Microstructure characterization of infrared-treated soybeans using X-Ray micro-computed tomography

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Thermal treatment such as infrared micronization is one the important unit operations in the processing of legumes and soybeans. The heat causes significant microstructural changes inside the kernels, resulting in the development of micro-cracks and air pores depending on treatment conditions such as initial moisture content of kernels and infrared radiation time. The mechanism of such microstructural transformation is not well understood due to the lack of quantitative data. The X-ray micro-computed tomography (micro-CT) has been proven to be a powerful non-destructive tool to explore the microstructure of biological samples, including legumes seeds. Therefore, in this study, the microstructure of soybeans with initial moisture contents (12, 16, 20, and 24% w.b.) and treated at different micronization durations (60, 90, and 120 s) were studied and related to quality parameters such as water absorption, hardness of non-cooked and cooked samples. The results from water absorption tests demonstrated no significant difference ($p > 0.05$) between the moisture absorbed for 60, 90, and 120 s micronization. Texture analysis was associated with the force required to break individual seeds. The highest texture degradation was achieved after 60 s of treatment on 24% moisturized seeds. Results of 3D multiscale analysis have shown an increase in porosity with increasing infrared treatment time. Overall, the qualitative and quantitative analysis provided in this study may serve as a basis for the development of improved food processing techniques such as roasting, milling, and storage.