Controlled release packaging (CRP)

(CRP) is defined as a new generation of packaging materials that can release active compounds such as antimicrobials and antioxidants at desirable rates to extend the shelf life of a wide variety of foods. CRP may also refer to the technique of using these new generation materials to enhance food safety and quality.

An advantage of CRP is its ability to provide a sustained supply of active compounds at suitable rates for food protection. Traditionally, active compounds such as antioxidants, antimicrobials, and anti-browning agents are incorporated into food formulations; however, once these active compounds have been consumed in reactions, protection ceases and food quality degrades rapidly. CRP can overcome this limitation by continuously replenishing active compounds via controlled release from the package to provide sustained food protection. Another advantage of CRP is that a smaller quantity of active compounds can sometimes be used to provide the same or better levels of protection than are achieved when adding larger quantities of active compounds directly to food. For example, microbial problems are known to occur mostly on food surfaces, and in CRP antimicrobials are released directly to the food surface where antimicrobials are most needed. Adding antimicrobials directly to food is less effective and may result in overloading, since most of antimicrobials added using this method end up inside the food where microbial growth is of less concern. Still another advantage of CRP is its ability to protect unstable active compounds from degradation until they are released. For example, when tocopherol (a common antioxi-dant) and nisin (a common antimicrobial) are added to food formulation, unused amounts of these active compounds may undergo rapid degradation resulting in significant loss and thus much reduced levels of active compounds for food protection at later time. Our experimental data indicate that CRP can prevent this problem by storing tocopherol and nisin inside the package and thus protecting them from degradation until their release to the food.

CRP may also be described as an active packaging system that uses the package to deliver active compounds in a controlled manner. Active packaging has been defined as a group of technologies that actively modify the internal package environment through physical, chemical, or biological interactions between the package, the food, and the headspace for the purpose of enhancing food quality and safety (Rooney, 1995; Brody *et al,* 2001). CRP modifies the internal package environment by releasing active compounds in a controlled and desirable manner. The CRP technology is particularly useful for controlling food degradation reactions that are continuous and increase exponentially, such as microbial growth and lipid oxidation,

as constant replenishment of inhibitory active compound can prevent these runaway deterioration processes.