National Institute of Technology Rourkela

Synopsis Seminar

Seminar Title	: Development of a Process for Improving Functionality of Little Millet Flour Using Cold Plasma
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Venue	: CH-113 (Department of Food Process Engineering)
Date and Time	: 20 Nov 2024 (11:30 AM)
Abstract	: The abundant production of little millet in India and having 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 multipin electrical discharge atmospheric cold plasma treatment on the functional properties of little millet flour for value addition. Little millet flour (LMF) was treated at powers of 10 and 20 kV with exposure times of 10, 20, and 30 minutes. Functional properties such as water and oil absorption capacity, swelling capacity, and solubility index were enhanced significantly ($p<0.05$) by plasma treatment from 1.34 &ndash 1.51 g/g, 1.10 &ndash 1.35 g/g, 2.92 &ndash 4.23 g/g and 0.054 &ndash 0.085 g/g respectively, while physical properties such as bulk density, dispersibility remained unchanged. 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 &ndash 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 an $R^2 > 0.99$. Studies comparing the functional and rheological properties of little millet flour using direct plasma and plasma activated water were determined. Enhanced functional properties such as water absorption capacity, solubility index, and emulsification stability were observed, particularly in samples treated with direct plasma at 15 kV for 30 minutes. Plasma treatment also increased total phenolic content significantly ($p<0.05$) and antioxidant activity from 527.54 ± 8.94 to 575.82 ± 3.58 mg GAE/100 g, and 14.39±0.77 to 22.94±1.84 %, respectively. On other hand, anti-nutritional factors such as tannins (226.96±27.54 to 135.65±2.90 mg tannic acid/ 100 g of d.m) and saponins (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, fat and ash content of millet flour didn&rsquot have significant difference for all treated voltage and times. However, protein and carbohydrate was found to be increased with an increased in applied voltage and treatment time. The optimized conditions for all properties was obtained at 20 kV 20 min. Accelerated storage studies were conducted at 40°C and 90% RH, and found that the treated flour had a shelf life of 2.52 months in HDPE and 0.77 months in LDPE packaging, while the control flour had a shelf life of 2.45 months in HDPE and 0.75 months in LDPE. Pasta was made using incorporation of 10% and 20% little millet flour with and without plasma treatment. Color parameters, such as the L value and whiteness index, were improved in the treated pasta samples and close to control. Optimal cooking time (OCT) was decreased in treated pasta than untreated pasta samples. Instrumental analysis such as infrared spectra, diffractograms, thermographs and micrographs were analyzed. These results highlighted the potential of atmospheric cold plasma treatment to enhance the functionality and nutritional value of LMF, suggesting its application in diverse food products.