Dehydration of Traditional Dried Instant Noodle (Mee Siput) Using Controlled Temperature & Humidity Dryer

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Abstract. Drying process is an essential step to produce instant noodles. Yet, the industries especially Small and Medium Enterprises (SMEs), is seeking for an efficient method to dry the noodles. This paper discusses the performance of an invented drying system which employed heating and humidifying process. The drying system was tested using 30 kilogram of the raw noodle known as “Mee Siput”. Temperature controlled system were used in the study to control the temperature of the drying process and prevent the dried noodles from damage by maintaining the temperature of lower than 80°C. The analysis shows that the system was drastically decreased the humidity from 80% to 40% just after 200 minutes of the drying process. The complete dehydration time of noodle has also decreased to only 4 hours from 16 hours when using traditional drying system without sacrificed the good quality of the dried noodle. In overall, the invented system believed to increase the production capacity of the noodle, reduce cost of production which would highly beneficial for Small Medium Industries (SMEs) in Malaysia.

1. Introduction

Malaysian local product of instant noodle or known as ‘Mee Siput’ is one of the local product that has a lot of potential to penetrate in a new business market. ‘Mee Siput’ is a traditional instant noodle produced by many rural entrepreneurs in southern region of Malaysia, particularly in Johor. The product comes in various types, shapes, formulations and contents, made from wheat, rice, buckwheat and starches [1]. ‘Mee Siput’ produced by dough mixing process combination of 6 basic ingredients; wheat flour, potato flour, Sodium Silicate, Sodium Bicarbonate, salt and water. The purpose of application of alkaline salt in noodle is to extend the lifespan by preventing the growth of fungus [1].
As the demand of the product not only came from Johor the product has been marketed throughout Malaysia including Singapore. Despite the increase in demand of the product from Singapore, the product has not yet produced in high quality and low production capacity. This is mainly due to the processing of the product that relied only on traditional method of drying.

The traditional drying processes and common practices for the traditional dried instant noodles are relied on air temperature ranges between 29ºC and 35ºC. As a result the noodle usually takes one to two days to complete the drying process in which it is depended on the weather condition. **Figure-1** illustrates the traditional drying method and dried noodle sample respectively.

![Figure-1. ‘Mee Siput’ dried under the sun [2] and Sample of good quality Mee Siput dried by traditional method](image)

Dried noodle can be produced using controlled drying process, in which the final moisture usually less than 14%. The noodle can be dried in a chamber where all parameters of temperature, humidity and ventilation are regulated [1]. This method is used to ensure long shelf life of the noodle. Drying is a classic process to preserve foods, which grant longer shelf life, making the food lighter and even smaller for storage and easy to be transported compared to wet product [3]. The process also believed to improve the food stability, reduce microbiological activity and minimizes physical and chemical changes during the food storage [4].

Elamin et.al in their study reported that the direct solar radiation as well as solar dryer are widely applied by small and medium scale industries for drying process [5]. During sun drying, inconsistency in temperature is a challenge in producing good quality of dried product. Nowadays, solar drying is the most popular method to preserve food based product. However contamination problem such as dust, insect, sand particles and soil is usually associated with this process. In fact, the drying time can be very long and inconsistent, as it is depended on the weather and temperature condition [1]. Controlling the temperature in between 60ºC to 80ºC are reported as able to produce high quality of dried noodles and pasta product [6][7][8]. N. Macmanus et.al stated that drying with regulated temperature of 55ºC to 81ºC and air velocity of 1.3 m/s to 2.51 m/s is able to remove 4.6 kg to 5.3 kg of water per day [9].

To solve the problem of inconsistent dried product quality and long duration of drying process, a new technology called a smart dryer machine was proposed. The machine was design purposely to reduce the drying time consumption and on the same time maintaining the hygienic drying condition. This paper presents the performance of the drying machine in term of its humidity reduction and temperature control capability.
2. Methodology

2.1 Materials
Raw material including wheat flour (Blue Key), tapioca starch (Cap ABC) and soda ash (American Natural Soda Ash Corporation, USA) are used to produce 30 kg noodle. All the materials were mixed with water using dough kneading machine. Small noodle making machine was used to cut the prepared dough sheet into noodle shape, similar to as used by T. Inazu [10]. The raw materials are physically examined to for quality inspection. To obtain uniform sample moisture distribution, the materials were kept at room temperature (25°C) for 15 minutes prior to experiment [11].

2.2 Drying Experiment
The drying experiment was performed by the same procedure as used by Ridvan and Mustafa [12], using a custom made drying chamber as shown in Figure-2. The chamber (6 feet x 6 feet x 6 feet) was completely isolated with aluminium plate to maintain specific temperature and humidity during the drying process. Two liquid petroleum gas (LPG) heaters were used to supply constant heat through a connecting pipe to the drying chamber. The air blower was used to extract the heat from the heat pipe in which the constant blower air velocity of 2.62 m/s ensures uniform heat is distributed in the system. The chamber was equipped with a temperature controller (WILLHI, WH-7016) to trigger and turn off the blower when the temperature exceed the limit of 80°C. Dehumidifier (DeLonghi DN40G, Italy) was used to remove the moisture and vapour produced by the evaporation. The humidity value was monitored by a humidity sensor (MEXTECH TM-2 Digital Thermo-Hygrometer). An aluminium noodle tray (4X4 feet) from the dryer machine was used to fill the as-boiled noodle.

Figure-2. Semi-automatic drying machine equipped with temperature controller, humidity reducer mechanism

Total of 30kg samples (maximum chamber capacity) were loaded into the basket and rinsed for 15 minutes before separated into several trays and transferred into drying chamber. During the process, internal temperature of the chamber was controlled to maintain at temperature below 80°C. The samples were weighed after 5 hour to calculate the weight of water lost.

3. Result and Discussion
The first experiment was conducted using gas LPG heater only (without turn on the blower system) found that the rate of sample drying are different for each tray. It was found that the sample in the bottom tray (tray no. 7 to tray no. 10) need longer time to dry as they are continously facing lower
temperature distribution in a range of 35°C to 40°C. The rest of tray that located at higher than tray no. 7 obtained almost equal temperature in the range of 65°C to 80°C. At longer processing period, poor heat circulation caused to the accumulation of heat at the upper portion of the chamber. It consequently produced high number of defective noodles which identified by dark brown in colour, high brittleness and shrunk significantly due to the temperature higher than 80°C.

Drying temperature and heating rate will result in inconsistent moisture content as mentioned in reference [13]. Hence, the blower fan and dehumidifier blower system were installed as a heat circulation mechanism of the drying chamber. As a result, uniform drying rate was obtained at different noodle trays in the drying chamber. Contradict to the aforementioned phenomenon of initial experiment (without turn-on the blower), the samples from the bottom tray (no.10) had the same result in drying rate and weight with the middle tray (no.5) as well as the upper tray (no.1). This attributed by the uniform hot-dry air that flow vertically from the bottom exaust pipe of dehumidifier blower to the overhead suction pipe which provide continous and uniform hot-dry air at every level. In addition, the suitable velocity of hot air that blowed from the side wall was sucessfully delivered uniform hot air distribution in horizontal direction. In this case, to ensure uniform drying result for different tray in drying chamber, rearranging or swaping the trays it is not necessary. It was proved that the circulation system was successfully decreased the drying time from 7 hours to 5 hours (2 hour shorten) in drying process of 30 kg Mee Siput in a single drying machine.

As shown in Figure-3, the dryer was able to reduce the moisture content up to 50%. From the experiment, it was found that the humidity in drying chamber reduced with the increasing in processing time. Upon 200 minutes of drying operation, air humidity in drying chamber sucessfully reduced significantly from 80% to 42%. The humidity stagnated at that level for few times before dropped again when it is reaching 400 minutes of drying period. It can be expected that the humidity can be reduced further if the drying machine is built with more hermetic.

As shown in Figure-4, a linear relationship of drying temperature with time was obtained. The temperature between 75°C to 80°C considered as the ideal temperature for drying without compromising the quality and texture of the noodle. The system that able to maintain the temperature of lower than 80°C was resulted to the production of good quality dried noodles as it will evade the texture damage that consequently increase the noodle brittleness and hardness. Higher the temperature of more than 80°C will make noodle turn into dark in colour. Investigation on the water removal ability found that average of 3.7 kg of water was removed after 5 hour of the drying process which is equal to 17.76 kg of water per day (Figure 5).
Figure 4. Average increasing temperature in drying chamber.

Figure 5. Average water weight loss in noodle production dried using drying machine.

Figure 6 shows the dried noodle after 5 hours of drying process. In overall, the invented system managed to perfectly dry the noodle. The samples produced shows no different with the original product produce by traditional method in term of its colour, odour and taste.
4. Conclusion

Integrated system of temperature control and humidifier in the isolated chamber was successfully developed. The system was proved as able to provide high drying rate in which the efficient humidity reduction of 80% to 40% happened in a very short time. The system was also proved as able to evade the increasing in temperature of higher than 80°C. In comparison with conventional method, the drying time was successfully shortened from 16 hours to 5 hours. The significant improvement drying times was believed to provide an opportunity to the SMEs to increase their production capacity and on the same time maintain the require quality of the product. The system is also believed as applicable to be used for drying process of other product.

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