A delayed Holling-type I food chain model

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In this research we improve a previous simple model of a food chain, that has been studied among others by G. Wolkowicz, M. Cavani, S. Romero, where the only equilibrium point of positive coordinates is globally asymptotically stable. The model occurs in the chemostat, a laboratory apparatus for research of microorganisms. Three species are considered: the top specie is a **nutrient** of an intermediate specie. We call this intermediate specie the **prey population**. In the bottom of the chain there is a **predator population** specie that predates the intermediate specie. The prey and the predator population exhibit a functional response of Holling type I , also called Lotka-Volterra functional response. The improvement consists of take into account significative time lag in the predator dynamic, specifically we suppose that the nutrient and the prey population have instantaneous dynamics, but the dynamic of the predator population depends of past quantities of the prey population. In this case we show that the only equilibrium point of the system with positive coordinates undergoes a Hopf bifurcation and more reasonable stable periodic oscillation are possible for the model.

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