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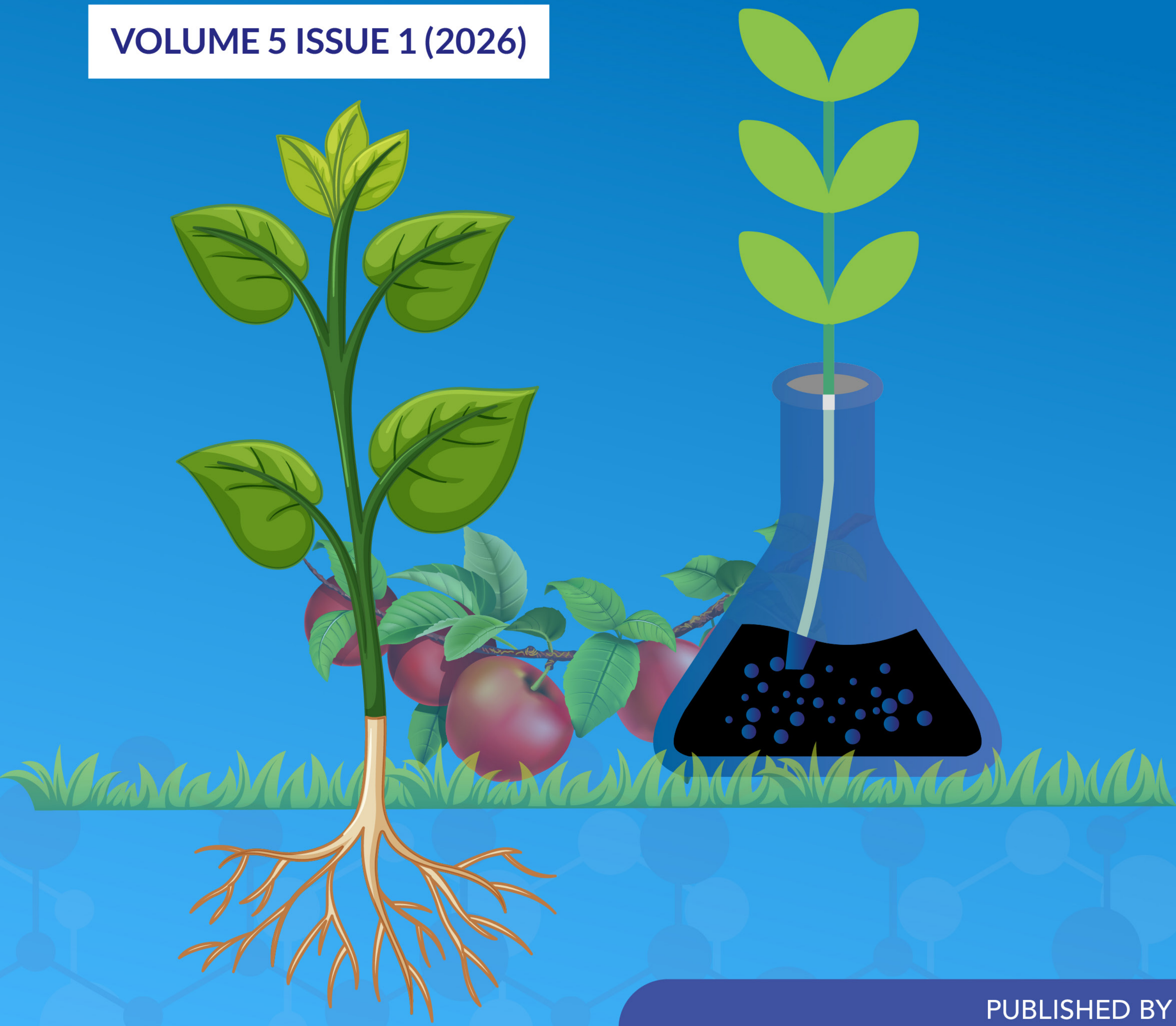

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Impact of the addition of hot water on the preparation of instant Maruchan soup

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ABSTRACT

The demand for dry instant soups has exhibited a marked increase among consumers, attributable to their expeditious preparation time, a feature that distinguishes them from conventional soups. Therefore, the objective of this work was to study the change that occurs in the physicochemical properties with the addition of hot water in the preparation of commercial instant Maruchan soup. The heated sample was prepared following the methodology recommended on the label. This consisted of adding hot water (95 °C) up to the mark on the container and resting for 3 min. The incorporation of hot water during the preparation of instant soup led to a decrease in WAI and WSI, with no statistical difference observed in OAC. Furthermore, the incorporation of hot water did not result in the formation of new bonds or alter the intensity of the bands in the FTIR analysis. A promising avenue for future research lies in the evaluation of the product's nutritional profile.

INTRODUCTION

Soup constitutes a fundamental component of the human diet. However, the transition to a contemporary lifestyle has rendered traditional soup preparations increasingly unattainable for contemporary consumers, primarily due to the extended duration required for its preparation (Liu *et al*., 2020). Conversely, the demand for dry instant soups has exhibited a marked increase among consumers, attributable to their expeditious preparation time, a feature that distinguishes them from conventional soups (Duan *et al*., 2010; Wang *et al*., 2010). Dried instant soups are a type of dehydrated product that is prepared by adding a mixture of fruits, vegetables, meat, fish, and seafood to hot water. Other dehydrated ingredients may also be incorporated (Li *et al*., 2022). In the dehydration process of soups, freeze-drying is one of the most widely used methods for preserving physicochemical characteristics. Moreover, foods dehydrated by this method can be rehydrated by adding water, thereby improving the final characteristics of the product (Raji *et al*., 2017). In addition, the extrusion process has been among the most widely utilized technologies for the production of instant foods, including soups. These foods undergo chemical and structural transformations, such as starch gelatinization (Téllez-Morales *et al*., 2020). The process of heating food products with a high starch content results in a structural change known as gelatinization. Consequently, it is imperative to understand the starch transition phases to ensure optimal food processing outcomes (Zaidul *et al*., 2008). Therefore, the objective of this work was to study the change that occurs in the physicochemical properties with the addition of hot water in the preparation of commercial instant Maruchan soup.

MATERIALS AND METHODS

Raw materials

The instant Maruchan soup (shrimp, lemon and habanero) was purchased at a supermarket in Mexico City.

Sample preparation

The raw sample was removed directly from the container and ground (Hamilton Beach, China) to a fine powder, which was stored at room temperature until further analysis. On the other hand, the heated sample was prepared following the methodology recommended on the label. This consisted of adding hot water (95 °C) up to the mark on the container and resting for 3 min. Subsequently, the soup was removed from the container and the entire contents were dried for 24 h at 35 °C (AFOS MINI KILN, England). The dry sample was ground (Hamilton Beach, China) to a fine powder, which was stored at room temperature for further analysis.

Physicochemical properties

Water absorption index (WAI), water solubility index (WSI) and oil absorption capacity (OAC) were evaluated following the methodologies described in a previous article (Téllez-Morales *et al*., 2020).

Fourier transform infrared spectroscopy (FTIR)

Fourier transform infrared spectroscopy (FTIR) was used to identify the functional groups present (Agilent IR spectrometer, model Cary 630). It was then analysed in absorbance mode. Spectra were collected with 128 scans at a resolution of 4 cm^{-1} in the range 4000 to 650 cm^{-1}. The MicroLab PC-Agilent software was used to obtain the spectra. Subsequently, baseline correction and curve

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smoothing were carried out with OriginPro 8 software.

Rheological properties

Samples (2 g) were combined with 18 mL of distilled water in the sample holder of the Discovery HR-3 Rheometer. The temperature was held at 25 °C for 60 s, heated to 95 °C at 10 °C/min, held at 95 °C for 360 s, cooled to 50 °C at 10 °C/min, and held for 300 s at 50°C, the rheometer paddle was rotating at a constant speed of 16.78 rad/s. The manufacturer's methodology was followed for both calibration and analysis and the graphs were obtained with OriginPro 8 software.

Thermal properties by DSC

The thermal characteristics of the samples were studied using a differential scanning calorimeter (DSC Q2000, TA Instruments Waters, Newcastle, USA) following the manufacturer's methodology for both calibration and analysis. The sample (3 mg) was loaded into a pan of 40 μL capacity and 9 μL of distilled water was added. The samples were hermetically sealed and allowed to stand for 24 h at room temperature before heating in the DSC. An empty pan was used as a reference. The sample pans were heated at a rate of 5 °C/min from 25 °C to 110 °C.

Statistical analysis

The results were examined statistically (mean ± standard deviation), and the significant difference was studied by one-way analysis of variance at 95% confidence level using Fisher's between-means test using OriginPro 8 software.

RESULTS AND DISCUSSION

Water absorption index (WAI) and Water solubility index (WSI)

As demonstrated in Figure 1, the addition of hot water to the product exhibited a statistically significant decrease in the water absorption index (WAI) and the water solubility index (WSI) in both the WAI and WSI. This phenomenon can be attributed to the increased formation of small molecules in the heated sample, resulting from starch degradation, which consequently reduced its water absorption capacity (Majzoobi *et al.*, 2016). In contrast, the sample that was not subjected to heat exhibited a different response. Conversely, it can be posited that the chemical reaction exhibited by the heated sample, when prepared according to the stipulated preparation mode, was influenced by the presence of additives (salts). Abedi and Pourmohammadi (2020) reported that sodium chloride exerts its effect by preventing water from entering the starch granules, thereby reducing WAI. Research has demonstrated that elevated temperatures result in the deterioration of the starch structure, thereby diminishing its swelling power and solubility (Gul *et al.*, 2014).

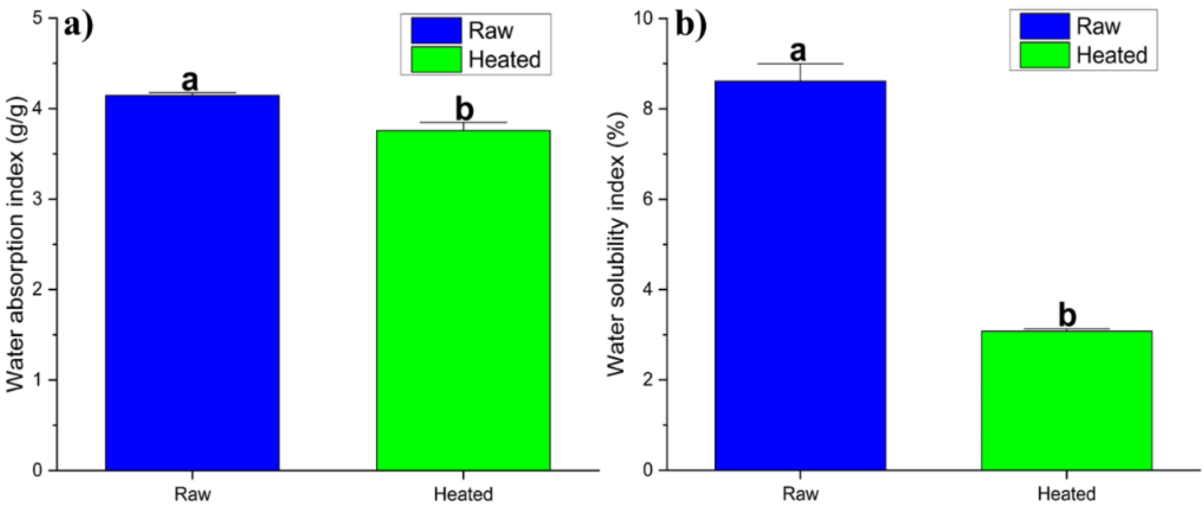

Figure 1. Water absorption index (WAI) and b) Water solubility index (WSI). Columns with different letters are significantly different (P <0.05).

Oil absorption capacity (OAC)

As demonstrated in Figure 2, the OAC of the samples exhibited no statistically significant variation, indicating that the incorporation of hot water during its preparation did not exert an influence on this property. It is imperative to acknowledge the correlation between OAC and the non-polar side chains of proteins. A low OAC index has been demonstrated to be a favorable indicator, exhibiting a correlation with a reduced likelihood of developing various types of cancer (Tellez-Morales *et al.*, 2020; Bento *et al.*, 2021). OAC measures the trapping of triacylglycerides that act as a flavor retainer, improving the palatability of foods (Bento *et al.*, 2021).

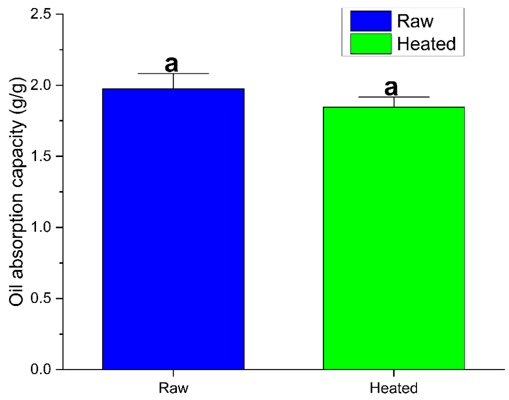

Figure 2. Oil absorption capacity (OAC). Columns with different letters are significantly different (P <0.05).

Fourier transform infrared spectroscopy (FTIR)

The infrared spectrum is a valuable tool for analysing the structural characteristics of chemical and functional groups within molecules. These groups exhibit specific vibrational or absorptive phenomena when exposed to infrared light. Due to its predominant composition of hydrogen bonds, starch offers a particularly suitable subject for FTIR analysis. The structural changes associated with gelatinization and retrogradation of starch can be discerned through the narrowing and intensity changes of specific bands in the FTIR spectrum (Chen *et al.*, 2023). As illustrated in Figure 3, the spectra demonstrated absorption peaks at 1000, 1750, and 2900 cm^{-1} for both samples. This finding suggests that the incorporation of water during their preparation did not induce alterations in the formation of new bonds or the intensity of the bands. In the fingerprint range of 1200 to 800 cm^{-1}, the predominant vibrations are C-C and C-O stretching vibrations. This range exhibits sensitivity to the physical state of the starch (Wang *et al.*, 2022). In contrast, the 1047-1016 cm^{-1} range demonstrates sensitivity to changes in the crystalline structure and the amorphous region. As posited by Liu *et al.* (2019), the absorption peaks at 3600–3000, 2950–2850, and 1630 cm^{-1} correspond to hydrogen bonds, stretching -CH, and crystalline water in starch, respectively.

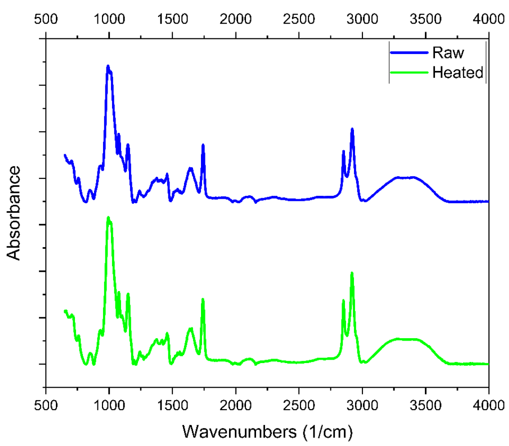

Figure 3. Fourier transform infrared spectroscopy.

Viscosity profile

As demonstrated in Figure 4, the viscosity ramp exhibits a maximum viscosity of 0.13 Pa.s in both samples at the maximum time point. This suggests an apparent increase, although these values are relatively low. Consequently, this reduced viscosity may be attributable to the disruption of starch granules and the denaturation of proteins present in the shrimp and/or vegetables. This process, involving the breakdown of these components, results in a weakened water retention capacity, leading to the formation of a gel-like structure. These phenomena are a consequence of the product's processing. This is confirmed by its null thermal properties in Figure 5. Balet *et al.* (2019) stated that an increase in temperature leads to an increase in the aggressive swelling of the native starch granule, which in turn increases the viscosity as the gel forms. Conversely, during the cooling ramp, the reassociation between starch molecules, predominantly amylose, gives rise to the formation of a gel, thereby augmenting viscosity. This phase is designated as the retrogradation region and is associated with the retrogradation and rearrangement of starch molecules. Retrogradation signifies the gelling capacity or tendency to retrograde amylose in starches (Lei *et al.*, 2008).

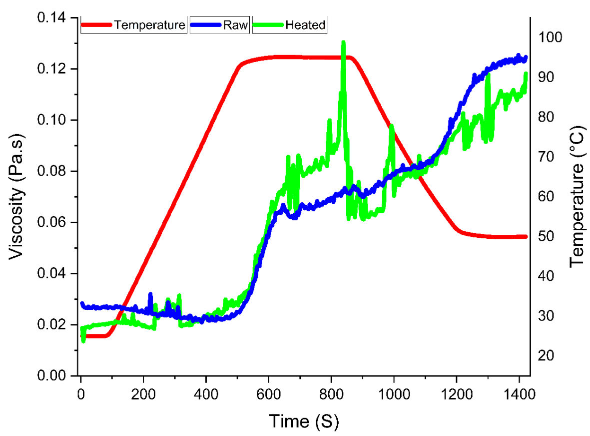

Figure 4. Viscosity profile.

Propiedades térmicas por DSC

As illustrated in Figure 5, the thermogram reveals that no endotherms were observed, indicating that the structure of the starch granules remained unchanged following the addition of hot water. This outcome is likely attributable to the gelatinization of the starch granules during the manufacturing process of the product, suggesting that the addition of hot water did not induce any significant structural changes to the starch granules. Endotherms that could be due to a change in the structure of the proteins that are present were also not observed, demonstrating that they are denatured.

CONCLUSION

In summary, the incorporation of hot water during the preparation of instant soup led to a decrease in WAI and WSI, with no statistical difference observed in OAC.

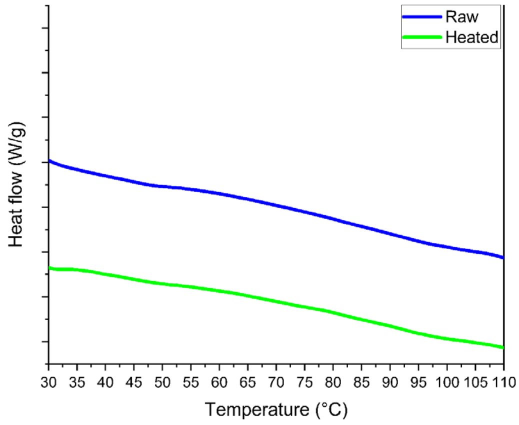

Figure 5. DSC thermogram

Furthermore, the incorporation of hot water did not result in the formation of new bonds or alter the intensity of the bands in the FTIR analysis. The viscosity profile and thermal properties of the samples were found to be analogous, indicating that the addition of hot water did not elicit a response attributable to the manufacturing process. Consequently, the product is prepared in advance, as indicated on the label, with the intention of being cooked in hot water and maintaining the food at an optimal temperature for immediate consumption. A promising avenue for future research lies in the evaluation of the product's nutritional profile.

REFERENCES

Abedi, E., & Pourmohammadi, K. (2020). Aggregation behaviors of sonicated tapioca starch with various strengths of Hofmeister salts under pre-and post-ultrasonic treatment. *Food Hydrocolloids, 105,* 105826. https://doi.org/10.1016/j.foodhyd.2020.105826

Balet, S., Guelpa, A., Fox, G., & Manley, M. (2019). Rapid Visco Analyser (RVA) as a tool for measuring starch-related physiochemical properties in cereals: A review. *Food Analytical Methods, 12,* 2344-2360. https://doi.org/10.1007/s12161-019-01581-w

Bento, J. A. C., Bassinello, P. Z., Morais, D. K., de Souza Neto, M. A., Bataus, L. A. M., Carvalho, R. N., ... & Júnior, M. S. S. (2021). Pre-gelatinized flours of black and carioca bean by-products: Development of gluten-free instant pasta and baked snacks. *International Journal of Gastronomy and Food Science, 25,* 100383. https://doi.org/10.1016/j.ijgfs.2021.100383

Chen, L., Yang, S., Nan, Z., Li, Y., Ma, J., Ding, J., ... & Yang, J. (2023). Detection of dextran, maltodextrin and soluble starch in the adulterated Lycium barbarum polysaccharides (LBPs) using Fourier-transform infrared spectroscopy (FTIR) and machine learning models. *Heliyon, 9*(6). https://doi.org/10.1016/j.heliyon.2023.e17115

Duan, X., Zhang, M., Mujumdar, A. S., & Wang, R. (2010). Trends in microwave-assisted freeze drying of foods. *Drying Technology, 28*(4), 444-453. https://doi.org/10.1080/07373931003609666

Gul, K., Riar, C. S., Bala, A., & Sibian, M. S. (2014). Effect of ionic gums and dry heating on physicochemical, morphological, thermal and pasting properties of water chestnut starch. *LWT, 59*(1), 348-355. https://doi.org/10.1016/j.lwt.2014.04.060

Lei, F. U., Tian, J. C., Sun, C. L., & Chun, L. I. (2008). RVA and farinograph properties study on blends of resistant starch and wheat flour. *Agricultural Sciences in China, 7*(7), 812-822. https://doi.org/10.1016/S1671-2927(08)60118-2

Li, Y., Li, J., & Fan, L. (2022). Effects of combined drying methods on physicochemical and rheological properties of instant Tremella fuciformis soup. *Food Chemistry, 396,* 133644. https://doi.org/10.1016/j.foodchem.2022.133644

Liu, W., Zhang, M., Devahastin, S., & Wang, W. (2020). Establishment of a hybrid drying strategy for instant cream mushroom soup based on starch retrogradation behavior. *International Journal of Biological Macromolecules, 147,* 463-472. https://doi.org/10.1016/j.ijbiomac.2020.01.084

Liu, Y., Wang, X., Li, X., Ma, Z., Liu, L., & Hu, X. (2019). Chinese steamed bread: Packaging conditions and starch retrogradation. *Cereal Chemistry, 96*(1), 95-103. https://doi.org/10.1002/cche.10112

Majzoobi, M., Kaveh, Z., & Farahnaky, A. (2016). Effect of acetic acid on physical properties of pregelatinized wheat and corn starch gels. *Food Chemistry, 196,* 720-725. https://doi.org/10.1016/j.foodchem.2015.09.096

Raji, A. O., Akinoso, R., Aruna, T. E., & Raji, M. O. (2017). Reconstitution potentials and moisture sorption isotherms of selected freeze dried Nigerian soups. *Journal of Food Process Engineering, 40*(4), e12516. https://doi.org/10.1111/jfpe.12516

Téllez-Morales, J. A., Herman-Lara, E., Gómez-Aldapa, C. A., & Rodríguez-Miranda, J. (2020). Techno-functional properties of the starch-protein interaction during extrusion-cooking of a model system (corn starch and whey protein isolate). *LWT, 132,* 109789. https://doi.org/10.1016/j.lwt.2020.109789

Wang, B., Dong, Y., Fang, Y., Gao, W., Kang, X., Liu, P., ... & Abd El-Aty, A. M. (2022). Effects of different moisture contents on the structure and properties of corn starch during extrusion. *Food Chemistry, 368,* 130804. https://doi.org/10.1016/j.foodchem.2021.130804

Wang, R., Zhang, M., & Mujumdar, A. S. (2010). Effect of food ingredient on microwave freeze drying of instant vegetable soup. *LWT, 43*(7), 1144-1150. https://doi.org/10.1016/j.lwt.2010.03.007

Zaidul, I. S. M., Absar, N., Kim, S. J., Suzuki, T., Karim, A. A., Yamauchi, H., & Noda, T. (2008). DSC study of mixtures of wheat flour and potato, sweet potato, cassava, and yam starches. *Journal of Food Engineering, 86*(1), 68-73. https://doi.org/10.1016/j.jfoodeng.2007.09.011