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TEMPERATURE AND HUMIDITY DETERMINATION FOR DRIED INSTANT NOODLE DRYING MACHINE

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ABSTRACT

This paper discuss and investigate the overall effects of oven drying time in determining the moisture content and drying rate of traditional dried instant noodle or locally known as 'Mi Siput'. In this study, the effect of drying parameter, temperature and humidity be investigated and determined. Initially, 30 kilogram of the raw noodle sample will be drawn from the boiling process. From the preliminary study conducted in which the moisture content of the samples varying decreasing in humidity from 80% to 20%. Four levels of temperature (70 ºC, 80 ºC, 90 ºC and 100 °C) were used in the present study. Analysis was performed to calculate the output produced by the machine. The data has been collected and measured using a thermometer and hygrometer. The drying study exhibited by the graph of temperature (°C) versus time (minutes) and the graph relative humidity, RH (%) versus time (minutes). The result shows that medium and high drying temperature effect drying time and humidity decreasing faster compare to low temperature 70ºC. Moreover, at increased temperature utilizing the dryer machine had improved the drying process's and shortened it to 4 hours compared to the traditional method that take at least 8 hours during hot sunny days and 16 hours during cloudy days, resulting in significant extension in drying capacity.

Keywords: Mi siput drying process, Mi siput drying parameter, Mi siput humidity and temperature study.

INTRODUCTION

'Mi Siput' is a flour-based food product that is popular among the people of Johor, especially in Muar, Batu Pahat and Ledang District since long ago. Now 'Mi Siput' is known throughout Johor and Singapore as a kind of snack. Cooked 'Mi Siput' will be cooled using cold water and rinsed before winding up in a circle using aluminium mould and then dried using traditional method or under the sun light. One of the famous entrepreneurs of 'Mi Siput' is Usahasama T and M Enterprise they produced 40 kg of noodles in a day out production. As mention by Elamin *et al* [1] the traditional sun drying by direct solar radiation and solar dryer are presently used by medium and small scale of industries in order to reduce the water density in the products. Nowadays, solar drying is the most general method been used to preserve food based product, however this method come with contamination problem such as dust, insect, sand particles and soil. Also being weather dependent which effect the required drying time can be quite long [2]. When the designer want to design and develops the noodles-drying devices, it must meet the demand of the particular dry noodle entrepreneur. In order to achieve that, it requires certain reliable data about drying characteristic of the noodle [3]. Within this study, a smart dryer machine has been developed in order to solve the time consumption in noodle drying process. According to the common practice for the traditional dried instant noodles, drying air temperature ranges between 29 ºC and 35 °C. According to Firdaus [7] the noodle takes a whole day to dry properly and sometimes it extended up to two days. Figure-1 show the traditional drying method.

Figure-1. 'Mi Siput' being dry used traditional method.

LITERATURE SURVEY

L.Mayor *et al* [4] stated in their study where food dehydration is one of the common methods used in improving food stability. Dehydration processes decrease the water content considerably, reduce microbiological activity and minimizes physical and chemical changes during the food storage. Drying is a classic process to preserve foods, which grant longer shelf life, making the food lighter and even smaller for storage and also easy to be transported compared to wet product [5]. There is a journal written by Ndukwu *et al* [6] in his journal titled the "Effect of Drying Temperature and Drying Air Velocity on the Drying Rate and Drying Constant of Cocoa Bean" has a similar concept with instant dried noodles drying machine that has been developed. In his journal the effect of some drying parameter and drying condition of cocoa bean has been determined. There levels of temperature (55

ºC, 70 ºC and 81 °C) and three air velocity levels (1.3m/s, 2.51m/s and 3.7 m/s) were used in the presented study. The moisture content of the cocoa bean used was 79.6% dry basis (db). The drying rate increased with increased in temperature and air velocity but decreased with time.

The dryer able to removed average of 4.66 kg of water per day at 55 ºC to 81 ºC and air velocity of 1.3 m/s while at 2.51 m/s it can remove an average of 5.3 kg of water per day under the same drying conditions [6]. Results from such studies may help to provide better solution and findings that can offer to shorten the drying time drastically. The effect of drying temperature on rehydration ratio a wet surface shown in Figure-2 below.

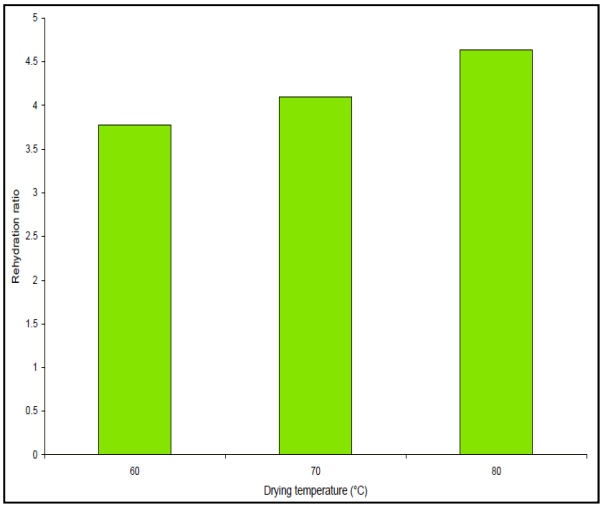

Figure-2. Effect of drying temperature on rehydration ratio of the dried mango slices [1].

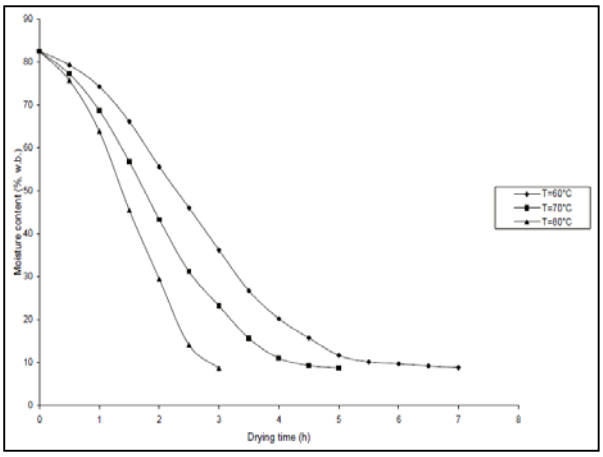

Figure-3. Effect of drying temperature on the drying time and moisture content of mango slices [1].

METHODOLOGY

Certain improvements has been made to the drying machine to satisfy all requirements according to instant dried noodles entrepreneur where further studies has been carried out to strengthen the results obtained from previous studies. In order to obtain the precise evaluation factor used for the research, measurement of ambient (surrounding) temperature, humidity, air temperature, air velocity and moisture content were made. In addition, to obtain the uniform moisture distribution among the samples 1, all of it will be stored at room temperature (25 °C) for 15 minutes prior to experiment. So that all sample storage condition will be keep the same before drying. Therefore 12 of experiment were performed at 4 different temperatures of 70 ºC, 80 ºC, 90 ºC and 100°C. Every single temperature will be repeated 3 times and the experimental results recorded. Within the experiment, the required weight of noodle which is 10 kilogram each sample will be loaded into the basket and were evaporated for 15 minutes. The moisture content of the evaporated noodle used was 80% dry basis (db). Then the noodle will be spread in a mould on the tray. The distance of each samples will be between 3 centimetre (cm) to 5 centimetre (cm). The drying air temperature was measured with the aid of a thermocouple attached to the insulation wall of the dryer. Drying air velocity is determined with a vane anemometer equipped with a multi-meter [6]. In summary, the drying parameters were as follows:

- Drying temperature: 70 ºC, 80 ºC, 90 ºC and 100 °C
- Relative humidity: 80 % (ambient)
- Mass of each sample: 10 kg

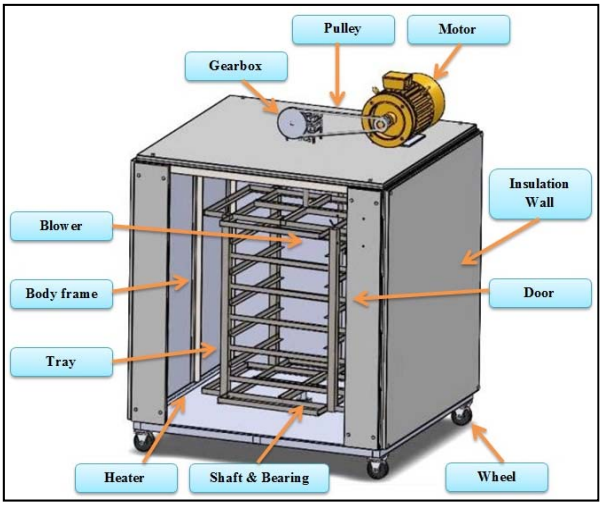

Figure-4. Detail design of the drying machine.

Drying parameter estimation

Moisture content calculation**:** The moisture content (*MC*) was calculated using equation 1 below [8].

$$MC = \frac{W_o - W_f^{'}}{W_o} \quad (1)$$

Where W_o and W_f is the initial and final weight of the noodles (g)

Moisture ratio during the drying process can be calculated from the equation below:

$$MR = \frac{M - M_e}{M_o - M_e} \quad (2)$$

Where MR is moisture ratio, M_o is initial moisture content, M_e is equilibrium moisture content, M is moisture content [9].

RESULTS AND DISCUSSIONS

There are significant effect of drying air temperature and relative humidity upon the drying rate. In this instance, the test was done to dry 1 kg of the wet instant noodle to save the time and avoid product wastages. The test objectives are to determine the capability and effectiveness of the dryer. Contributed to the drying machine developed, drying process has been successfully shortened from 8 hours to 4 hours hence cost reduction in terms of time and energy in the drying process where consequently increases the production output.

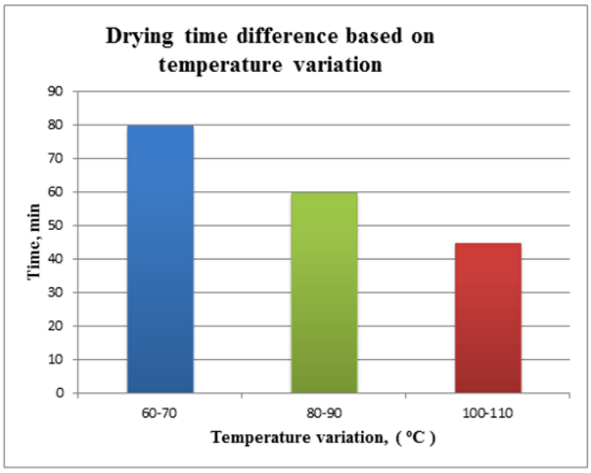

Figure-5. Drying temperatures against time.

Within these experimental carried out, 3 variations of temperature had been utilized on noodle sample, low temperature between 60 ºC to 70 ºC, mid temperature of 80 to 90 ºC, and a high temperature of 100 ºC to 110 ºC. Drying time for all of three was recorded and shown above in Figure-5.

The changes in temperature and relative humidity and its effect are shown in Figure-6 and Figure-7 below. The determination of the appropriate time is based on standard product set. The highest temperature (°C) recorded is between 100 °C to 110 °C need only 45 minutes to dry the wet noodle resulting in darkened color and rejected aesthetically. While the lowest temperature recorded was between 60 ºC to 70 ºC, the time required to perfectly dry the noodle is 80 minutes. Intermediate drying temperature was recorded using a thermocouple is between 80 °C to 90 °C. At this temperature the drying time was successfully accelerated to 20 minutes faster than the previous temperature, at this temperature the quality 'Mi Siput' was not affected by overheating. V.K. Jindal [10] stated in his study where different oven drying temperature and times resulting in consistent moisture content in range of roughly 9% to 22% w.b.

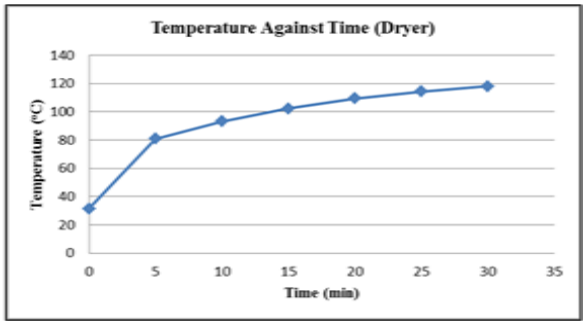

Figure-6. Relative humidity decreasing against time.

Medium drying temperature has managed to dry noodle perfectly. The experiment sample shows no different with the original product in color, odor and taste where this indicates medium drying temperature is very suitable to dry the noodle in order to get the perfect drying condition along with good product quality. Figure-8 show the result of noodle samples.

Figure-7. Sample of the dry 'Mi Siput' under the sun drying method.

Figure-8. Result from experiment sample dried with low temperature where the noodle does not dry completely

Figure-9. Result from experiment sample dried with medium temperature.

However, the relatively high drying temperature has affected the quality and led to extreme drying to the noodle. This specifies a high temperature will affect the noodle appearance looks like charred. Figure-10 shows the effect of extreme temperature. Figure-11 show the dryer machine used for the noodle study.

Figure-10. Noodle looks too dry and change color to dark due to too high temperatures.

Figure-11. Smart dryer machine which be used in the study.

CONCLUSIONS

From the study it can be concluded that the research has tried to widen the fundamental knowledge on 'Mi Siput' drying process. In conclusion, the study is part of a project in effort to develop a smart drying machine for purpose of 'Mi Siput' industries. The result has shown that drying rate has significant relationship with drying temperature and air humidity. The drying time showed a linear relationship with drying temperature. The result of the study can be adopted to improve the dryer concept and capability. The optimum drying time is 80°C and humidity below 20%, will give the desired result and should be chosen based on the drying temperature and air humidity. This study also focused on the new improvement of the new dryer machine. More than that, this machine has the ability to operate at any weather condition and also require less maintenance. Moreover what is certain the reduction in time consumption in the drying process. This machine was designed to operate at low relative cost using Liquid Petroleum Gas (LPG) replacing the electrical heater which lead to high cover for relatively cost. After the experiments, the wet noodle successfully dried in 2 hours to complete one cycle of drying process with an estimated weight around 30 kg. So it can be concluded that the main objective of the project has been achieved. The shortest drying time is 45 minutes for drying 1 kg of wet instant noodle. Temperature between 80ºC to 90ºC is the suitable for this instant noodle quality and can shorten the drying time.

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