drying process to be exposed to strong winds and even rain which causes the drying process to be hampered and the fish must be dried again [1]. Therefore, we need a system that can help fishermen in the fish drying process. This fish dryer is shaped like a chamber covered in adiabatic styrofoam as an insulating material for the air inside the chamber and the outside air [2]. heaters that utilize the sun as a source of thermal energy and also solar panels as components that can be used to convert sunlight energy into electrical energy [3-4]. In designing this dryer, the results of drying fish can reach a moisture content of 40% which is allowed according to the Indonesian National Standard (SNI) 01-2721-1992 [5]. With the development of fish drying technology, it can be done by utilizing solar panels. The solar panel-based fish dryer has a temperature that is always above 30°C so that the drying process will not be disturbed and the fish will dry easily, and it is also hoped that this system will be useful for users because it is environmentally friendly. This system is designed so that fish drying can be carried out even when it is raining or at night because the fish are in the dryer. The basis of the drying process is the evaporation of water into the air due to the difference in water vapor content between the air and the material to be dried [6]. In this case, the water vapor content of the air is less or the air has a low relative humidity, resulting in evaporation. In evaporation, water is transferred in the form of steam at the boiling point while in drying it is usually in the form of steam and air [7]. Several parameters that affect the drying of fish are temperature and humidity of the ambient air, the drying air flow rate, the percentage of the desired water content of the material, drying energy, drying efficiency, mass in fish [8]. Therefore, referring to the above problems, a research entitled "The Correlation Between Of Time and Water Content in Fish Dryed Using a Solar Panel-Based Dryer" adds variations to the use of fish management for the community, especially fishermen.

METHOD

Observation and data collection of fish water content was carried out in the time range of August 31, 2020 to September 17, 2020 at 11.00 WIB at the Instrumentation Laboratory, Department of Physics, FMIPA, State University of Malang. The method used is a quantitative method, by taking fish weight data and recording changes during the drying process. The percentage water content (%) was computed as follows: Water content (%) = Loss in mass on drying (g) / Initial sample mass (g) X 100 [9]. In the data collection process, the following research procedures were carried out: 1) The first procedure in this research is to design a solar panel-based fish dryer. 2) Check whether the tool is feasible and operating properly. If so, you are ready to carry out research. 3) This study used fresh tilapia fish to hang on the dryer. In the first week 1 kg, the second week 2 kg, and the third week 3 kg. 4) The fish that have been obtained, each fish is divided into 2 parts, not to be cut off by using the Fillet Technique, then cleaned and washed thoroughly. 5) The cleaned fish were weighed to determine the water

content of the tilapia. 6) Then the fish are hung on the drying rack with the same distance and not close together. 7) Fish were weighed daily at a constant time. Fish weighing is carried out at 11.00 WIB. On the next day, the fish were weighed again at a predetermined time until the fish weight was in accordance with the target fish water content. 8) When the fish has reached the desired water content, the fish is tested for suitability for consumption. If feasible the fish is ready to be packaged. 9) Repeat trials 3-7 for week 2 and week 3. The dimensions of the drying chamber used in this research are as follows: Mono crystalline solar panel (103.5 x 69.75) cm, 12 Volt DC Heater Plate Heating Element 80^{o}C Power: 1-30W, Size: 21x36x5mm, Material: Aluminum. And controll system used Aurdino. Measurement humidity at chamber drying average 43 %. The fish drying system can be seen in FIGURE 1.

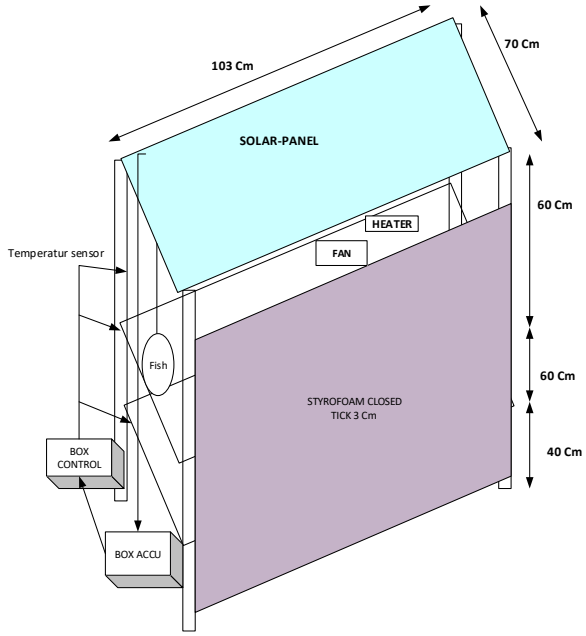

FIGURE 1. The fish drying Using a Solar Panel-Based Dryer system

RESULT AND DISCUSSION

The first experiment required tilapia fish with a mass of 1 kg. The experiment was conducted in the time range of August 31, 2020–September 4, 2020, the following observational data were obtained:

TABLE 1. Data 1 Fish Time and Mass

No.	Fish	Mass (gr)				
		31/8/2020	1/9/2020	2/9/2020	3/9/2020	4/9/2020
1	1	206	138	100	85	75
2	2	241	146	108	92	82
3	3	205	138	104	90	77
4	4	211	136	101	83	76
TOTAL	4	863	558	413	350	310

It can be seen in TABLE 1 that the relationship between time and fish mass is that the more days the fish mass will decrease. The reduction in fish mass from day to day decreased due to the evaporation of water content so that the fish mass decreased over time.

TABLE 2. Data 2 Fish Time and Water Content

No.	Fish	Water Content (%)				
		Day 0	Day 1	Day 2	Day 3	Day 4
1	1	100	66.99	48.54	41.26	36.41
2	2	100	60.58	44.81	38.17	34.02
3	3	100	67.32	50.73	43.90	37.56
4	4	100	64.45	47.87	39.34	36.02
Average		100	64.84	47.99	40.67	36.00

Then the correlation between time and water content can be seen in TABLE 2, namely as the days increase, the water content (%) also decreases until the water content is in accordance with SNI, which is less than 40%. The following is the correlation between time and water content of dried fish which is described in the graph below.

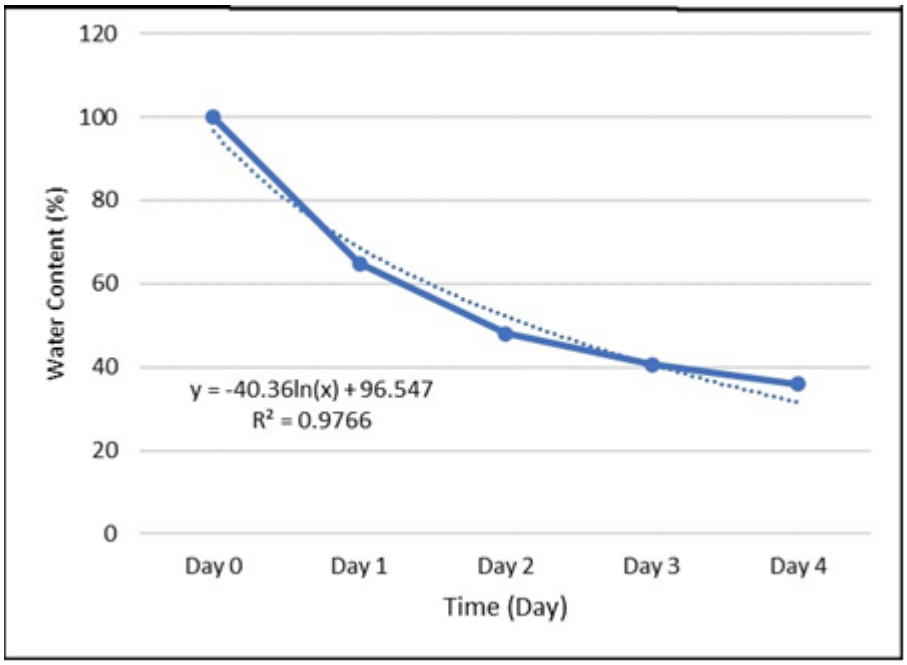

FIGURE 2. Graph of data 2 Correlation of Time (days) and Water Content of Dried Fish (%) For Mass 863 grams.

It can be seen in FIGURE 2 on the graph of the decline curve, if a logarithmic *trendline is* drawn, it will produce a line equation (y) as follows:

$y = -40.36\ln(x) + 96.547$

$R^2 = 0.9766$

With this equation the value of x is the long day of drying with a correlation coefficient of R^2 = 0.9766, which means that the closer the correlation value is approach to 1, the stronger the correlation between time and water content (positive). With this equation for the first

experiment using 863 gram of Tilapia fish, that the correlation between the mass of dried fish and the loss of mass lost or evaporated water content per day is shown to be a logarithmic. it can be concluded that it was successful because the water content at fish was less than 40% for 4 days. The second experiment required tilapia fish with a mass of 1661 grams. The experiment was carried out in the time range of September 8, 2020–September 14, 2020, the following observational data were obtained:

TABLE 3. Data 3 Fish Time and Mass

No.	Fish	Mass (gr)						
		8/9/2020	9/9/2020	10/9/2020	11/9/2020	12/9/2020	13/9/2020	14/9/2020
1	1	202	118	77	61	-	-	56
2	2	201	125	89	72	-	-	56
3	3	181	122	88	69	-	-	57
4	4	206	127	93	76	-	-	62
5	5	230	157	105	75	-	-	61
6	6	224	154	115	92	-	-	68
7	7	202	130	81	58	-	-	49
8	8	215	160	106	71	-	-	53
TOT	**8**	**1661**	**1093**	**754**	**574**	**-**	**-**	**462**

It can be seen in TABLE 3 that the correlation between time and fish mass is that the more days the fish mass will decrease. The reduction in fish mass from day to day decreased due to the evaporation of water content so that the fish mass decreased over time.

TABLE 4. Data 4 Time and Water Content of Fish

No.	**Fish**	**Water Content (%)**						
		Day 0	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**
1	1	100	58.42	38.12	30.20	-	-	27.72
2	2	100	62.19	44.28	35.82	-	-	27.86
3	3	100	67.40	48.62	38.12	-	-	31.49
4	4	100	61.65	45.15	36.89	-	-	30.10
5	5	100	68.26	45.65	32.61	-	-	26.52
6	6	100	68.75	51.34	41.07	-	-	30.36
7	7	100	64.36	40.10	28.71	-	-	24.26
8	8	100	74.42	49.30	33.02	-	-	24.65
Average		**100**	**65.68**	**45.32**	**34.56**	**-**	**-**	**27.87**

Then the correlation between time and water content can be seen in TABLE 4, namely the more days the water content decreases. On the 4th and 5th day no measurements were taken because of the red date (holiday) but the heater on the device was still on. The following is the corelation between time and water content of dried fish which is described in the graph below.

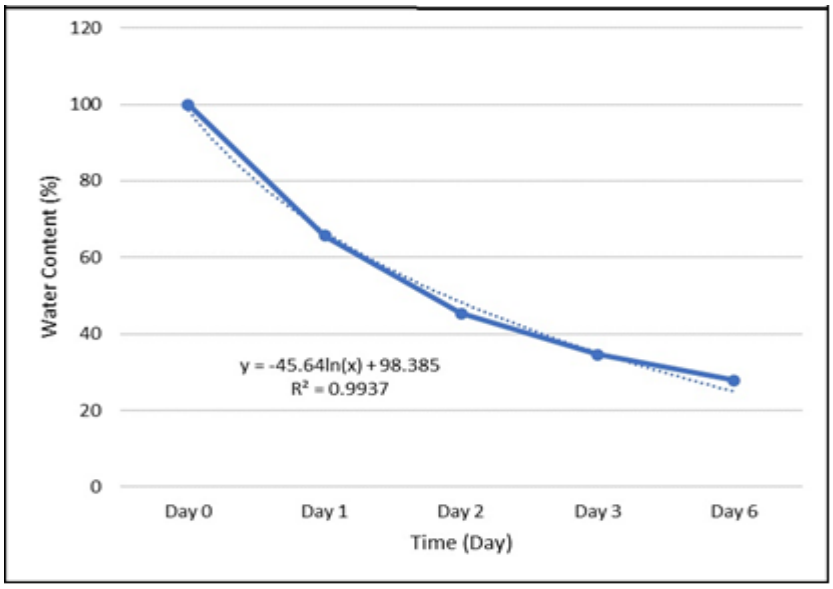

FIGURE 3. Graph of data 4 Correlation of Time (days) and Water Content of Dried Fish (%) For Mass 1661 grams.

It can be seen in FIGURE 3 on the graph of the decline curve, if a logarithmic trendline is drawn, it will produce a line equation (y) as follows:

$y = -45.64\ln(x) + 98.385$

$R^2 = 0.9937$

With this equation the value of x is the long day of drying with a correlation coefficient of $R^2 = 0.9937$, which means that the closer the correlation value is approach to 1, the stronger the correlation between time and water content (positive). With this equation for the second experiment using 1661 grams of Tilapia fish, that the correlation between the mass of dried fish and the loss of mass lost or evaporated water content per day is shown to be a logarithmic. it can be concluded that it was successful because the water content at fish was less than 40% for 3 days. The third experiment required tilapia fish with a mass of 2237 grams. The experiment was carried out in the time range of September 14, 2020–September 17, 2020, the following observational data were obtained:

TABLE 5. Data 5 Fish Time and Mass

No	Fish	Mass (g)			
		14/9/2020	15/9/2020	16/9/2020	17/9/2020
1	1	157	96	58	47
2	2	179	112	74	61
3	3	169	106	75	61
4	4	176	106	70	59
5	5	285	204	130	112
6	6	204	138	90	73
7	7	181	129	88	71
8	8	173	130	84	64
9	9	181	132	85	66
10	10	192	137	79	62
11	11	171	121	72	51
12	12	169	114	59	43
TOTAL	12	2237	1545	990	785

It can be seen in TABLE 5 the correlation between time and fish mass, namely the more days the fish mass will decrease. The reduction of fish mass from day to day is experiencing the decrease is caused by the evaporation of water so that the mass of fish decreases over time.

TABLE 6. Data 6 Fish Time and Moisture Content

No.	Fish	Water Content (%)			
		Day 0	Day 1	Day 2	Day 3
1	1	100	61.15	36.94	29.94
2	2	100	62.57	41.34	34.08
3	3	100	62.72	44.38	36.09
4	4	100	60.23	39.77	33.52
5	5	100	71.58	45.61	39.30
6	6	100	67.65	44.12	35.78
7	7	100	71.27	48.62	39.23
8	8	100	75.14	48.55	36.99
9	9	100	72.93	46.96	36.46
10	10	100	71.35	41.15	32.29
11	11	100	70.76	42.11	29.82
12	12	100	67.46	34.91	25.44
Average		100	67.90	42.87	34.08

Then the relationship between time and water content can be seen in TABLE 6, namely the more days the water content decreases. The following is the relationship between time and water content of dried fish which is described in the graph below.

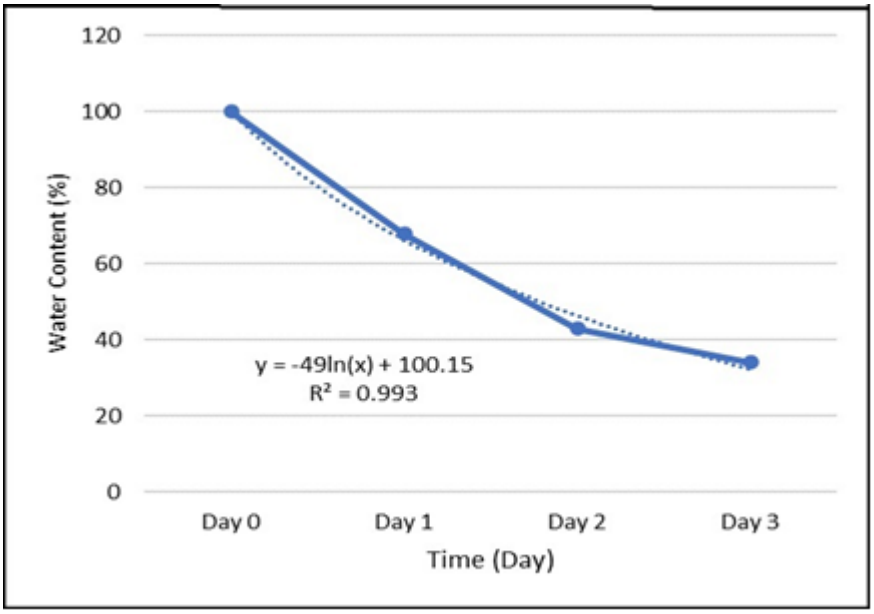

FIGURE 4. Graph of data 6 Correlation of Time (days) and Water Content of Dried Fish (%) For Mass 2237 grams.

It can be seen in FIGURE 4 on the graph of the decline curve, if a logarithmic trendline is drawn, it will produce a line equation (y) as follows:

$y = -49\ln(x) + 100.15$

$R^2 = 0.993$

With this equation the value of x is the long day of drying with a correlation coefficient of R^2 = 0.993, which means that the closer the kForelation value is approach to 1 , the correlation between time and water content is stronger (positive). With this equation for the third experiment using 2237 grams of Tilapia fish, , that the correlation between the mass of dried fish and the loss of mass lost or evaporated water content per day is shown to be a logarithmic. it can be concluded that it was successful because the water content at fish was less than 40% for 4 days. From the first experiment to the third experiment, it was shown that the correlation between the mass of the dried fish and the loss of mass loss or the water content that evaporated per day, the greater the mass of the dried fish, the greater the shrinkage of the water content, which is indicated in the logarithmic relationship equation. This can be interpreted that the heating system in the drying chamber is evenly distributed and quite good, so that the temperature control system runs well.

CONCLUSION

The drying process in principle is a process of reducing water content in fish. The drying process uses a solar panel-based dryer which has a maximum capacity of 3 kg (12 fish) with a temperature above 30°C. In the correlation between time and water content, the average correlation coefficient is $R^2 = 0.99$ (positive). It can be concluded that the correlation between the mass of dried fish and the water content of fish, the more mass of fish that is dried the more water content evaporates (dry), To meet the water content of fish that is permitted according to SNI, which is less than 40%, it takes a long time to dry. about 4 days. The heating system in the drying chamber was based on the first experiment until the third experiment, the heat was evenly distributed and quite good in the drying chamber, so that the temperature control system worked well. This solar panel-based fish drying system can be used by fishermen to lighten fish in improving the quality of their products according to SNI.

ACKNOWLEDGEMENT

We would like to thank the Faculty of Mathematic and Natural Science State University of Malang for funding this research through the PNBP MIPA 2021 budget and the entire community Academics of the Department of Physics, FMIPA UM who have helped implementation of this research.

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