ACCELERATED LIFE TESTING OF STARCH BIODEGRADABLE FILMS WITH NANOCLAY USING THE ELONGATION LEVEL AS STRESSOR

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ABSTRACT

In this experiment, the effect of the mechanical stress was evaluated as an accelerating factor in the durability of biodegradable starch-based thermoplastic films with nanoclay (montmorillonite). For this purpose, two samples with different plasticizer (glycerol) content (35 and 50% w/w on dry starch basis) were produced by the casting method. Both samples consisted of 7% w/w dry chickpea starch and 10.5% w/w on dry starch basis montmorillonite, acting as a reinforcing agent of the polymeric matrix. The experimental design included a tensile test using a texture analyzer, during which the tensile strength, as well as the exact break time, of the specimens under different stress conditions were monitored. In particular, the different stress conditions of the films were evaluated, varying the elongation levels, time periods, and stress cycles. In conclusion, it was found that the films prepared by adding a higher percentage of glycerol (50% w/w on dry starch basis) showed lower tensile strength and higher elasticity than those with a lower percentage of glycerol (35% w/w of dry starch basis). In addition, it was observed that they tended to remain intact for longer stress cycles. By fixing the probability of failure at 50%, it was observed that films containing 35% w/w on dry starch basis glycerol had significantly lower break times than those containing 50% w/w on dry starch basis glycerol. In particular at elongation levels 10, 12 and 15%, the exact break times for films with 35% w/w on dry starch basis glycerol were approximately 260, 160 and 77 s, respectively, and the exact break times for films with 50% w/w on dry starch basis glycerol were approximately 688, 498, and 306 s, respectively. Moreover, the acceleration factor (AF) values at the higher elongation levels 12 and 15% for films with 35% w/w on dry starch basis glycerol were approximately 5 and 11, respectively. However, at the same elongation levels, the films containing 50% w/w on dry starch glycerol had AF values of approximately 3 and 5, respectively, which are almost two-fold lower. This observation also explains the shorter break time of 35% w/w on dry starch basis glycerol films as compared to the samples containing the higher percentage of glycerol.

KEYWORDS: Starch films, montmorillonite, acceleration factor, food packaging