National Institute of Technology Rourkela

Defence Seminar

Seminar Title	: Development of Process for Improving Functionality of Little Millet Flour Using Cold Plasma
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Venue	: CH-113 (Department of Food Process Engineering) (& Hybrid Mode)
Date and Time	: 04 Mar 2025 (16.15 hr)
Abstract	: The abundant production of little millet in India and having a rich nutritional profile, prompting a need for scientific interventions to optimize its utility compare to other primary cereal crops. This study investigates the effects of cold plasma on the functionality of little millet flour (LMF) for value addition. LMF was treated at applied voltages of 10 and 20 kV with treatment times of 10, 20, and 30 min. Functional characteristics such as oil absorption capacity, water absorption capacity, swelling capacity, and solubility index were enhanced significantly ($p<0.05$) by plasma treatment from 1.10 to 1.35 g/g, 1.34 to 1.51 g/g, 2.92 to 4.23 g/g and 0.054 to 0.085 g/g respectively, while physical properties such as bulk density, dispersibility remained unchanged and not significant. Microstructural analysis showed starch granule breakdown, and X-ray diffraction indicated decreased crystallinity from 47.98 % to 43.97% due to starch depolymerization by reactive oxygen and nitrogen species. Rheological studies using varying voltages (10 – 20 kV) and durations (10, 20 & 30 min) demonstrated that plasma-treated LMF exhibited improved storage and loss moduli and pseudoplastic behavior, fitting the Herschel-Bulkley model with $R2>0.99$. Comparison studies such as functional rheological properties conducted between the direct plasma and the plasma activated water treatment. Enhanced functional characteristics, particularly in samples treated with multipin cold plasma at 15 kV for 30 min. Plasma treatment also enhanced total phenolic content and antioxidant activity significantly ($p<0.05$) from 527.54 ± 8.94 to 575.82 ± 3.58 mg gallic acid equivalent /100 g, and 14.39±0.77 to 22.94± 1.84% respectively. On the other hand, anti-nutritional factors like tannins and saponins (226.96±27.54 to 135.65 ± 2.90 mg tannic acid/100 g of d.m and 454.33±50.75 to 190.15±35.82 mg diosgenin/100 g of d.m) were reduced and significantly differed at $p<0.05$. Besides moisture, ash and fat content of millet flour didn't have a significant difference for all treated voltage and times. However, protein and carbohydrate contents were increased with a rise in applied voltage and treatment time. The optimized conditions for all properties were obtained at 20 kV and 20 min. Accelerated storage studies were conducted at 40ºC & 90% RH, the treated flour had a shelf life of 2.52 months in high density polyethylene (HDPE) and 0.77 months in low density polyethylene (LDPE) packaging, while the untreated flour had a shelf life of 2.45 months in HDPE and 0.75 months in LDPE. Pasta was prepared by incorporating 10% and 20% LMF with and without plasma treatment. Color parameters, such as the L-value and whiteness index, were improved in the treated pasta samples and were close to the control. Optimal cooking time was decreased in treated pasta than untreated pasta samples. Instrumental analysis such as infrared spectra, diffractograms, thermographs and micrographs were analyzed. These results highlight the potential of plasma treatment to enhance the functionality and rheological parameters of LMF, suggesting its application in diverse food products.