Tropentag, September 10-12, 2025, hybrid conference

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Convective drying dynamics of onion flower stalks: Quality retention and powder property enhancement

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Abstract

Onion flower stalk (OFS), an agricultural by-product of onion cultivation, has become a popular and widely consumed green vegetable in recent years due to its high dietary fibre, phytochemical content and associated health benefits. It is also used as a spice in stews and soups, either as a substitute for onion bulb or in combination because of its mild onion flavour. However, OFS is highly perishable, causing huge post-harvest losses due to its high moisture content. Therefore, valorisation of OFS through drying would help to reduce post-harvest losses and increase its application in the food industry. This study investigated the effect of material handling methods (split and unsplit) and hot air-drying temperatures (45–55 °C) as processing parameters on the drying kinetics, rehydration ratio (RR) of the dried OFS, bioactive compounds and functional properties of OFS powder. The material preparation method and drying air temperature significantly ($p < 0.001$) influenced the drying and quality attributes of the dried OFS. The drying process followed a falling rate pattern, with higher drying rates observed in split samples dried at 55 °C. Splitting the OFS significantly enhanced drying efficiency, reducing drying time by 31 % to 46 %. The dried OFS samples exhibited high hydration properties, with maximum RR values of 6.67 and 7.20 after 75 min of rehydration. The OFS powder contained total carotenoids, total phenolic content, and total flavonoid contents ranging from 12.14 to 13.95 mg/100g dry basis (d.b.), 387.3 to 443.29 mg GAE/100 g d.b., and 227.45 to 293.67 mg QE/100 g d.b., respectively. Furthermore, the OFS powder showed high DPPH free radical scavenging activity, ranging from 74.9 % to 88.4 %. Drying unsplit OFS at 55 °C optimised bioactive compounds retention. The OFS powder exhibited a green hue (112° to 115°), and good flowability with a Hausner ratio and Carr index values of 17.23 % to 17.74 % and 1.21 to 1.22, respectively. Additionally, the OFS powder had water activity between 0.247 and 0.258, indicating its safety from biochemical and microbial spoilage. The findings highlight the potential of OFS as a functional food ingredient for both household and industrial applications.

Keywords: Antioxidant activity, bioactive compounds, drying, onion flower stalk, rehydration ratio

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