RHEOLOGICAL BEHAVIOR AND STRUCTURAL RECOVERY OF PÂTÉ MASSES UNDER MECHANICAL LOADING

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Introduction. The study of the rheological behavior and structural recovery of pâté masses is a critical step in optimizing technological processes such as cutting, pumping, and packaging. In this work, rotational rheometry was applied to evaluate the effect of amaranth addition on the structural-mechanical characteristics and thixotropic properties of the protein-fat matrix.

Material and Methods. Measurements were performed on a Kinexus pro+ rotational rheometer (NETZSCH) equipped with rSpace software at a temperature of 25.0 °C. To minimize the risk of wall slip, a PU40 Serrated L3884 SS geometry (a serrated parallel plate with a diameter of 40 mm) was used, with a working gap of 2.0 mm during testing.

Results and Discussions. To study the structural and mechanical properties of the pâtés and their ability to regenerate after mechanical loading, a three-step thixotropic test was conducted. This method allows simulating real technological processes: a state of rest, intensive breakdown of the internal structure (for instance, during bowl chopping, pumping, or extrusion), and subsequent relaxation of the system. At the initial stage, under a shear rate of $\dot{\gamma}$= 0,1 c^{-1}, the initial structure of the pâtés exhibits high dynamic viscosity (η) values, indicating the presence of a well-formed network. At the end of the first step, the quasi-stationary viscosity of the control sample was 4153 Pa .s, whereas for the sample with amaranth, this value was lower, reaching 3301 Pa. s. This agrees with the frequency sweep results and confirms that the addition of amaranth forms a slightly less rigid protein-fat matrix. The second step involves structural breakdown at a shear rate of $\dot{\gamma}$=30 c^{-1}. The transition to high shear rates caused a sharp, almost step-like drop in η values to 10 Pa. s for both systems. Such pronounced shear-thinning (pseudoplastic) behavior indicates intensive destruction of intermolecular bonds, restructuring of macromolecules, and their orientation in the flow direction under shear stress. The third step represents recovery and relaxation at a shear rate of $\dot{\gamma}$= 0,1 c^{-1}. Upon removal of the intensive load, a typical thixotropic response was observed: a rapid initial viscosity buildup followed by a gradual approach of the curves toward a new stationary level. Over 600 seconds of relaxation, the degree of initial structure recovery was 34.5% for the control and 36.5% for the experimental sample with amaranth. Thus, the obtained results confirm that while the amaranth-enriched pâté is characterized by a lower initial viscosity, its thixotropic recovery capacity (reconstitution of the structural matrix) after intensive mechanical action is slightly higher, ensuring proper consistency restoration and shape retention of the finished product after packaging.

Conclusions. Taken together, the results allow considering amaranth as a structure-modifying ingredient that shifts the pâté into a softer and more plastic state without compromising its viscoelastic properties.

Keywords: *amaranth, rheological behavior, thixotropy, compliance and deformability, pate*