PENAMBAHAN GUAR GUM TERHADAP SIFAT FISIK MI JAGUNG KERING EKSTRUSI DARI CAMPURAN TEPUNG JAGUNG BASAH DAN KERING

GUAR GUM ADDITION ON PHYSICAL CHARACTERISTICS OF EXTRUDED DRY CORN NOODLE FROM MIXTURE OF WET AND DRY CORN FLOURS

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ABSTRACT

The drying process of corn noodles was an effort to increase the shelf life and it was a form of noodles diversification. The objective of this research was to study and analyze the effect of guar gum addition on the physical quality of the extruded dry corn noodle made from a mixture of wet and dry corn flour. Manufacturing dry corn noodles was conducted using wet corn noodles from a mixture of wet and dry corn flour, which was then dried in a tray dryer at a temperature of 60-70 °C for 1 - 1.5 hours. The treatments used were a combination of alum levels of 0.01%; moisture content of 80% (dry base); and guar gum concentration of 0%, 1%, and 2%. Physical properties of dry corn noodles included rehydration time, hardness, adhesiveness, suppleness, elongation, and cooking loss. The results showed that the optimum rehydration time for dry corn noodles was about 9 minutes. The addition of guar gum to the physical qualities of dry corn noodles tended not to be significant statistically, but as a score, an increase in guar gum levels tended to increase the elongation of dry corn noodles. While, increasing levels of guar gum tended to reduce the stickiness and cooking loss levels of them.

Keywords: dry corn noodles, texture profile, rehydration time, guar gum, extrusion

ABSTRAK

Proses pengeringan pada mi jagung merupakan usaha meningkatkan masa simpan dan merupakan bentuk diversifikasi pangan mi. Tujuan dari penelitian ini adalah untuk mempelajari dan menganalisis pengaruh penambahan guar gum terhadap sifat mutu fisik mi jagung kering metode ekstrusi yang dibuat dari campuran tepung jagung basah dan kering. Pembuatan mi jagung kering dilakukan setelah pembuatan mi jagung basah dari campuran tepung jagung basah dan kering yang kemudian dikeringkan dalam tray dryer pada suhu 60-70 °C selama 1 – 1.5 jam. Perlakuan yang digunakan adalah kombinasi kadar tawas 0.01 %; kadar air adonan 80 % (basis kering); dan kadar guar gum 0%, 1%, dan 2%. Analisis sifat fisik mi jagung kering meliputi waktu rehidrasi, kekerasan, kelengketan, kekenyalan, persen elongasi, dan cooking loss. Hasil menunjukkan bahwa waktu rehidrasi optimum mi jagung kering hingga mi jagung menjadi lunak dan lembut serta tidak ada bercak putih pada untaian adalah sekitar 9 menit. Penambahan guar gum terhadap mutu fisik mi jagung cenderung tidak berbeda nyata secara statistik, akan tetapi secara skor, peningkatan kadar guar gum cenderung meningkatkan persen elongasi mi jagung kering. Sedangkan peningkatan kadar guar gum cenderung menurunkan tingkat kelengketan dan cooking loss mi jagung kering.

Kata kunci: ekstrusi, guar gum, mi jagung kering, profil tekstur, waktu rehidrasi.

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PENDAHULUAN

Dry noodles, according to SNI 01-2974-1996, are defined as processed products with a typical form of noodles that are dried with the addition of other permitted food ingredients. Dry noodles must have a minimum of 87% solids, which means that the moisture content must be less than 13%. Tan *et al*. (2009) explained that dry starch noodles should have a moisture content of 10-14.5% related to the prevention of mold growth. The moisture content of less than 10% can cause dry noodles that break easily during the transportation process. Dry noodles have a longer shelf life compared to wet noodles due to lower moisture content, which is for 6-12 months during good storage. The drying process in starch or non-gluten noodles is different from that of wheat-based noodles. Drying can be done by using conventional drying using sunlight or using a dryer at a certain temperature and time. Drying at 20ºC can cause noodles to break easily when cooked due to cracks that form on dry noodles. Inazu *et al*. (2002) explained the kinetics of drying on Japanese noodles (udon) by gradual drying, which was started at a low temperature (15-20ºC) and then followed by a temperature of 30-35ºC at high RH (70-80%) to a moisture content of 14% produced good noodles without cracking. However, the use of high temperatures can also be done like Baiano *et al*. (2006), who reported high-temperature drying (90ºC for 5 hours) produced good cooking and sensory quality.

Several studies related to the manufacture of dry starch noodles using extruders have been carried out. Charutigon *et al*. (2008) reported making dry vermicelli from rice flour ingredients, Waniska *et al*. (1999) made dry corn noodles with a high cooking loss value of 47%, and Muhandri *et al*. (2019) reported the drying process with a fluidized bed dryer on extruded corn noodles. Also, the use of additives is applied to improve the quality of the noodles. Subarna *et al*. (2012) added monoglycerides in the manufacture of dry corn noodles where the qualities of hardness and elongation were better despite high levels of cooking loss and adhesiveness. Besides, hydrocolloids were also used in improving the quality of noodles, among others by Muhandri *et al*. (2013), who reported that the higher the guar gum concentration led to the higher the elongation and the lower the cooking loss of the noodles. Ratnawati and Afifah (2018) used guar gum, CMC, and carrageenan in a mixture of mocaf, rice flour, and cornflour. The manufacturing of these dry and wet starch noodles was made using dry flour, which is added with a certain degree of water. Making the dry noodles from a mixture of the wet and dry flour has never been done.

This study aims to improve the physical qualities of extruded dry corn noodles from a mixture of wet and dry cornflour. They are rehydration time, cooking loss, elongation, and texture profiles by adding different concentrations of guar gum.

MATERIALS AND METHODS

The manufacturing process of dry corn noodles

The manufacturing of dry corn noodles was started with the manufacturing of wet corn noodles based on Aminullah *et al*. (2019). The initial stage was the process of corn flouring by using wet milling with alum treatment of 0.01% of the weight of water. Corn noodles manufacturing consisted of determining the proportion of wet and dry flour (Aminullah *et al*., 2016) which was mixed until a moisture content of 80% (bk) with the addition of salt (2% by weight of the dough) and guar gum (0%, 1%, and 2% by weight of the dough); steaming the dough at 100 °C for 15 minutes; extruding the dough using a paste extruder; steaming the noodles for 15 minutes at 100 °C. Then, the drying process was carried out using a tray dryer at a temperature of 60-70 °C for 1 - 1.5 hours.

Physical analysis of dry corn noodles

Determination of the rehydration time of dry corn noodles (Collado *et al*., 2001)

Five grams of noodles, that have been cut as long as 2-3 cm, were put into boiling water as much as 200 ml. Then, the strands of noodles were taken every minute, which were then placed between two watch glasses and pressed. The optimum cooking time was obtained when all of the noodles absorb water completely or when white dots did not form when the noodles were pressed.

Analysis of texture profiles (hardness and stickiness) (Chen *et al*, 2002)

Hardness analysis using the Texture Analyzer type TA-XT2i. The probe used was cylindrical with a diameter of 35 mm. The Texture Analyzer settings were as follows: pre-test speed of 2.0 mm/s, test speed of 0.1 mm/s, rupture test distance of 75%, measure force in compression mode, and force of 100 g.

A rehydrated noodle strand with a length that exceeds the probe diameter was placed on the runway and then pressed by the probe to 75% strain. The result was a curve that showed the relationship between the required force for compression and time. Hardness value was indicated by absolute (+) peak, which was a maximum force, and stickiness value was indicated by absolute (-) peak. The unit of these parameters was gram force (gF).

Analysis of elongation percentage (Inglet *et al*., 2005)

A rehydrated noodle strand was wrapped around the probe with a distance between the probes of 2 cm and the probe speed of 0.3 cm/s. Elongation percentage was calculated according to equation (1).

$$Elongation\ (\%) = \frac{break\ time\ (s)\ \text{x}\ 0{,}3\ cm/s}{2\ cm}\ \text{x}\ 100\% \quad (1)$$

Analysis of cooking loss (Oh *et al*., 1985)

Five grams of dry noodles were boiled in 150 ml of boiling water during the rehydration time of dry corn noodles, then drained the noodles. After that, dried at 100 °C until the weight was constant, then weighed again. The cooking loss value was calculated using equation (2).

$$CL = 1 - \left(\frac{weight\ of\ dried\ sample}{initial\ weight\ of\ sample\ \text{x}\ (1 - moisture\ content\ of\ sample)}\right)\ \text{x}\ 100\% \quad (2)$$

Data analysis

The resulted data were analyzed using Analysis of Variance (ANOVA) and Duncan post hoc test when $p<0.05$ via Statistical Product and Service Solutions (SPSS) software version 23.

RESULTS AND DISCUSSION

Rehydration time of dry corn noodles

Rehydration time is the required time of the material to re-absorb water for obtaining a homogeneous texture. Table 1 shows that the noodles are still rather hard, and there are spots in the middle of the noodles in the 6th to 8th minutes. At 9th minute, the noodles become soft and there is no spot in the middle of the noodles, whereas, at the 10th minute, the noodles are too soft. Based on these data, the selected rehydration time of dry corn noodles is 9 minutes. This selected rehydration time is by following Muhandri *et al* (2018) and Subarna *et al*. (2012), who reported the rehydration time of dry corn noodles, respectively, around 10 and 8 minutes. However, the length of the rehydration time is due to the consistency of dry corn noodles, that is more compact than dry wheat noodles, where the optimum rehydration time of dry wheat flour noodles are in the range of 3-5 minutes. Also, Subarna and Muhandri (2013) reported that dry corn noodles with the calendering process required rehydration time of about 4 minutes. This calendering process is a method used in the manufacturing process of wheat noodles.

Table 1. Determination of the rehydration time of dry corn noodles.

Rehydration time (minute)	Condition of the rehidrated dry noodles
6 7 8	The noodles are still a bit hard, and there are spots in the middle of the noodles
9	The noodles are soft, and there are no spots in the middle of the noodles
10	The noodles are too soft

Hardness profile

Hardness is defined as an absolute (+) peak, which is the maximum force, which describes the force of the probe to suppress mi. The higher the peak (peak of the curve) shown by the curve, the higher the hardness of the materials.

Figure 1. Histogram of the guar gum addition (%) on the hardness (gF) of rehydrated dry corn noodles.

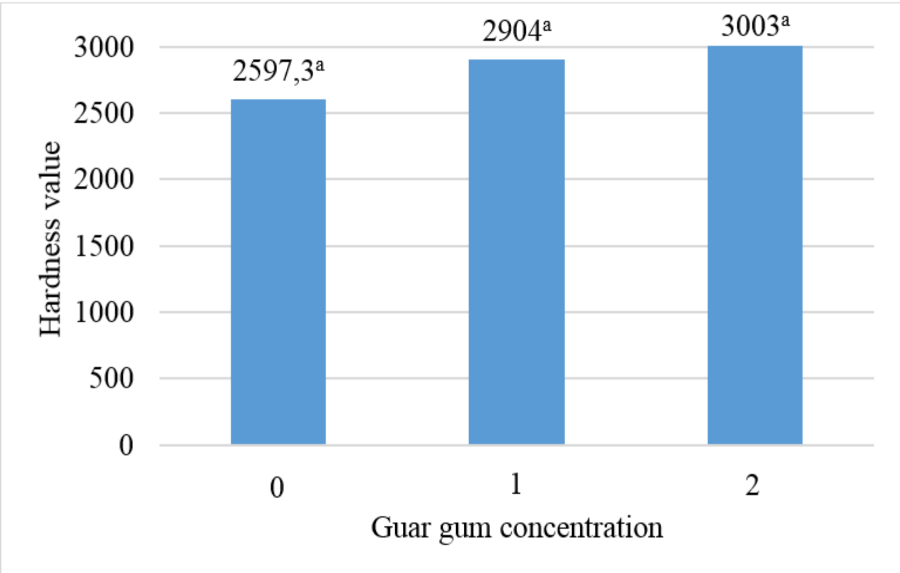
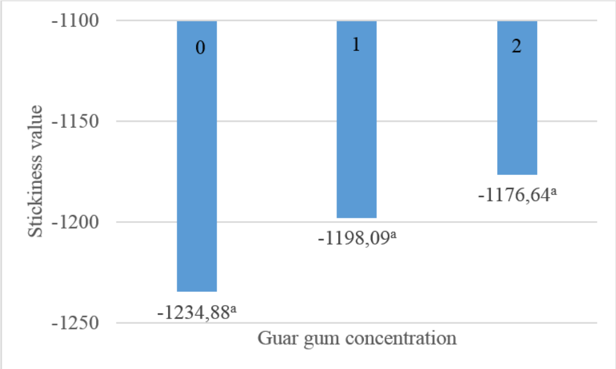


Figure 1 shows that the addition of guar gum does not affect statistically on the hardness level of dry corn noodles. According to Muhandri *et al*. (2013) and Aminullah *et al*. (2019), the use of guar gum on wet corn noodles tends to reduce the hardness of noodles. The guar gum on noodles has the function to bind water (Sozer, 2009) that will result in the stability of the material matrix and thereby reducing the hardness of the noodles. Ratnawati and Afifah (2018) reported that the higher concentration of added guar gum produced the lower the hardness level of the noodles. The resulted hardness values are not much different from Muhandri *et al*. (2018) which was equal to 3917.75 gF. Neither with the research of Subarna *et al*. (2012) who reported the hardness value of corn noodles was 5897.75 gF. The hardness value of dry corn noodles is much higher when compared to the hardness value of wheat noodles which was 987.70 gF (Muhandri *et al*., 2011).

Stickiness profile

Stickiness or adhesiveness is defined as an absolute (-) peak, which describes the amount of effort to pull the probe off the sample. The greater the negative area shown by the curve, the higher the stickiness value of the noodles.

Figure 2. Histogram of the guar gum addition (%) on the stickiness (gF) of rehydrated dry corn noodles



Based on the stickiness score, Figure 2 shows that the higher the guar gum concentration used tends to reduce the stickiness value, although it does not affect the stickiness value of the noodles statistically. It can be seen that the lowest stickiness value occurs at a 2% guar gum level, which is -1176.64 gF. While the highest adhesiveness at 0% guar gum content with a value of -1234.88 gF. Fadlillah (2005) and Kusnandar (1998) reported that the addition of guar gum can reduce the stickiness value of wet noodles.

Elongation profile

Percent of elongation shows the maximum length of the noodles that experience a pull before breaking up. Elongation is expressed in units of percent (%).

Figure 3. Histogram of the guar gum addition (%) on the elongation (%) of rehydrated dry corn noodles.

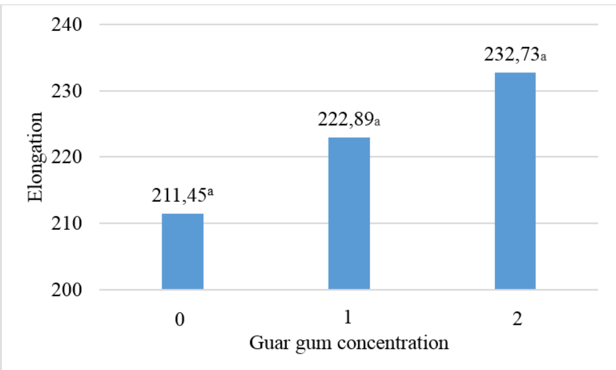


Figure 3 shows that the addition of guar gum on dry corn noodles does not affect statistically at α of 0.05. However, elongation score shows that increasing levels of guar gum can relatively increase the elongation of dry corn noodles. The highest elongation percentage is obtained with the addition of 2% guar gum, which is 232.73%. The addition of guar gum 0% produces dry noodles with elongation of 211.45%, while the addition of guar gum 1% give the elongation of 222.89%. Increasing levels of guar gum cause the binding capacity of the water to be higher, which causes a decrease in the hardness of the noodles, or the noodles become softer means that softer noodles do not break easily. This elongation value is by following Taqi *et al.* (2018), who reported elongation percentage are in the range of 125.84%-269.34%. Muhandri *et al.* (2011) stated that the range of elongation percentage of corn noodles are 157.28% -351.60%.

Cooking loss profile

Hou and Kruk (1998) stated that cooking loss was the most important parameter for wet noodle products, that are traded in the cooked form. The desired cooking loss value is relatively small. The lower cooking loss value indicates that the noodles have a good and homogeneous texture.

Figure 4. Histogram of the guar gum addition (%) on the cooking loss (%) of rehydrated dry corn noodles.

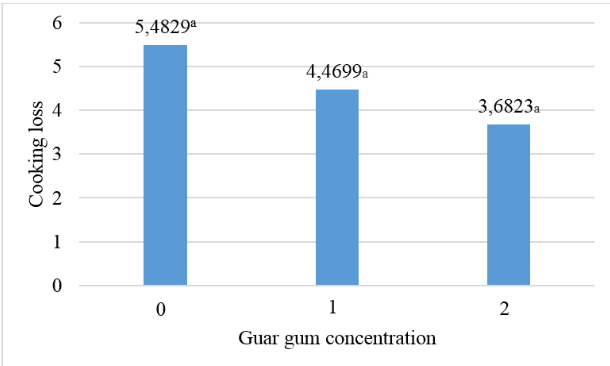


Figure 4 shows that the higher the level of guar gum used, the lower the obtained cooking loss value. Increasing the concentration of guar gum to a certain concentration can reduce the cooking loss of the noodles because guar gum has a function as a water binder (Sozer, 2009), which distributes the water distribution in the material so that the bond between starch granules becomes stronger (Sivaramakrishnan *et al.*, 2004). This is in line with Muhandri *et al.* (2013), who reported guar gum addition as much as 2% can reduce the cooking loss of wet corn noodles. The cooking loss value in this study is consistent with the research of Muhandri *et al.* (2013), who reported a range of cooking loss values between 3.09% -3.86%.

CONCLUSION

Rehydration time of dry corn noodles was 9 minutes, which was marked by the condition of the noodles are soft, and there were no spots in the middle of the noodles. Increasing levels of guar gum tend to increased the elongation of dry corn noodles but decreased the stickiness and cooking loss of dry corn noodles.

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