Studii şi Cercetări Ştiinţifice 2019, **20** (1), pp. 043 – 052
Chimie şi Inginerie Chimică, Biotehnologii, Industrie Alimentară

Scientific Study & Research
Chemistry & Chemical Engineering, Biotechnology, Food Industry *ISSN 1582-540X*

ORIGINAL RESEARCH PAPER

OPTIMIZATION OF DRYING PROCESS OF CORN NOODLES USING FLUIDIZED BED DRYER

Tjahja Muhandri[1,2*], Subarna[1,2], Afifah Zahra Agista[1], Purwiyatno Hariyadi[1,2], Aminullah[3*]

[1]Bogor Agricultural University (Institut Pertanian Bogor - IPB), Faculty of Agricultural Technology, Department of Food Science and Technology, 16680, Bogor, Indonesia
[2]Bogor Agricultural University (Institut Pertanian Bogor - IPB), SEAFAST Center, 16680, Bogor, Indonesia
[3]Djuanda University, Faculty of Halal Food Science, Department of Food Technology and Nutrition, 16720, Bogor, Indonesia

*Corresponding authors: tjahjamuhandri@apps.ipb.ac.id, aminullah@unida.ac.id

Received: February, 08, 2018
Accepted: February, 14, 2019

Abstract: Drying process was one of the main factors in preserving noodles because it can reduce water content to less than 12 % (w/w (weight by weight)). The objectives of this study were to optimize the drying process of corn noodles using fluidized bed dryer (temperatures of 50 °C, 60 °C, and 70 °C with airflow velocities of 0.73 $m \cdot s^{-1}$, 1.53 $m \cdot s^{-1}$, and 2.17 $m \cdot s^{-1}$) and to determine the influence of water addition (60 %, 70 %, and 80 % (w/w)) to the dough of corn noodles. The results showed that the best rehydration profile of dried noodles was obtained from drying process at temperature of 60 °C with airflow velocity of 2.17 $m \cdot s^{-1}$. The quality of dried corn noodles was influenced by final moisture content of dried noodles and water addition. The critical moisture contents on water additions of 60 %, 70 %, and 80 % were 12, 11, and 10 % (w/w), respectively. The results also showed the optimum quality of dried corn noodles which was obtained from the dough with water addition of 80 %, drying temperature of 60 °C with velocity of 2.17 $m \cdot s^{-1}$ for 107 minutes, and moisture content of 10 %. This has similar properties of moisture content, cooking loss, elongation, and hardness to the conventional drying.

Keywords: *corn noodles, critical moisture content, dried noodle profile, drying duration, drying temperature*

INTRODUCTION

Drying is one of processing methods which is commonly used to preserve foods due to its lower water availability. Spoilage microorganisms and enzymatic reactions in foodstuffs cannot grow and cannot be active under these conditions. Despite these beneficial effects, improper drying process can change the textural properties of food [1]. Drying process, which utilizes air (conventional drying), is implemented on starch-based products such as starch noodles, especially corn noodles. However, this method requires a long process as reported by Charutigon *et al.* [2] whose drying of rice vermicelli using conventional process took 24 hours, as well as Hormdok and Noomhorm [3] which dried rice noodle for more than 24 hours to reach a moisture content between 10-12 % at a temperature of 40 °C.

Drying process using certain dryers can reduce the drying duration significantly. Subarna *et al.* [4] reported that the drying duration of corn noodles using fluidized bed dryer (FBD) at temperature of 50 °C was three hours. This method produces a cracked noodle which will then be deformed into a small portion of 2 cm when it was rehydrated. Cracking in dried corn noodles is presumed to be an effect of improper drying process and very low moisture content in corn noodles. Tan *et al.* [5] reported that drying process for noodles should be applied until the moisture contents are in the range of 10 - 14.5 %. Noodles are easily overgrown by mold if moisture content was more than 14.5 % and have the tendency to crack and break during transportation if moisture content is less than 10 %.

A study by Tam *et al.* [6] showed that the ability of starch noodles to retain its integrity was related to amylose gelatinization in starch or flour. Gelatinized amylose will form hydrogen bonds between each molecule when retrogradation occurs. Later, these bonds will form the structure of starch noodles [7]. Starch gelatinization is affected by several factors, i.e. material moisture content, heating rate, botanical source of starch, all processes which are applied to starch before gelatinization process, and ratio of amylose and amylopectin in starch [8]. From these findings, it can be assumed that corn noodles ability to retain its structure is also affected by the water addition into the dough.

Based on these assumptions, this research are designed to optimize the drying method of corn noodles using fluidized bed dryer and to determine the critical moisture content of dried corn noodles, which are related to the quality of dried corn noodles as well as to observe the effect of water addition in the dough to the cracks occurrence in dried corn noodles.

MATERIALS AND METHODS

Materials

The main material used in this study was 80 mesh-sieved corn flour of P21 variety, which has amylose and moisture contents of 30.67 % and 12.40 %, respectively (Agriculture Department of Ponorogo Regency, East Java). Other ingredients were glyceryl mono stearate (GMS), distilled water, and salt.

Determination of optimum temperature and air velocity of corn noodles drying process

Determination of air velocity in the dryer was performed using anemometer (EA-1000 Line Seiki, Co. Ltd, Japan) and then the data were used to ensure the analysis and instrument construction. Corn noodles were made by using modified method of Subarna *et al.* [4]. Corn flour (100 %), GMS (0.8 %), distilled water (70 %) and salt (2 %) were mixed using a hand mixer (HR 1530, Philips, Indonesia) for 5 minutes. Then the dough was extruded using a cooking-forming extruder (A302 UH 35 S3, Labtech Engineering, Thailand) with specifications which was stated in Muhandri *et al.* [9]. Noodles were extruded at 90 °C with screw speed of 100 rpm. The short and long ellipse-formed mold with diameters of 1 and 1.5 mm, respectively, were used. Eighty five (85) grams of corn noodles were formed according to the mold. Corn noodles were dried using fluidized bed dryer (MK 2, Sherwood Scientific Ltd., Cambridge, England) with various temperature settings of 50 °C, 60 °C, and 70 °C and airflow velocities of 0.73 $m \cdot s^{-1}$, 1.53 $m \cdot s^{-1}$, and 2.17 $m \cdot s^{-1}$. As a standard, corn noodles were dried using a conventional (air drying) method and weighed every 30 minutes until reached constant weight. The number of moisture loss will be used as a benchmark to indicate the completion of drying process in corn noodles, especially those which were dried using fluidized bed dryer. Corn noodles, which were dried by fluidized bed, were weighed every 10 minutes in the first hour and every 30 minutes afterwards until its weight reduction equals to the standard which was implied to the moisture loss. Then the moisture content, cooking loss, elongation and texture profiles of resulted dried corn noodles were analyzed. The optimum temperature and airflow velocity of dried corn noodles which have similar profiles of moisture content, cooking loss, elongation, and hardness to the standard were chosen.

Determination of drying duration of dried corn noodles

Corn noodles were made by mixing corn flour (100 %), GMS (0.8 %), salt (2 %), and distilled water (60 %, 70 %, and 80 % (w/w)) and then extruded using the same method. In order to determine the drying time, the previous method was applied and the resulting diagram, which represents the correlation between the moisture content of corn noodles and the drying time, will be made after the completion of data. The drying duration of corn noodles at moisture contents of 12 %, 11 %, 10 %, 9 %, and 8 % (w/w) were predicted from the diagram and the verification was made by measuring the noodles weight every two minutes while the noodles were being dried. Moisture content of corn noodles was calculated by using its weight reduction. The calculation was conducted through several steps as follows: 1) assessing the moisture and solid contents of each batch of noodles, which was made from three different types of dough; 2) subtracting the corn noodles weight during the drying process from wet corn noodles weight; and 3) calculating solid and moisture weight of corn noodles before the drying process was conducted. The moisture content during the drying process can be determined by calculating the moisture ratio (obtained by analyzing the difference between the initial weight of moisture in the noodles before the drying and the weight of moisture which was lost during drying process) and weight of noodles during drying process.

Determination of critical moisture content of dried corn noodles

The optimum moisture content of dried corn noodles was determined by forming 20 g of corn noodles into small circle. Five circles were formed for each dough (there were three types of doughs), and then dried until moisture contents reached 8 %, 9 %, 10 %, 11 %, and 12 %. After that, dried corn noodles were put in a desiccator for one hour and simultaneously observed for detecting any cracks development. Then, the moisture content of dried noodles was analyzed.

Quality analysis of dried corn noodles

Dried corn noodles were rehydrated by boiling 5 g of corn noodles in 150 mL of water for 12 minutes. The quality analyzes performed included: moisture content, cooking loss, elongation and hardness analysis.

Moisture content analysis

The moisture content of dried corn noodles were analyzed using oven method of AOAC [10].

Cooking loss analysis (modification from Oh et al. [11])

Same procedure which was used in quality analysis of dried corn noodles was used. After that, noodles were dried at 105 °C until reached constant weight and weighed again. Five (5) grams of these dried noodles were taken for measuring the moisture content and then this moisture content was used to calculate dry sample weight. Cooking loss (*CL*) was expressed as equation (1):

$$CL\,[\%] = \frac{A - B}{A} \times 100\,\% \tag{1}$$

where: *A* and *B* were dry solid sample before boiling and after boiling, respectively.

Elongation analysis (Inglet et al. [12])

A strand of noodle was wrapped at two parallel horizontal rods. The distance between these rods was set at 2 cm, and the speed of the probe was set to 0.3 cm·s^{-1}. The initial length of sample was 5.5 cm. The percentage of elongation was calculated by using equation (2).

$$Elongation\,[\%] = \frac{Duration\ \ until\ sample\ breaks\,[s] \times 0.3\,cm \cdot s^{-1} \times 100\,\%}{2\,cm} \tag{2}$$

Hardness analysis (Chen et al. [13])

Analysis of hardness was conducted by using texture analyzer (TA-XT2i, Stable Micro Systems, England) with specification of cylindrical probe with diameter of 35 mm. The instrument setting as follows: pre-test speed 2.0 mm·s^{-1}, test speed of 0.1 mm·s^{-1}, rupture test distance of 75 %, and TPA mode (Texture Profile Analysis). A strand of noodle, which has length more than the probe diameter, was placed on the base table and then pressed by the probe, with two compression cycles. Absolute hardness value which has (+) peak was indicated as the maximum force.

RESULTS AND DISCUSSION

Optimum temperature and airflow velocity of dried corn noodles

Drying process of corn noodles is conducted in various temperatures and airflow velocities. Drying process using fluidized bed dryer is conducted until corn noodles reach about 32.6 % of weight reduction; similar to the result of conventional method. Data of moisture content reduction during drying process are shown in Figure 1, then dried corn noodles are rehydrated and the profiles are analyzed.

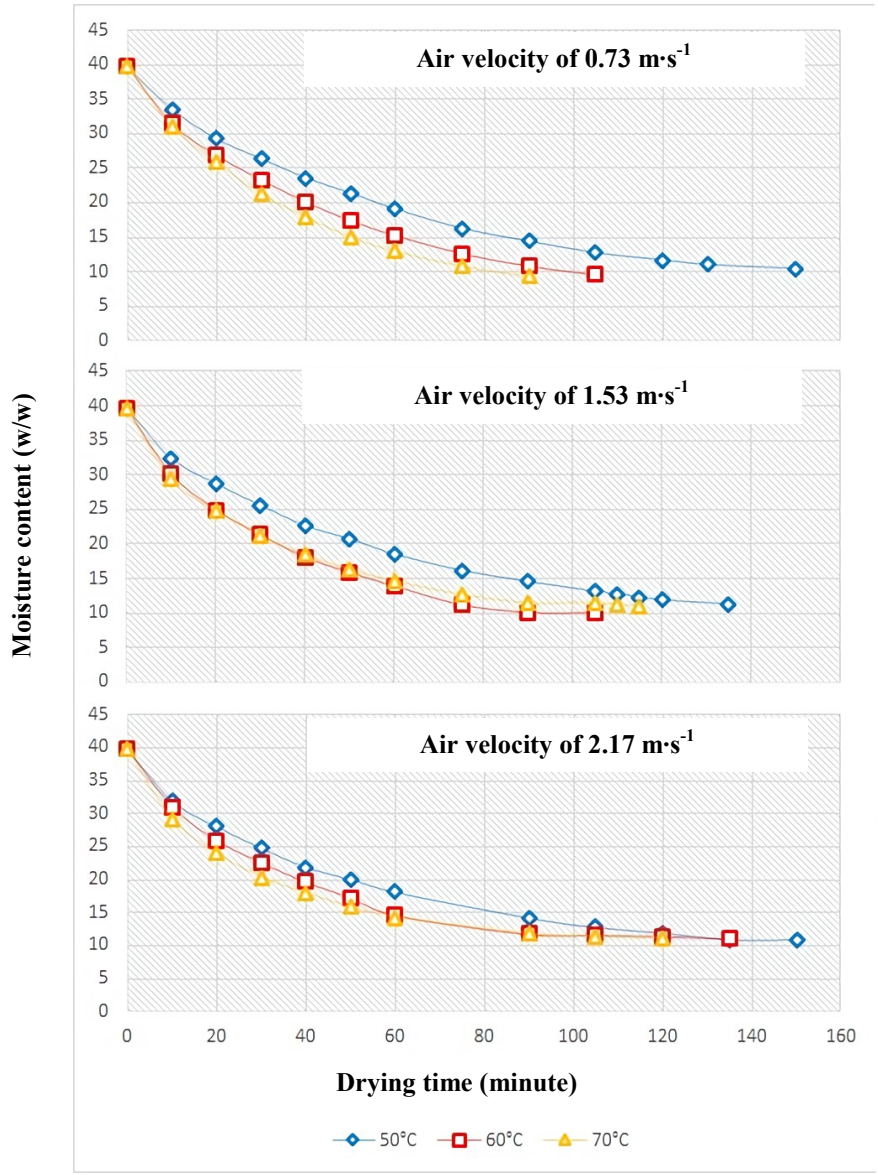


Figure 1. *Moisture content reduction of corn noodles during drying process with air velocities of 0.73 m·s^{-1}, 1.53 m·s^{-1}, and 2.17 m·s^{-1}*

This figure shows the higher the air velocity at 50 °C leads to the faster the moisture content decreasing of corn noodle. This is in line with Tumba [14] on ground

macademia nuts. Doymaz [15] also stated in his research on drying kinetics of Jerusalem artichoke that the drying time was shortened greatly with increasing air-drying temperatures. However, the moisture content decreasing at 60 °C and 70 °C are slower than that at 50 °C. At a temperature setting of 50 °C, the drying process is more influenced by the air velocity, so the faster the air velocity, the faster the drying process. At temperatures of 60 °C and 70 °C, the higher air velocity leads to the lower the real temperature of hot air in contact to the product. The lower the air velocity causes the higher air temperature in contact to the product and drying process will be faster.

Profile comparisons of dried corn noodles, which are made from several methods of drying process, are shown in Table 1. SNI (Indonesian National Standard) [16] for Dried Noodles stated that the maximum moisture content, which is allowed for dried corn noodles, is 10 %. The moisture contents of dried corn noodles in this study are in the range of 9.93 % - 13.79 %, which indicate that most of them have already fulfilled this requirement. Even so further, drying is also required to avoid microbial growth in dried corn noodles.

***Table 1**. Profiles of dried corn noodles based on drying method**

Drying method		**Moisture content (w/w) [%]**	**Cooking loss [%]**	**Elongation [%]**	**Hardness [gf]**
Conventional		13.79 ± 0.07	3.68 ± 0.21	115.64 ± 8.19	2512 ± 59
Fluidized bed dryer					
Airflow velocity [m·s^{-1}]	Temperature [°C]				
0.73	50	12.08 ± 1.06	5.35 ± 0.04^{a}	92.52 ± 9.14^{a}	2981 ± 36^{c,d}
	60	10.82 ± 1.83	6.01 ± 0.40^{a}	87.25 ± 1.21^{a}	2745 ± 46^{a}
	70	10.98 ± 1.16	6.10 ± 0.69^{a}	95.97 ± 3.33^{a,b}	2664 ± 21^{a}
1.53	50	11.81 ± 0.56	6.09 ± 0.53^{a}	105.35 ± 4.46^{b}	3168 ± 18^{e}
	60	11.63 ± 0.66	6.24 ± 0.44^{a,b}	90.63 ± 1.46^{a}	3064 ± 13^{d}
	70	9.93 ± 0.17	6.06 ± 0.35^{a}	95.42 ± 5.24^{a,b}	3046 ± 30^{c,d}
2.17	50	11.27 ± 0.76	7.47 ± 1.35^{b}	106.27 ± 6.35^{b}	2965 ± 35^{c}
	60	10.97 ± 1.55	6.76 ± 0.45^{a,b}	112.47 ± 3.35^{c}	2675 ± 13^{a}
	70	10.52 ± 2.42	6.08 ± 1.14^{a}	102.15 ± 3.29^{b}	2863 ± 24^{b}

*Different superscript letter in a coloumn means significant difference at α of 5 %

Cooking loss scores of rehydrated corn noodles using fluidized bed dryer are higher than those of rehydrated corn noodles using conventional dryer namely 6.06 % - 6.76 % compared to 3.68 ± 0.21 %, respectively. This is due to the acceleration of drying which produces a less cohesive gelatinization matrix compared to conventional process. Li *et al.* [17] stated that the conventional method of air drying below 50 °C produces starch noodles with excellent quality and high uniformity. However, these scores are inferior to the score of commercial starch noodles, which have cooking loss of 0.54 % [3]. It should be noted that the commercial noodles were made from starch flour of mung bean, and the noodles also have different dimensions. If cooking loss scores of corn noodles are compared to those of commercial wheat noodles, which are in the range of 8.21 % - 8.29 % [18], and commercial pastas, which have cooking loss of 6.72 % [8], cooking loss scores of dried corn noodles are acceptable.

It can be seen from Table 1 that drying process using fluidized bed dryer tend to produce corn noodles with higher hardness scores to the conventional dried corn noodles. This is due to the fact that the evaporation process still occurs in the noodles although the drying was finished so that the final moisture content of noodles will be lower than the conventional drying. Muhandri *et al.* [9] stated that noodles which have high hardness score are unfavored by consumers. Compared to commercial spaghetti, which has a hardness of 987.0 gf, our corn noodles are still harder.
Dried corn noodles with velocity of 2.17 $m \cdot s^{-1}$ have similar elongation to conventional dried corn noodles. Based on these profile comparisons, it can be concluded that noodles which are dried at 60 °C with velocity of 2.17 $m \cdot s^{-1}$ have the closest profiles to conventional dried corn noodles. This treatment only needs 135 minutes for drying the corn noodles, the shortest duration compared to the others which need 150 minutes for reaching similar weight loss (Figure 1).

Drying duration of dried corn noodles

Three different water additions of 60 %, 70 %, and 80 % to the dough resulted in three different moisture contents of corn noodles as shown in Table 2. Generally, it can be presumed that the more the water addition leads to a higher moisture content of corn noodles.

Table 2. *Moisture content of corn noodles with various water additions to the dough*

Water addition [% ratio with corn flour]	Moisture content (w/w) of corn noodles [%]*
60	39.48 ± 0.02^{a}
70	42.72 ± 0.89^{b}
80	45.28 ± 0.27^{c}

*Different superscript letter in a coloumn means significant difference at α of 5 %

Then, these corn noodles are dried using fluidized bed dryer with selected temperature and airflow velocity, at 60 °C with velocity of 2.17 $m \cdot s^{-1}$. Noodles which are made from dough with water of 80 % have the fastest decreasing in moisture content than the others during the drying process. This phenomenon is assumed to happen due to their differences in noodle dimension. After being extruded, noodles with 80 % water addition are thinner than those obtained with other percentage of added water to the dough. This hypothesis was encouraged by Inazu *et al.* [19] which proved that water movement in noodles has reversed correlation to the square of half-thickness of the noodle strand.
Corn noodles are dried until their moisture contents reached 12 %, 11 %, 10 %, 9 %, and 8 % (w/w), where the drying duration to reach them is shown in Table 3. Then, this drying duration is used to conduct the last stage of research.

Table 3. *Drying duration of corn noodles (minute)*

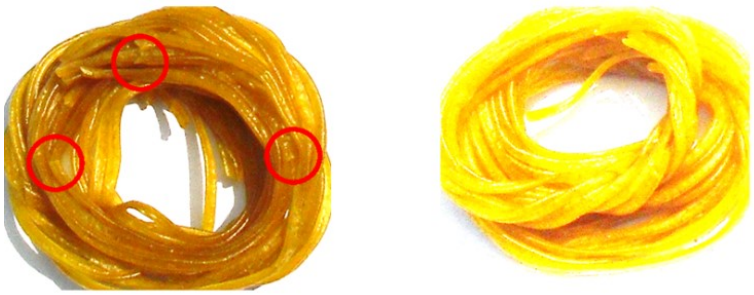
Water addition [%]	Drying duration at different moisture content (w/w) [%]:				
	8	9	10	11	12
60	192 (cracks)	152 (cracks)	128 (cracks)	111 (cracks)	98 (no cracks)
70	212 (cracks)	163 (cracks)	135 (cracks)	116 (no cracks)	103 (no cracks)
80	149 (cracks)	122 (cracks)	107 (no cracks)	92 (no cracks)	83 (no cracks)

Critical moisture content of dried corn noodles

Kahcevi and Cihan [1] stated that improper drying process can produce defects on the final products. In dried corn noodles, improper drying process, such as long drying duration and low moisture content, can produce some cracks that will decrease the noodle quality.

All treatments that are applied in corn noodles will produce cracks development if the moisture content of corn noodles is less than 9 %. Even so, as shown on Table 2, there are differences in critical moisture content of three noodles with water of 60 %, 70 %, and 80 % to the dough. Table 2 also presented that both water addition to the noodle's dough and final moisture content of dried noodles have influence to the dried corn noodles quality. This assumption is supported by Tan *et al*. [5], which proved that moisture content of dried starch noodles affected the quality of dried starch noodles. Tan *et al*. [5] also specified that noodles tend to overgrown in the mold if the drying process was terminated while its moisture content was more than 14.5 %. Meanwhile, if moisture content is less than 10 %, noodles were likely to be damaged.

Table 3 shows that dried corn noodles which are produced from dough with water of 60 %, 70 %, and 80 % start to crack when their moisture contents reach 11 %, 10 %, and 9 %, respectively. Figure 2 shows the physical difference between noodles with cracks and without cracks. These outcomes clearly demonstrate that a larger water addition into the dough leads to less cracked noodles. This phenomenon is assumed since the greater amount of water in corn noodles means that gelatinization is more likely to occur in the extruding process, step in which the gelatinization leads to a more sturdier structure of starch noodle. This hypothesis was reported by Tam *et al*. [6], which stated that the ability of starch noodles to retain its integrity is a result of amylose gelatinization in starch or flour. Gelatinization itself is influenced by several factors; one of them is the amount of water available in food [9]. Liu [20] also mentioned that when gelatinization occurs in products with high moisture content, the available water will act as a solvent so that the starch granules can be hydrated and will be completely gelatinized.



a. ***b.***

Figure 2. *The physical difference between noodles with cracks (a) and without cracks (b)*

Critical moisture content which has a role in dried corn noodles quality is defined as the lowest moisture content that can be reached in drying process without resulting cracked noodles. Table 3 shows the critical moisture contents of dried corn noodles from the

dough with water additions of 60 %, 70 %, and 80 % are 12 %, 11 %, and 10 %, respectively. The Indonesian National Standard for Dried Noodles [16] stated that the maximum moisture content for dried noodles is 10 %, so that only dried corn noodles from dough with water addition of 80 % fulfill this requirement. This condition indicates that dried corn noodles with optimum quality can be acquired by adding 80 % of water into the dough, and then drying in fluidized bed dryer at temperature of 60 °C with airflow velocity 2.17 $m \cdot s^{-1}$ for 107 minutes. This condition was chosen due to its profiles, especially elongation profile, which is similar to the noodles obtained by conventional method.

CONCLUSIONS

In this research, it can be concluded that drying process at temperature of 60 °C with airflow velocity of 2.17 $m \cdot s^{-1}$ produced dried corn noodles which have optimum rehydration profile. The higher water content of the dough corresponds to the lowest critical moisture content of dried corn noodles. The dried corn noodles which were produced from the dough with 80 % of water addition and dried for 107 minutes at 60 °C with airflow velocity of 2.17 $m \cdot s^{-1}$ has 10 % of critical moisture content. These dried corn noodles have fulfilled the requirement of Indonesian National Standard for Dried Noodles, which mentioned that the maximum moisture content for dried noodles was 10 %.

ACKNOWLEDGEMENT

This research was funded by Penelitian BOPTN (Biaya Operasional Perguruan Tinggi Negeri) under contract No. 107/IT3.41.2/L2/SPK/2013, DIKTI, Republic of Indonesia.

REFERENCES

1. Kahcevi, K., Cihan, A.: Transport Phenomena during Drying of Food Materials, in: *Focus on Food Engineering Research and Developments* (Editor: Pletney, V.N.), Nova Science Publishers, New York, **2007**, 13-163;
2. Charutigon, C., Jitpupakdree, J., Namsree, P., Rungsardthong, V.: Effects of Processing Conditions and the Use of Modified Starch and Monoglyceride on Some Properties of Extruded Rice Vermicelli, *LWT - Food Science and Technology*, **2008**, **41** (4), 642-651;
3. Hormdok, R., Noomhorm, A.: Hydrotermal Treatments of Rice Starch for Improvement of Rice Noodle Quality, *LWT - Food Science and Technology*, **2007**, **40** (10), 1723-1731;
4. Subarna, Muhandri, T., Nurtama, B., Firlieyanti, A.S.: Peningkatan Mutu Mi Kering Jagung dengan Penerapan Kondisi Optimum Proses dan Penambahan Monogliserida [Quality Improvement of Dried Corn Noodle through the Optimization of Processing Conditions and Addition of Monoglyceride] (in Indonesian), *Jurnal Teknologi dan Industri Pangan*, **2012**, **2**, 146-152;
5. Tan, H.-Z., Li, Z.-G., Tan, B.: Starch Noodle: History, Classification, Materials, Processing, Structure, Nutrition, Quality Evaluating and Improving, *Food Research International*, **2009**, **42** (5-6), 551-576;
6. Tam, L.M., Corke, H., Tan, W.T., Li, J., Collado, L.S.: Production of Bihon-Type Noodles from Maize Starch Differing in Amylose Content, *Cereal Chemistry*, **2004**, **81** (4), 475-480;

7. Muhandri, T.: Mekanisme Proses Pembuatan Mi Berbahan Baku Jagung (in Indonesian), *Buletin Teknologi Pascapanen Pertanian*, **2012**, **8**, 71-79;
8. Altay, F., Gunasekaran, S.: Influence of Drying Temperature, Water Content, and Heating Rate on Gelatinization of Corn Starches, *Journal of Agricultural and Food Chemistry*, **2006**, **54** (12), 4235-4245;
9. Muhandri, T., Ahza, A.B., Syarief, R., Sutrisno: Optimasi Proses Ekstrusi Mi Jagung Dengan Metode Permukaan Respon [Optimization of Corn Noodle Extrusion Using Response Surface Methodology] (in Indonesian), *Jurnal Teknologi dan Industri Pangan*, **2011**, **22** (2), 97-102;
10. ***AOAC International: *Official Methods of Analysis* of *AOAC International*, 18th edition, AOAC International, Arlington (VA), **2005**;
11. Oh, N.H., Seib, P.A., Deyoe, C.W., Ward, A.B.: Noodles II. The Surface Firmness of Cooked Noodles from Soft and Hard Wheat Flours, *Cereal Chemistry*, **1985**, **62** (6), 431-436;
12. Inglet, G.E., Peterson, S.C., Carriere, C.J., Maneepun, S.: Rheological, Textural, and Sensory Properties of Asian Noodles Containing an Oat Cereal Hydrocolloid, *Food Chemistry*, **2005**, **90** (1-2), 1-8;
13. Chen, Z., Sagis, L., Legger, A., Linssen, J.P.H., Schols, H.A., Voragen, A.G.J.: Evaluation of Starch Noodles Made From Three Typical Chinese Sweet Potato Starches, *Journal of Food Science*, **2002**, **67** (9), 3342-3347;
14. Tumba, K.: Convective Air Drying Characteristics of Ground Macadamia Nuts, *Scientific Study & Research: Chemistry & Chemical Engineering, Biotechnology, Food Industry*, **2018**, **19** (3), 243-255;
15. Doymaz, I.: Effect of Pre-Treatment and Air Temperature on Drying Kinetics and Quality of Jerusalem Artichoke, *Scientific Study & Research: Chemistry & Chemical Engineering, Biotechnology, Food Industry*, **2018**, **19** (4), 395-409;
16. ***Indonesian National Standard (Standar Nasional lndonesia - SNI): *SNI 01-2974-**1996** – Mi Kering* (in Indonesian);
17. Li, Y., Liang, J.-F., Yang, M.-Y., Chen, J.-Y., Han, B.-Z.: Traditional Chinese Rice Noodles: History, Classification, and Processing Methods, *Cereal Food Worlds*, **2015**, **60** (3), 123-127;
18. Ojure, M.A., Quadri, J.A.: Quality Evaluation of Noodles Produced from Unripe Plantain Flour using Xanthan Gum, *International Journal of Recent Research and Applied Studies*, **2012**, **13** (3), 740-752;
19. Inazu, T., Iwasaki, K., Furuta, T.: Stress and Crack Prediction during Drying of Japanese Noodle (Udon), *International Journal of Food Science and Technology*, **2005**, **40** (6), 621-630;
20. Liu, Q.: Understanding Starches and Their Role in Foods, in: *Food Carbohydrates: Chemistry, Physical Properties and Applications* (Editor: Cui, S.W.), Taylor & Francis Group, Boca Raton, **2005**, 309-356.