

# Physicochemical and sensory analysis of instant corn porridge made from nixtamalized waxy corn

*[Analisis sifat fisikokimia dan sensoris bubur jagung instan berbahan dasar jagung pulut nixtamal]*

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## ABSTRACT

Waxy corn is a commodity that can be developed into various food products; one is instant porridge, which only requires a short cooking preparation process because it has undergone previous processing. This research aimed to determine the physicochemical and sensory properties of instant porridge made from nixtamalized waxy corn. This research used a completely randomized factorial design (CRFD). The first factor was soaking time (30, 60, and 90 minutes), and the second was pregelatinization time (5, 10, and 15 minutes). The results showed that soaking and pregelatinization time significantly affected rehydration capacity, rehydration time, and viscosity. In contrast, the effect on syneresis and sensory properties was only affected by one of the factors. Instant nixtamalized corn porridge with a soaking time of 90 minutes and a pregelatinization time of 15 minutes was the best instant nixtamalized corn porridge with highest rehydration capacity (5.78 ml/g), calcium content (66.80 mg/L), and viscosity (3850 cP), smallest syneresis value (29.94%), and shortest rehydration time (2.19 minutes), with a neutral taste preference, while the panelists somewhat preferred color, texture, and aroma.

**Keywords:** Instant porridge, waxy corn, nixtamalization, pre gelatinization

## ABSTRAK

Jagung pulut adalah komoditas yang dapat dikembangkan menjadi berbagai jenis olahan pangan salah satunya bubur instan yang penyajiannya tidak memerlukan proses pemasakan yang lama karena telah mengalami proses pengolahan sebelumnya. Tujuan dari penelitian ini adalah untuk mengetahui sifat fisikokimia dan sensoris bubur instan berbahan dasar jagung pulut nixtamal. Penelitian ini menggunakan Rancangan Acak Lengkap (RAL) faktorial. Faktor pertama adalah waktu perendaman (30, 60, 90 menit) dan faktor kedua adalah waktu pregelatinisasi (5, 10, dan 15 menit). Hasil penelitian menunjukkan bahwa waktu perendaman dan waktu pregelatinisasi berpengaruh nyata terhadap daya rehidrasi, waktu rehidrasi, viskositas, sementara terhadap sineresis dan sensori hanya dipengaruhi oleh salah satu faktor. Bubur jagung instan nixtamal dengan lama perendaman 90 menit dan lama waktu pregelatinisasi 15 menit merupakan bubur jagung instan nixtamal terbaik dengan daya rehidrasi (5,78 ml/g), kalsium (66,80 mg/L), dan viskositas (3850 cP) tertinggi, nilai sineresis terkecil (29,94%), dan waktu rehidrasi yang singkat (2,19 menit), dengan tingkat kesukaan terhadap rasa (netral), sementara warna, tekstur, dan aroma agak disukai panelis.

**Kata Kunci :** Bubur instan, Jagung pulut, nixtamalisasi, pregelatinisasi

## Introduction

The food crisis has led the government to encourage the public to create alternative food sources with non-rice foodstuffs. Corn is an economical food product, making it strategic for development as a non-rice carbohydrate and protein source. One type of local corn grown in Gorontalo province is waxy corn (*Zea mays* L var. ceratina), which reportedly reaches 4% of total corn production (Une et al., 2023). Waxy corn has sticky characteristics with a sweet, savory, and tender taste, making it popular among many people (Juhriah et al., 2019). The savory taste of waxy corn is due to its very high amylopectin content (Tadjema et al., 2018).

Waxy corn has a carbohydrate source, with the main component being 95.75% amylopectin, 9.20% protein, and 10.00 mg of calcium (Purnomo & Purnamawati, 2010). Although it contains relatively high carbohydrates and proteins, the calcium content of waxy corn is low. This factor can be overcome by calcium fortification through the nixtamalization process. Research on the nixtamalization process in corn has been previously conducted in many studies (Vega-Rojas et al., 2017; Putri, 2018; Paz-Samaniego et al., 2019; Ramírez-Araujo et al., 2019; Contreras-Jiménez et al., 2020). Nixtamalization is a process of boiling mature corn kernels with the addition of a  $\text{Ca(OH)}_2$  solution, which improves corn's chemical and physical characteristics (Ferdiansyah et al., 2020). The boiling process using lime water,  $\text{Ca(OH)}_2$  spreads into the corn kernels, then changes the physicochemical properties of the corn germ, endosperm, and internal anatomical structure. This condition can alter the kernel composition due to heat and mass exchange (Ramírez-Araujo et al., 2019).

The nixtamalization process can increase calcium content, with the treatment duration involving cooking in lime water. Using an alkaline solution in the soaking process can create a crunchy texture. The alkaline solution contains a significant amount of calcium, which can be absorbed by the fruit flesh and also speed up cooking, enhance water-binding capacity, and delay retrogradation (Contreras-Jiménez et al., 2020). The cooking temperature plays a crucial role in forming cross-links between starch molecules and  $\text{Ca}^{2+}$  ions, the quantity of which is influenced by the concentration of  $\text{Ca(OH)}_2$ . Based on previous research (Vega-Rojas et al., 2017), the physicochemical properties of starch can be altered by Van der Waals interactions between  $\text{Ca}^{2+}$  ions and starch. Stronger interactions between calcium and starch can result in stable starch crystallinity.

Nixtamalized waxy corn can be processed into instant porridge as a non-rice food source. The provision of instant products for the current food trend is increasingly favored by the public due to their practicality and short preparation time, necessitating the development of instant food products. Instant porridge is a product that requires only a short preparation or cooking process because it has already undergone processing, such as spray drying, freeze drying, foam mat drying, and pregelatinization. Pregelatinization is an instantization technique that physically alters the starch structure by processing the starch in water below the gelatinization temperature. Pregelatinization can enhance starch absorption and swelling power (Ma et al., 2022), thus making the preparation process for instant porridge quick, needing only hot water to be ready for consumption. The modification of starch paste through pregelatinization at different temperatures in the production of instant products has been reported, for example, in cassava starch (Iwansyah et al., 2022), wheat (Ma et al., 2022), and sago starch (Fitriani et al., 2023).

Processing waxy corn into instant porridge through nixtamalization and pregelatinization processes has yet to be widely conducted. This research aims to determine the physicochemical and sensory properties of instant porridge made from nixtamalized waxy corn with varying soaking times in lime water and pregelatinization time.

## **Materials and Methods**

### ***Materials and equipment***

The materials used in the research include waxy corn harvested at 73 days,  $\text{Ca(OH)}_2$ , distilled water (aquadest),  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ ,  $\text{NaOH}$ , Calcon, and  $\text{Na}_2\text{EDTA}$ . The equipment includes a stove, 60 mesh and 80 mesh sieves, a grinder, a baking tray, a blender, an oven, tongs, and a spatula. The equipment used for analysis includes centrifuge tubes, centrifuge, a hot plate, an analytical balance, a digital viscometer, a water bath freezer, and glassware.

## **Research methods**

The study uses a Completely Randomized Design (CRD) with two factors: soaking time in lime water (L1 = 30 minutes, L2 = 60 minutes, and L3 = 90 minutes) and pregelatinization time (T1 = 5 minutes, T2 = 10 minutes, and T3 = 15 minutes) for instant nixtamalized corn porridge, with three repetitions. Data were analyzed using Analysis of Variance (ANOVA) followed by Duncan's Multiple Range Test (DMRT) at a 5% significance level using SPSS Statistics 21 software.

### *Making nixtamalized waxy corn porridge*

Five hundred g of dried waxy corn kernels were cleaned and placed in a pot containing 1 liter of water, mixed with 150 g of lime water, and then boiled for 30 minutes at 100°C. The cooked corns were then soaked for 30 minutes, 60 minutes, and 90 minutes. The soaked corn was then thoroughly drained, ground using a grinder, and dried using an oven at 60°C for 24 hours. The dried corns were ground again and sieved to achieve a uniform grit size (60 mesh).

### *Making instant waxy corn porridge*

Add 900 ml of water to 450 g of nixtamalized corn grits, then cook for 5 minutes, 10 minutes, and 15 minutes at 100°C until thickened. Spread the cooked porridge on an aluminum foil tray and dry using an oven at 125°C for 3 hours. Blend the dried porridge using a blender and dry again at 100°C for 15 minutes using an oven. Once dry, crush the porridge again using a crusher and sieve using a 60-mesh sieve.

### *Preparation for analysis*

Weigh 25 g of dried corn porridge, add 75 ml of hot water at 100°C, let it sit for 2 minutes, then stir the porridge until ready for consumption.

## **Observations**

### *Calcium content by complexometric titration*

Calcium content was analyzed using the complexometric titration method (Taufik et al., 2018). Weigh 4 grams of the sample and add 100 ml of water. Adjust the pH of the sample solution to 12-13 by adding 2N NaOH. Add 50 mg of 0.2% murexide indicator (w/w) to the sample, then titrate using Na<sub>2</sub>EDTA solution until the color changes from light pink to purple.

### *Rehydration capacity*

Rehydration capacity was measured by weighing 1 gram of the sample into a centrifuge tube and adding 10 ml of water. Stir and let it stand for 30 minutes, then centrifuge the solution for 30 minutes at 3500 rpm (Michael, 2017).

### *Rehydration time*

Rehydration time measurement follows Kuang et al. (2011). One gram of the sample was added to 4 ml of 100°C water. Measure the time it took for the water to penetrate the sample completely and achieve homogeneity.

### *Viscosity*

Viscosity was analyzed using a digital viscometer (Wibawanti & Rinawidiastuti, 2018). Weigh 50 grams of the sample into a beaker, add 100 ml of boiling water, and then insert the spindle attached to the viscometer set at 60 rpm for 30 seconds. The measurement reading can be taken from the viscometer.

### Syneresis

Syneresis was measured following Kasemwong & Uttapap (2003). A 10% w/w starch suspension was prepared in a centrifuge tube, heated in a water bath at 95°C for 15 minutes, and cooled to room temperature. The starch gel then was weighed and cooled in a freezer at -15°C for 20 hours. The starch gel from the freezer was removed, allowing it to reach room temperature, and centrifuged for 10 minutes at 3000 rpm to remove the water. The gel was weighed again and tested at -15°C until the weight was stable.

### Sensory evaluation

Sensory evaluation follows the hedonic test method by 30 untrained panelists. The panelists were asked to rate each sample as per Appendix 1. The organoleptic test scores range from 1 to 7, where 1 = strongly dislike, 4 = neither like nor dislike (neutral), and 7 = strongly like (Setyaningsih et al., 2010).

## Results and Discussion

### Calcium content

The results of the calcium content test for instant porridge made from nixtamalized waxy corn with varying soaking times in lime water and pregelatinization times ranged from 48.43 mg/L to 66.80 mg/L. The ANOVA test results with a significance level of  $\alpha = 0.05$  showed that the soaking time and pregelatinization time significantly affected the calcium content of the instant nixtamalized corn porridge, with no interaction effect between soaking time and pregelatinization time on the calcium content.

**Table 1.** Calcium content test results of nixtamalized instant corn porridge

| Treatment | Calcium content (mg/L) |
|-----------|------------------------|
| L1        | 48.43±1.67a            |
| L2        | 55.11±3.34ab           |
| L3        | 66.80±1.67b            |
| T1        | 54.55±9.49ab           |
| T2        | 56.78±9.29ab           |
| T3        | 59.01±9.19ab           |

Note: Numbers followed by the same lowercase letters in the same column did not differ markedly at the 5% level, according to the DMRT test. L1 = 30 minutes soaking, L2 = 60 minutes soaking, L3 = 90 minutes soaking. T1 = 5 minutes pregelatinization, T2 = 10 minutes pregelatinization, T3 = 15 minutes pregelatinization.

The highest calcium content was found in lime water in 90 minutes of soaking. According to Putri (2018), the soaking time can influence the calcium content absorbed into the corn kernels and help select the appropriate processed products for nixtamalized corn flour. The wet time is crucial in nixtamalization because calcium absorption occurs during this stage (Subagiyo, 2021). Lime water, chemically  $\text{Ca(OH)}_2$ , softens the corn by binding proteins and polysaccharide side chains. When mixed with water, lime dissociates into  $\text{Ca}^{2+}$  and  $\text{OH}^-$  ions. Therefore, the longer the corn is soaked, the more calcium from the lime water solution is absorbed into the starch granules. Thus, the 90-minute soaking treatment had higher calcium values than the 60-minute and 30-minute soaking times, regardless of the cooking durations.

The pregelatinization time did not significantly affect the increase in calcium content in nixtamalized instant corn porridge because calcium absorption only occurs during the lime water-soaking process. Consequently, the calcium content in the 5-minute, 10-minute, and 15-minute pregelatinization treatments did not differ significantly.

### Physical properties of nixtamalized waxy corn instant porridge

The ANOVA test results showed that the soaking time and pregelatinization time significantly affected the rehydration capacity, rehydration time, and viscosity of nixtamalized waxy corn instant porridge, with an interaction between the two factors. The DMRT test results are presented in Table 2.

**Table 2.** Rehydration and viscosity of nixtamalized waxy corn instant porridge products

| Treatments | Rehydration Capacity (ml/g) | Rehydration Time (minutes) | Viscosity (Centipoise) |
|------------|-----------------------------|----------------------------|------------------------|
| L1T1       | 3.65±0.15a                  | 10.47±0.11i                | 1500±100.0a            |
| L1T2       | 3.71±0.05a                  | 8.15±0.05g                 | 1683±76.4a             |
| L1T3       | 3.82±0.14a                  | 6.94±0.02f                 | 2150±50.0b             |
| L2T1       | 4.38±0.19b                  | 8.84±0.04h                 | 2450±50.0bc            |
| L2T2       | 4.59±0.19bc                 | 6.21±0.07d                 | 2750±50.0cd            |
| L2T3       | 4.74±0.16c                  | 4.19±0.15b                 | 2883±76.4de            |
| L3T1       | 5.28±0.11d                  | 6.49±0.03e                 | 2650±50.0cd            |
| L3T2       | 5.67±0.18e                  | 4.38±0.11c                 | 3150±50.0e             |
| L3T3       | 5.78±0.18e                  | 2.19±0.12a                 | 3850±567.9f            |

Note: Numbers followed by the same lowercase letters in the same column do not differ significantly at the 5% level, according to the DMRT test. L1T1 = 30 minutes soaking 5 minutes pregelatinization, L1T2 = 30 minutes soaking 10 minutes pregelatinization, L1T3 = 30 minutes soaking 15 minutes pregelatinization, L2T1 = 60 minutes soaking 5 minutes pregelatinization, L2T2 = 60 minutes soaking 10 minutes pregelatinization, L2T3 = 60 minutes soaking 15 minutes pregelatinization, L3T1 = 90 minutes soaking 5 minutes pregelatinization, L3T2 = 90 minutes soaking;10 minutes pregelatinization, L3T3 = 90 minutes soaking15 minutes pregelatinization)

Table 2 shows an increase in the rehydration capacity of instant corn porridge with longer soaking times in lime water and longer pregelatinization times. The highest rehydration capacity was found in the L3T3 treatment, while the lowest was in the L1T1 treatment. A 30-minute soaking time with 5-15 minutes of pregelatinization resulted in lower rehydration capacity, whereas a 90-minute soaking time with 10-15 minutes of pregelatinization resulted in higher rehydration capacity. This condition suggests that longer soaking and pregelatinization times cause the starch granules to swell, increasing the potential for water absorption during rehydration. According to Koswara (2009), starch granules can absorb up to 30% water during soaking without damaging their structure. This absorption percentage increases with heating; the longer the starch is heated (cooked), the more the starch granules gelatinize (Sugiyono et al., 2004). Research showed that pregelatinization can increase starch's absorption and swelling power (Ma et al., 2022).

#### *Rehydration time*

Results (Table 2) showed that soaking the corn grits in lime water for 30-90 minutes reduces the rehydration time. The DMRT test results show differences in rehydration time across all treatments. The shortest rehydration time was observed in the L3T3 treatment, which had the longest soaking and pregelatinization times. Using lime water as the soaking medium facilitates the gelatinization process of the starch granules during rehydration. This effect is because lime water softens the corn grit tissues, making it easier for water to penetrate the starch granules and hasten the gelatinization process. The boiling process in the lime water, or nixtamalization, changes the kernel composition due to heat and mass transfer (Ramírez-Araujo et al., 2019). Cooking breaks down the starch granules, and those that have undergone pregelatinization and drying can absorb water until the granules swell (Limonu, 2008). Grits cooked with longer pregelatinization times have more potential for granule swelling, leading to quicker gelatinization during rehydration. This fact aligns with Sugiyono et al. (2004), who noted that longer pregelatinization times create a more porous molecular structure, resulting in looser hydrogen bonds between molecules, which can bind more water molecules. Thus, extended cooking times can shorten the rehydration time.

#### *Viscosity*

The highest viscosity values are at the treatment of L3T3 (90-minute soaking treatment and a 15-minute pregelatinization time) with a value of 3850 cP, and the lowest viscosity is at the long L1T1 with a value of

1500 cP. The results of Table 2 show an increase in viscosity during the prolonged soaking of the lime water along with the long pregelatinization time of instant corn flour. The nixtamalization process can change the kernel's composition due to heat and mass exchange (Ramírez-Araujo et al., 2019). Extended soaking will soften the granules and make them more easily absorb water, leading to significant water absorption. This condition causes the granules to swell and increases the viscosity. Prolonged soaking can lead to an increase in water-soluble starch fractions, specifically amylose fractions. As a result, the amylose content will decrease with longer soaking times, while the amylopectin starch fractions will increase (Marta & Tensiska, 2017).

Besides the soaking effect, pregelatinization time, which is partial gelatinization, affects the viscosity. Starch granules swell to their maximum size during pregelatinization and create pores during drying. Consequently, if a viscosity test is performed, the water will be absorbed more readily, increasing viscosity. According to Wang et al. (2015) and Cappa et al. (2016), granular changes resulted in flour undergoing pregelatinization being able to absorb and increase viscosity. Ma et al. (2022) noted that pregelatinization can enhance the absorption and swelling power. When the granules reach their highest swelling capacity, interactions occur between them and the volume fraction outside the granules, which will be smaller, referred to as the close pack of starch. This state can increase viscosity and water-holding capacity (Marseno et al., 2022).

### **Syneresis**

Soaking in lime water for 30 – 90 minutes can reduce the syneresis of instant corn porridge (Table 3). ANOVA indicates that the soaking time in lime water significantly affects syneresis. In contrast, the pregelatinization time and the interaction between the two factors do not significantly affect ( $p>0.05$ ) the syneresis of instant corn porridge made from nixtamalized waxy corn.

**Table 3.** Syneresis test results for nixtamalized instant corn porridge

| Treatment | Syneresis (%) |
|-----------|---------------|
| L1        | 50.14±4.14c   |
| L2        | 41.97±2.38b   |
| L3        | 29.94±4.51a   |

Note: Numbers followed by the same lowercase letters in the same column did not differ significantly at the 5% level according to the DMRT test. Soaking for 30 minutes (L1), Soaking for 60 minutes (L2), Soaking for 90 minutes (L3)

Table 3 shows that the longer the soaking time in lime water, the lower the syneresis. Calcium ions function as cross-link agents, enhancing the three-dimensional structure and trapping the water, preventing it from being quickly released. According to Vega-Rojas et al. (2017), the physicochemical properties of starch can be altered by Van der Waals interactions between  $\text{Ca}^{2+}$  ions and starch, and stronger interactions between calcium and starch can result in stable starch crystallinity. The treatment with a 90-minute soaking time resulted in less syneresis compared to other treatments. It is likely because the granules have swelled to their maximum and trapped a significant amount of water, releasing less. According to Dipowaseso et al. (2018), products with minimal or no syneresis are of high quality as they can retain water well.

Among all the physical parameters observed in the nixtamalized instant waxy corn porridge, the L3T3 treatment had the highest calcium content, rehydration capacity, viscosity, the shortest rehydration time, and the lowest syneresis.

### **Sensory properties of nixtamalized instant waxy corn porridge**

ANOVA at a significance level of 0.05% shows that the soaking duration and pregelatinization time do not affect the taste of the instant corn porridge, and there is no interaction between the two factors. Based

on sensory test results, the taste of the instant corn porridge has a panelist preference level of around 4 (neutral). However, there is a tendency that the longer the soaking and pregelatinization time, the softer and more tender the resulting waxy corn will be, thus making the taste and texture more preferred by the panelists (Table 4). Waxy corn produces a soft, savory, tender, and delicious taste. The high amylopectin content, which ranges from 90% to 100% in waxy corn kernels, contributes to the pleasant, soft, and chewy texture (Suarni, 2009).

**Table 4.** Sensory test results for the taste of nixtamalized instant corn porridge

| Treatment | Pregelatinizes time (minute) |            |            |
|-----------|------------------------------|------------|------------|
|           | T1                           | T2         | T3         |
| L1        | 4.17±1.46a                   | 4.27±1.17a | 4.50±1.28a |
| L2        | 4.20±1.47a                   | 4.30±0.95a | 4.53±1.22a |
| L3        | 4.23±1.30a                   | 4.43±0.73a | 4.63±1.47a |

Note: Numbers followed by the same lowercase letters in the same column did not differ markedly at the 5% level, according to the DMRT test. Score 1 = strongly dislike, 4 = neither like nor dislike (neutral), and 7 = strongly like, L1 = 30 minutes soaking, L2 = 60 minutes soaking, L3 = 90 minutes soaking. T1 = 5 minutes pregelatinization, T2 = 10 minutes pregelatinization, T3 = 15 minutes pregelatinization.

The ANOVA for color and aroma indicates that pregelatinization time and interactions between factors do not affect the color and texture of instant corn porridge, but the soaking time does. Sensory tests for the color and texture of instant corn porridge show panelists' preference levels ranging from neutral to somewhat liked.

**Table 5.** Sensory test results for color, texture, and aroma of nixtamalized instant corn porridge

| Treatment | Color                  | Texture                 | Aroma                   |
|-----------|------------------------|-------------------------|-------------------------|
| L1        | 4.21±0.11 <sup>a</sup> | 4.33±0.20 <sup>a</sup>  |                         |
| L2        | 4.73±0.06 <sup>b</sup> | 4.51±0.27 <sup>ab</sup> |                         |
| L3        | 4.81±0.11 <sup>b</sup> | 4.86±0.08 <sup>b</sup>  |                         |
| T1        |                        |                         | 4.33±0.15 <sup>a</sup>  |
| T2        |                        |                         | 4.57±0.10 <sup>ab</sup> |
| T3        |                        |                         | 4.82±0.21 <sup>b</sup>  |

Note: Numbers followed by the same lowercase letters in the same column did not differ markedly at the 5% level, according to the DMRT test. Score 1 = strongly dislike, 4 = neither like nor dislike (neutral), and 7 = strongly like, L1 = 30 minutes soaking, L2 = 60 minutes soaking, L3 = 90 minutes soaking. T1 = 5 minutes pregelatinization, T2 = 10 minutes pregelatinization, T3 = 15 minutes pregelatinization

Longer soaking and pregelatinization times make the corn more likely to absorb Ca<sup>2+</sup> ions. A soaking time of 90 minutes results in a higher panelist preference for color, as the color of the waxy corn, the main ingredient of the instant porridge, can be preserved. Waxy corn has a milky white color similar to rice. This is in line with the research by Yunus et al. (2017), which found that papaya color can be preserved by soaking in Ca(OH)<sub>2</sub> due to the absorption of Ca<sup>2+</sup> ions by the material's tissue. Similarly, a 90-minute soaking time for sensory color results in the highest texture preference score of somewhat liked (4.86). Longer soaking and pregelatinization times make the corn softer. The texture of the nixtamalized instant waxy corn porridge is very thick, likely due to the high amylopectin content of the waxy corn. According to Fitriani & Astuti (2013), the abundant amylopectin structure with strong adhesive properties affects gel formation during the starch gelatinization process, giving it a chewy characteristic.

ANOVA results for the aroma of instant corn porridge show that soaking time does not affect the aroma. In contrast, pregelatinization time does influence the aroma of the instant corn porridge, although there is no interaction between the two factors. The highest panelist preference for aroma is for the 15-minute pregelatinization treatment, with a score of 4.82 (somewhat liked). The aroma of the instant corn porridge is likely influenced by the distinctive aroma of waxy corn, which becomes more pronounced with longer

pregelatinization times. On the other hand, the aroma of the nixtamalized instant waxy corn porridge remains regular with prolonged soaking in lime water, showing no difference among the soaking treatments. It is consistent with the findings of Tiurlan & Lukman (2013), which state that corn soaked in a saturated lime solution retains a typical smell.

## Conclusion

There is an interaction between soaking time in lime water and pregelatinization time on the rehydration capacity, rehydration time, and viscosity of the nixtamalized instant waxy corn porridge. Meanwhile, calcium content, syneresis, and sensory properties of the instant porridge are only influenced by one of the two factors (either soaking time or pregelatinization time). The best nixtamalized instant corn porridge is achieved with a 90-minute soaking time and a 15-minute pregelatinization time, resulting in the highest rehydration capacity, calcium content, and viscosity, the lowest syneresis, and the shortest rehydration time, with a neutral taste preference, while the panelists somewhat like color, texture, and aroma.

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