IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Impact Factor: 7.301

Volume 3, Issue 1, August 2023

Effects of Solar Drying Process Parameters on the Quality of Edible Mushrooms: A Review

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Abstract: *Edible mushrooms are highly valued for their nutritional and culinary benefits. It is commonly consumed worldwide because they are a potential non-animal source of vitamins. Drying is a widely used preservation method to extend their shelf life and retain their valuable properties. Solar dryers have the potential to revolutionize mushroom processing by providing a sustainable, cost-effective, and nutritionally rich solution. The drying process significantly impacts the quality attributes of mushrooms, such as texture, color, flavor, and nutritional content. The present research work provides a comprehensive review of the effects of drying process parameters for the drying of edible mushrooms in the case of various solar drying methods. Each method involves distinct process parameters, such as temperature, air velocity, relative humidity, and drying time. These parameters influence the drying rate, drying kinetics, and overall product quality. Several studies have shown that the choice of drying method and specific process parameters can greatly affect the final product quality.*

Keywords: Solar Drying; Process Parameter; Dried Mushroom; Solar energy

I. INTRODUCTION

Mushrooms are usually treated as a vegetable in culinary practise; however, they are not a plant and reside in their own biological kingdom, namely fungi. Unlike plant foods, edible fungi are rich in ergosterol, also known as pro-vitamin D_2 (Cardwell et al., 2018; Jasinghe et al., 2007). It is characterized by huge, visible, and easily harvested fruiting bodies that may be either epigeous (found above ground) or hypogeous (found below ground). There is evidence that proves that tropical mushrooms are particularly rich in a number of nutrients (Perez-Moreno et al., 2021; Chugh et al., 2022). Mushrooms are recommended as a healthy food for those with heart disease or who are at risk for developing a lipid-induced ailment because of their low fat and oil content (Martinez-Medina et al., 2021).

Dried mushrooms are a valuable source of vitamins after rehydration and cooking (Jasinghe et al., 2007). Drying is a widely adopted preservation technique that effectively prolongs the shelf life of mushrooms while retaining their valuable properties. The drying process involves the removal of water content from the mushrooms, thereby inhibiting microbial growth and enzymatic reactions responsible for spoilage. The quality of dried mushrooms is a critical factor that determines their acceptability in the market and their nutritional value to consumers. Various drying methods and process parameters significantly influence the final quality of dried mushrooms. It is imperative to understand how these parameters impact the sensory attributes, nutritional content, and overall quality of the end product to optimize the drying process for different mushroom varieties (Martinez-Medina et al., 2021). This comprehensive review aims to explore the effects of different drying process parameters on the quality of edible mushrooms. The main process parameters are temperature, air velocity, relative humidity, and drying time for the drying study of any material. Each of these parameters plays a significant role in determining the drying kinetics and the subsequent changes in the physicochemical properties of mushrooms (Chugh et al., 2022). By carefully controlling these parameters, it is possible to minimize quality degradation and ensure that dried mushrooms retain their nutritional value and sensory appeal. Moreover, this review will shed light on pre-treatments that can be employed before the drying process to enhance the overall quality of dried mushrooms. Pre-treatments, such as blanching or osmotic dehydration, can improve the drying efficiency and preserve the natural colors, flavors, and nutrients of mushrooms, thereby enhancing their commercial viability (Jasinghe et al., 2007).

II. LITERATURE REVIEW

The use of edible mushrooms can help to counteract the homogenization of diets and decreasing resilience of food systems. We performed a systematic review to consolidate information about perceptions of edible mushroom changes from the perspective of local communities. We found that 92% of all perceived changes of wild edibles relate to their decreased abundance. 76% of the wild edibles with perceived decreased abundance are fruits and vegetables and 23% crop wild relatives. The main drivers of decreased abundance are perceived to be land use change (38% of all taxa) and direct exploitation (31%). These changes have potential negative implications on food systems from local to global scales (Schunko et al., 2022). Health consciousness has been increasing gradually in the entire world during the last three decades. Naturally and artificially produced medicines are consumed by the people for curing short and long-term diseases. Many natural medicines and some of the artificial medicines are produced using medicinal herbs and plants. Direct and indirect usage of medicinal herbs require a special conditioning and drying. The moisture present in the herbs and other parts of medicinal plants need to be reduced or removed without affecting their quality for medicinal use. Drying offers improved shelf life, reduced density, and low transportation cost. In recent years, the application of solar dryers for drying medicinal herbs has been explored (Rao et al., 2021; Mezrhab et al., 2010).

Agricultural products such as coffee, tobacco, tea, fruit, cocoa beans, rice, nuts, and timber generally require drying through a consistent application of relatively low heat. Traditionally, crop drying has been accomplished by burning wood and fossil fuels in ovens or open air drying under screened sunlight (Musembi et al., 2016). These methods, however, have their short comings. The former is expensive and damages the environment and the latter is susceptible to the variety and unpredictability of the weather. Solar crop drying is a happy medium between these two methods and it dries crops with more efficiency, uniformity, and less expense. A solar crop drying system does not solely depend on solar energy to function; it combines fuel burning with the energy of the sun, thus reducing fossil fuel consumption. The various designs of solar dryers, its types and performance analysis are reviewed. Special attention is given to the solar drying technologies that facilitate drying of crops in off-sunshine hours. The solar dryers specifically designed or tested using specific crops like the vegetable dryer, fruit dryer, grain dryer, grape dryer, etc. (Ramana et al., 2012).

Global demand for dried mushrooms continuously increases so understanding the effects of drying process parameters on their quality becomes even more vital for the mushroom industry. This review aims to provide valuable insights into the impact of drying methods and process parameters on the quality of edible mushrooms, aiding researchers, producers, and consumers in making informed decisions for optimizing the drying process and ensuring the availability of high-quality dried mushrooms with extended shelf life and enhanced nutritional value.

Influence of Process Parameters

The influence of process parameters on the drying of edible mushrooms is significant, as these parameters directly affect the drying kinetics, product quality, and overall efficiency of the drying process. Here, we will analyze the effects of key process parameters on the drying of mushrooms:

3.1 Temperature: Temperature plays a crucial role in the drying process, as it affects the rate of moisture evaporation. Higher temperatures generally result in faster drying rates, reducing the overall drying time (Thanaraj et a., 2007). However, excessive heat can lead to the degradation of heat-sensitive nutrients, enzymatic browning, and changes in the sensory attributes of mushrooms (Ramana et al., 2012). Finding the optimal drying temperature for different mushroom varieties is essential to achieve the desired drying efficiency while preserving quality (Mezrhab et al., 2010; Verma et al., 2016).

3.2 Air Velocity: Air velocity determines how quickly moist air is replaced with dry air around the mushrooms during drying. Higher air velocity enhances the moisture removal rate, leading to faster drying (Mohanraj, 2014). However, excessive air velocity may cause mechanical damage to the mushrooms or lead to uneven drying. Proper control of air velocity is crucial to ensure uniform drying and minimize quality deterioration (ELkhadraoui et al. 2015).

3.3 Relative Humidity: Relative humidity (RH) refers to the amount of moisture present in the air relative to its saturation point at a given temperature. Lower relative humidity accelerates the drying process by increasing the moisture gradient between the product and the surrounding air (Musembi et al., 2018). High humidity levels can hinder moisture evaporation, leading to prolonged drying times and potential microbial growth. Maintaining optimal RH levels is essential to achieve efficient drying while preventing quality issues (Hossain et al., 2008; Mezrhab et al., 2010).

3.4 Drying Time: The total duration of the drying process directly impacts the final quality of the dried mushrooms. Longer drying times may lead to over-drying and a reduction in product quality. Conversely, insufficient drying time can result in residual moisture, leading to spoilage during storage. Determining the appropriate drying time for each mushroom variety is crucial to achieve the desired moisture content and preserve product quality (Mishra et al., 2020; Thanaraj et al., 2007).

IV. CONCLUSION

Overall, the comprehensive review provides valuable insights into the effects of drying process parameters on the quality of edible mushrooms. By considering the identified challenges and exploring future prospects, the mushroom industry can advance its drying practices, offering premium dried mushroom products with enhanced sensory attributes, extended shelf life, and preserved nutritional value. Temperature and pre-treatments were identified as key factors affecting both the drying efficiency and quality of dried mushrooms. Careful temperature control is crucial to prevent nutrient degradation and ensure desirable sensory attributes. Pre-treatments, especially blanching and osmotic dehydration can be advantageous in enhancing drying efficiency and preserving product quality.

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