National Institute of Technology Rourkela

Synopsis Seminar

Seminar Title	: Development of Resistant Starch Rich Breakfast Cereal from Kodo millet (Paspalum scrobiculatum) using Dry-heat Process Technology
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Venue	: CH-113 (Department of Food Process Engineering)
Date and Time	: 19 May 2025 (16.45 hr)
Abstract	: Kodo millet (*Paspalum scrobiculatum*), a climate-resilient crop rich in iron and low glycemic index, holds immense potential for value-added breakfast cereals. However, its flour has few functional limitations, such as poor flowability, high cohesiveness, and low expansion, hindering its direct use in dry blending and extrusion. Structural degradation during hulling and milling reduces resistant starch (RS) and amylose content, compromising processing and textural quality. This research investigates dry-heat processing as a sustainable, chemical-free method to enhance the functional and structural attributes of Kodo millet for breakfast cereal applications. The study explored two key dry-heat methods: roasting (pan and salt-bed) and convective hot-air oven treatment. Kodo kernels were roasted at 15 and 20% initial moisture contents (IM). Hulled flour underwent dry-heat treatment (DHT)at 130 °C for 2-4 h. Roasting improved starch morphology, producing honeycomb-like structures, increased amylose content (up to 28.62%), and higher RS (up to 14.49%) while reducing hydration properties, compared to native and salt-bed roasted samples. X-ray diffraction revealed a shift from A-type to a mixed A-V polymorph structure, particularly in pan-roasted samples, indicating enhanced crystalline reorganization. Pan roasting at 20% IM (PR20) resulted in flour with superior bowl-life crispiness (0.5 Nmm), reduced water activity (0.467), and favorable texture for ready-to-eat cereals. The dry-heat treated flour using a convective hot-air oven at a higher IM (20%) for a thermal prolongation period of 4 h (DHT20-4h) showed significant enhancement in amylose (28.63%), resistant starch (45.29%), and reduced overall pasting properties. DHT enhanced amylose content (11.44%), paste clarity (38%), bulk density (22.90%), and relative crystallinity (20.62%) compared to untreated flour. Its crystallinity remained A-type, while flour quality was improved for extrusion. The extruded breakfast cereal (BC-DHT) from a mixture of DHT Kodo millet flour with hybrid maize flour (70:30) exhibited lower bowl-life crispiness (0.27 Nmm) and more amorphous B-type sites compared to PR flour-based cereal. A grit-based approach (600 μm), using pan-roasted grits (BC-PRG), demonstrated exceptional results, having RS up to 55.14%, a higher expansion ratio (30.80), and a smaller, uniform pore distribution. This breakfast cereal outperformed others with a bowl-life crispiness of 3.17 Nmm and 30.74% RS, further improved by enhanced soluble dietary fibre (11.47%). These findings suggest a synergistic mechanism between short amylose chains and fibre, enabling quick retrogradation and enzymatic resistance, key to satiety and bowl-life stability. Flowability issues were also addressed. Pretreatments via roasting and convective-hot air oven heating reduced the compressibility index up to 24.53%, minimized cohesive forces (0.042 kPa), and improved dry blending compatibility. This was critical for industrial extrusion, ensuring efficient material transition and consistent output quality. In conclusion, this research validates the use of dry-heat process technology, specifically roasting and convective hot-air treatment, as effective strategies to modify Kodo millet for use in health-oriented breakfast cereals. These approaches preserve and enhance resistant starch and textural attributes and provide viable solutions to overcome cohesiveness and flow-limitations. It contributes toward sustainable processing, clean-label breakfast cereal development, and functional food innovation, supporting the broader goal of promoting millets as future-smart grains in industrial applications.