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A Comprehensive Review on Drying Kinetics of Common Corn *(Zea mays)* Crops in the Philippines

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INTRODUCTION & AIM

A variety of its multitude of nutritional components, corn is regarded as a vital agricultural product and is widely grown around the world. Fresh kernels of corn would be vulnerable to a variety of degeneration processes upon storage as a result of its water-rich properties, which would lower the concentration of nutrients. The samples' enormous density and robust epidermal framework, nevertheless, reduces the effectiveness of water diffusion during treatment.

In the Philippines, corn is also regarded as a staple crop. The country has six common types of corn, this includes: ***(a) Sweet corn, (b) Wild Violet corn, (c) White Lagkitan, (d) Visayan White corn, (e) Purple corn, and (f) Young corn***. The drying process reduces moisture, preventing microbial growth and deterioration, and is essential for maintaining its nutritional value and flavor. Understanding the drying kinetics of sweet corn is key to optimizing storage conditions and ensuring its quality.

Figure 1. Common corn *(Zea Mays)* crops in the Philippines: (a) Sweet corn, (b) Wild Violet corn, (c) White Lagkitan, (d) Visayan White corn, (e) Purple corn, and (f) Young corn

METHODOLOGY

This study investigates the effects of process parameters and pretreatment methods on the drying rate of common corn crops, as well as the application of kinetic models to describe moisture content changes during drying.

Effects of Process Parameters on the Drying Rate of Common Corn Crops

This study investigates the impact of key drying parameters - *temperature, air velocity, relative humidity, kernel size, and air pressure* - on the drying rate and efficiency of corn. Controlled drying experiments will vary these parameters, with moisture content measured at regular intervals to assess their effects. The findings will provide insights into optimal drying conditions and enhance the understanding of moisture removal mechanisms in corn drying.

Effects of Pretreatment on the Drying Rate of Common Corn Crops

This study examines the effects of pretreatment methods (blanching, steam blanching, osmotic dehydration, microwave, and ultrasonic) on the drying rate of corn. Each pretreatment will be applied to corn kernels, which will then be dried at 60°C. Moisture content will be measured at intervals to assess drying efficiency, and statistical analysis will compare the effectiveness of these methods on drying time and moisture removal.

Drying Kinetics Modelling of Common Corn Crops

In this context, the use of drying kinetics modeling proves to be an indispensable tool that allows a quantitative and systematic understanding of the physicochemical transformations that occur during the drying process.
The different kinetic models used in drying corn crops are listed in table 2.

Weilbull and Pelleg Model

$$X_{wt} = X_{eq} + (X_{w0} - X_{eq}) \exp[-(\frac{t}{\beta})^{\alpha}]$$

$$X_{wt} = X_{wt} + [\frac{t}{k_1 + (k_2 t)}]$$

Pelleg Model

$$M_t = M_0 + \frac{t}{K_1 + K_2 t}$$

Midili Kucuk Model

$$MR = \frac{M_t - M_e}{M_0 - M_e}$$

Mixed Flow Dryers

$$MR = \exp(-kt)$$

$$MR = \exp(-kt^n)$$

Page Model on Dry Basis

$$M_t = \frac{(W_0 - W) - W_1}{W_1} x\, 100$$

Tunnel Dryer on Wet Basis

$$M_w = \left(\frac{W - d}{W}\right) x\, 100$$

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RESULTS & DISCUSSION

Effects of Process Parameters on the Drying Rate of Common Corn Crops

Higher temperatures (optimal at 60°C), increased air velocity, lower humidity, smaller kernels, and thinner layers all enhance drying efficiency. However, careful management is needed to prevent damage and maintain corn quality.

Table 1. Summary of effects of process parameters on drying of corn

Process Parameters	Effects on Drying	Reference
Temperature	Increased temperature, increases drying rate.	Ogan, 2021
Air Velocity	Excessive air velocity causes damage and/or uneven drying.	Tuncel et al., 2010
Relative humidity	Lower relative humidity increases drying rate.	Cosme-De Vera et al., 2021
Thickness of corn layer	Smaller-sized kernels dry faster than larger-sized kernels.	Sun et al., 2016
Initial moisture content	Lower initial moisture content increases drying rate and increases overall efficiency.	Wang et al., 2023

Effects of Pretreatment on the Drying Rate of Common Corn Crops

Pretreatment methods like blanching, steam blanching, osmotic dehydration, microwave, and ultrasonic treatments enhance corn drying rates by modifying its structure and moisture content. These methods improve moisture evaporation, reduce drying time, and help maintain corn quality. Optimizing these pretreatments can significantly improve drying efficiency, highlighting their potential for advanced agricultural processing.

Drying Kinetics Modelling of Common Corn Crops

The study of drying kinetics in common corn is crucial for optimizing drying conditions and ensuring high-quality corn products. By accurately modeling these kinetics, the drying process can be controlled to minimize drying time and preserve corn quality across various types of corn, as summarized in Table 2.

Table 2. Summary of kinetic modeling of common corn crops

Corn Sample	Kinetic Modeling	Reference
Sweet Corn	Weibull and Peleg model	Nayi et al., 2023
Visayan White Corn	Peleg model	Uriarte-Aceves and Sopade, 2021
White Lagkitan Corn	Midilli Kucuk model	Akowuah et al., 2021
Purple Corn	Lewis and Page model	Mondal et al., 2024
Wild Violet Corn	Tunnel dryer	Char Mongkolpradit et al., 2021
Young Corn	Modified Page model	Kumar and Saka, 2021

CONCLUSION

The drying process is crucial for preserving the quality and shelf life of corn crops. Understanding how various parameters such as temperature, airflow, humidity, corn size, and air pressure affect the drying rate is key to optimizing the process and maintaining product quality. Proper management of these factors ensures efficient moisture removal and minimizes drying time. Further research and development of accurate kinetic models will enhance drying techniques, leading to improved corn processing and high-quality maize-based products for diverse industries.

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