Foam index as a surrogate measure of protein content: an exploratory and inexpensive laboratory-free tool for students

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An easily executable method to track nutritive potential of raw food grains at home is described here. Blanching the soaked grains with the boiled supernatant aided the release of protein into the supernatant which in-turn correlated with the protein content of the grains analysed in this study. When agitated, the supernatant generated stable froth, measured as foam index (FI). When compared with standard protein estimation methodologies (ultra-violet absorption and Folin–Lowry), both the percentage volume of the water absorbed (VA) and FI emerged as potential quantitative parameters. Correlation analyses using multiple grains of varying protein content indicated that VA and FI could serve as laboratory-free surrogate measures of protein content, and therefore a reflection of their nutritional value. To eliminate the possibility of surfactant-mediated foam, an ink-based 'dye diffusion test' was developed, wherein the dye was significantly retarded by protein foam. The simplicity of these assays were tested as a part of learning modules, successfully executed even by school students (12–15 years old). Qualitatively, it engaged them in more authentic scientific inquiry in a way that was meaningfully associated with their daily lives. We propose that this technique creates opportunities for participation in citizen science, and can help address questions about cultivar growth in different climatic conditions when analysed temporally in a large networked format.

Keywords: Froth, grains, home lab, nutrition, protein estimation.

on the climate, type of cultivation methods and cultivars used[4]. The 2015 United States Department of Agriculture (USDA), Dietary Guidelines Advisory Committee (DGAC) report emphasized the need for characterizing protein content of local produce, due to its implications on nutrient adequacy.

Meanwhile in education, the Indian National Curriculum Framework (2005) has acknowledged the degradation of laboratory infrastructure and lack of focus on experimentation in secondary and senior-secondary schools[5]. It notes the importance of activity-based teaching and emphasizes that cost should not be a barrier to science education[6]. Recently, COVID-19 lockdowns not only disrupted supply chains thereby affecting nutrition availability during the pandemic, but also imposed online education, replacing interactive classrooms with a two-dimensional screen. Affecting learning outcomes globally[7], teachers found the online mode to be particularly lacking in laboratory exposure and ineffective in assessments[8]. With students being unable to access even shared laboratory facilities at schools, the need to generate low-cost instructional designs that can maximize the use of equitable resources was primal. Moreover, if such modules allow us to ask relevant utilitarian questions, then popularizing them as learning tools for citizen science could become easier[9].

To address these seemingly different inequities, the present study develops 'home-lab' experiments to estimate the protein content of locally sourced grains. Since studies have suggested direct links between foamability and