Study of the physicochemical and functional properties of Tenebrio molitor larvae defatted flour and evaluation of its application in hamburger

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According to a study published by the Food and Agriculture Organization FAO in 2021, the global population will reach approximately 9 billion by 2050. With the fast growth of the world's population, new viable food sources such as edible insects are being explored. This research aimed to obtain Tenebrio molitor defatted flour (TDF), investigate its nutritional values and functional properties and analyze the characteristics of a hamburger added with 4% of TDF. The functional properties evaluated were emulsion capacity (EC), emulsion stability (ES), foaming capacity (FC), water absorption capacity (WAC), and fat absorption capacity (FAC). Instrumental color (L*, a*, b*), cooking yield, shrinkage, and diameter reduction analysis were carried out to evaluate the physical properties of the hamburgers. Also, the hardness, springiness, cohesiveness, gumminess, chewiness, and resilience values were determined by texture profile analysis (TPA). The defatted flour chemical composition (g/100 g, wb) consisted of (12.2±0.9) % moisture, (60.5±7.5) % protein, (7.9±1.8) % fat, (4.0±0.1) % ash, and 15.43 % of carbohydrates. The results of the functional properties showed EC = (57.33±0.28) mL/g, ES = (76.67±2.89) %, WAC = (1.35±0.19) mL/g, FAC = (3.63±0.01) g/g and FC = (52.88±4.08) %. The raw hamburgers supplemented with insect flour indicated similarities in the L* parameter ($P>0.05$) with the control, while the parameters a* and b* differed significantly ($P<0.05$). However, after the cooking process, there were no significant differences ($P>0.05$) between each color parameter. The TPA results showed no significant differences between hamburgers ($P>0.05$) for all the textural properties. The supplemented hamburger presented a better outcome regarding its shrinkage and diameter reduction ($P<0.05$) than the control. However, there was no significant difference between cooking yield results ($P>0.05$). The hamburger control showed cooking yield (64.8±3.5) %, shrinkage (21.7±3.7) %, and diameter reduction (21.0±2.7) %, while the supplemented hamburger showed (75.9±0.4) %, (10.4±1.2) % and (10.5±1.3) % for the same parameters, respectively. The defatted insect flour proved a potential protein source, improving some beef hamburger properties, such as less shrinkage and diameter reduction, while maintaining its traditional texture profile and color after cooking.