Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(6): 2044-2046
Received: 25-09-2018
Accepted: 27-10-2018

K Vinay Pramod Kumar
Department of Food Processing Technology, College of Food Science and Technology, Pulivendula, YSR Kadapa, Andhra Pradesh, India

Jessie Suneetha W
Post Graduate & Research Centre, Department of Foods & Nutrition, Professor, Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, India

B Anila Kumari
Post Graduate & Research Centre, Department of Foods & Nutrition, Professor, Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, India

Correspondence
K Vinay Pramod Kumar
Department of Food Processing Technology, College of Food Science and Technology, Pulivendula, YSR Kadapa, Andhra Pradesh, India

Active packaging systems in food packaging for enhanced shelf life

K Vinay Pramod Kumar, Jessie Suneetha W and B Anila Kumari

Abstract
The growing population and receding land resources necessitate the use of produce to maximum extent and it is here that packaging plays an important role in enhancing the shelf life of food products through the supply chain. The improvements in packaging has led to the availability of a number of products yearlong across various parts of the world. Active packaging is one such technique that has help in keeping the food quality avoiding deterioration and consists of absorbers and emitters. Absorbers remove unwanted components that cause deteoration in the food from within and the surrounding environment whereas emitters are added compounds to the packaged food. In this method of preservation of foods, chemicals need not be added directly to foods but can be used in the packaging materials with minimal harmful effects.

Keywords: Active packaging, absorbers, emitters, oxygen scavengers, moisture absorbers, ethanol emitters, odour removers, aroma releasers.

Introduction
Packaging plays a pivotal role in improving the shelf life and adding value to food products. The primary function of packaging is to protect the food in a container enabling efficient transport in the supply chain, preventing any sort of physical damage, protecting against adulteration and theft. Packaging also meets the fundamental need to maintain food quality and safety from initial production to final consumption by preventing any unwanted deterioration in terms of chemical and biological changes. It helps in protecting against harsh external environmental factors like heat, light, presence or absence of moisture, pressure, microorganisms and gaseous emissions (Bilska, 2011) [3]. The consumer is provided with the greater convenience of use and is time saving as the products are available in various sizes and shapes along with details of label claim also. The smart packaging systems like active and intelligent packaging concepts help in understanding the interaction between packaging environment and the food to which active protection is required (Yadav *et al*. 2015) [26]. Active packaging is a novel approach to maintain or prolong the shelf life of food products ensuring its quality, safety and integrity. The European regulation (EC) No. 450/2009 defined active packaging as packaging systems that interact with the food in such a way as to "deliberately incorporate components that would release or absorb substances into or from the packaged food or the environment surrounding the food" (European Commission, 2009). Active packaging systems can be divided into absorbers (active scavenging systems) and emitters (active releasing systems). Absorbers remove undesired compounds from the food or its surrounding environment like moisture, carbon dioxide, oxygen, ethylene gas or odours from the package whereas emitters add compounds to the packaged food or into the headspace like antimicrobial compounds, carbon dioxide, antioxidants, flavors, ethylene or ethanol to prevent development of undesirable changes (Almenar *et al*. 2007; Dobrucka, 2014) [2, 11].

Need for active packaging: The growing awareness among consumers is causing reluctance for use of chemical conservatives as many of them are suspected carcinogens with residual toxicity resulting in increased pressure for adoption of more "natural" alternatives for shelf life of foods. These include the use of natural antimicrobials derived from plant extracts like essential oils can be used as alternatives to chemical additives (Kapetanakou and Skandamis, 2016) [14]. It will be better if they don't have direct contact with the food as they may affect the organoleptic properties of the food. Hence these antimicrobial agents are incorporated in packaging as edible films (biopolymers), gelatin, casein and other proteins.

Active packaging systems: Active packaging refers to the incorporation of few types of additives into packaging film or within packaging containers to extend the product shelf life

(Day, 1989). Active packaging allows packages to interact with food and its surrounding environment thus plays a significant role in food preservation (Brody, *et al*. 2001; Lopez-Rubio, *et al*. 2004) [4, 5]. The principle behind active packaging is based either on the intrinsic properties of the polymer used in packaging material itself or the inclusion of Specific substances inside the polymer (Gontard, 2006) [12]. Packaging may be termed active when it performs some desired role in food preservation other than providing an inert barrier to external conditions (Hutton, 2003) [13]. It can also be defined as packaging that changes the condition of the packed food to extend shelf life or improve safety or sensory properties while maintaining the quality of packaged food (Ahvenainen, 2003) [21]. It also includes additives referred to freshness enhancers as they participate in a host of packaging applications to enhance the preservative function of the primary packaging system.

Oxygen scavengers: Development of oxygen scavenging systems primarily included the use of self-adhesive labels or loose sachets in the packaging containers along with food. Next was based on the design of active substances to be included in the packaging material itself using monolayer or multilayer materials or reactive closures liners for bottles and jars (Rooney, 2005) [23]. Oxygen scavenging compounds react with oxygen to reduce its concentration inside the package. Ferrous oxide is the most widely used scavenger. Oxygen scavenging technologies have been successfully used in the meat industry alone or in combination with modified atmospheric packaging (MAP) (Kerry *et al*. 2006) [15]. Their use alone eliminates the need for MAP machinery and can increase packaging speeds. But, it is more common commercially to remove most of the atmospheric oxygen by MAP and then use a relatively small and inexpensive scavenger to eliminate the remaining oxygen within the food package. Non-metallic oxygen scavengers like ascorbic acid, ascorbate salts or catechus were developed to eliminate the potential for metallic taints being imparted to food products (Day, 2003; Randell *et al*. 1995) [9, 21].

Moisture absorbers: Moisture absorbers as sachets, pads, sheets or blankets are commonly used for packaging dried foods that include desiccants like silica gel, calcium oxide, activated clays and minerals as they are tear resistant in permeable plastic sachets. In addition to moisture absorber sachets for humidity control in packaged dried foods, moisture drip absorbent pads, sheets and blankets for liquid water control in high water activity containing foods like meats, fish, poultry, fruit and vegetables are being employed. Basically, they consist of two layers, a micro porous non-woven plastic film like polyethylene or polypropylene between which a superabsorbent polymer is placed that is capable of absorbing up to 500 times its own weight. Typical superabsorbent polymers include polyacrylate salts, carboxy methyl cellulose (CMC) and starch copolymers as they have very strong affinity to water. Moisture drip absorber pads are commonly placed under packaged fresh meats, fish and poultry to absorb unsighted tissue drip exudates. Larger sheets and blankets are used for absorption of melted ice from chilled seafood during air freight transportation or for controlling transpiration of horticultural produce in long distance transportation.

Ethanol emitters: Ethanol emitters are preservative releasing technologies and are usually in sachet forms. The use of ethanol as an antimicrobial agent is well documented and is particularly effective against moulds but can also inhibit the growth of yeasts and bacteria. Several reports have demonstrated that the mould free shelf life of bakery products can be significantly extended after spraying with 95% ethanol at concentrations of 0.5–1.5% (w/w) on the products. However, a more practical and safer method of generating ethanol is through the use of ethanol emitting sachets (Rooney, 1995; Labuza and Breene, 1989; Day, 2003) [23, 16]. The size and capacity of the ethanol emitting sachet is dependent on the weight of food, its water activity and the desired shelf life. When food is packed with an ethanol emitting sachet, moisture is absorbed from the food and diffused as ethanol vapour into the package headspace. Ethanol emitters are used extensively in Japan to extend the mould free shelf life of bakery products by up to 2000% (Rooney, 1995; Day, 2003) [23].

Ethylene scavengers: Different mechanisms of action to reduce or eliminate ethylene from packages and thus delay the ripening process to extent the shelf life of fruit are being pursued. Currently, polymeric matrix is introduced into the packaging material or they can be applied as a coating (dispersion).

Antimicrobial coatings: Antimicrobial films may provide an effective way to control food borne pathogens and spoilage microorganisms to enhance food safety and decrease product spoilage. Antimicrobial films can be produced by incorporation of chemical preservatives or antimicrobial agents into a plastic film which can diffuse into the food to control target microorganisms (Moraes *et al*. 2007) [18]. Antimicrobial coatings were developed by incorporation of nisin, lactoferrin, sodium diacetate, sorbic acid and potassium sorbate into a coating material. Films containing sorbic acid were the most compatible with the resin solution and had the best physical appearance (Quintavalla and Vicini, 2002) [20].

Odour removers: Active packaging concepts include removal of unpleasant aromas and flavors. Applications for scavengers of undesirable odours includes removal of amines produced due to oxidation of protein rich foods like fish, removal of aldehydes by oxidation of fatty acids in biscuits, fried foods and cereals as well as removal of bitter tasting components like limonene in fruit juices (Brody *et al*. 2001; de Kruijf *et al*. 2002; Vermeiren *et al*. 2002) [4, 10, 25]. Commonly, off odours are produced during protein breakdown due to sulphurous compounds like hydrogen sulphide and during lipid oxidation and of fats and oils due to formation of aldehydes and ketones. Aldehydes and ketones are also produced during anaerobic glycolysis (Brody *et al*. 2001; Vermeiren *et al*. 2002) [4, 25]. The off odours can be sensed at very low levels and cause an unpleasant smell when opening such packages even if the food product is still safe to eat (Rice, 1994) [22]. Another reason to use odour scavengers is that odours may be develop in packaging material especially during plastic processing like extrusion and molding. Antioxidants are often included as processing additive to vie of the produced off odours.

Aroma releasers: The addition of pleasant aroma compounds can mask unpleasant and bothering odours and can be a way to avoid flavor scalping by modifying the equilibrium conditions. Further improvement in the consumer appeal of the food product by amending the aroma precipitation when opening the packaging or attracting them can be done. However, currently most aroma emitting products are applied in plastic products for non-food applications (Brody *et al*. 2001) [4].

Conclusion

Active packaging is anticipated to grow significantly over the next 10 years because of the innovations available today through research and development. Consumer demands for meat and other food products with premium qualities like adequate shelf life, safety, convenience and information is driving for development of active packaging. Reduction in packaging material costs can occur if sales volume grows along with emergence of newer and cheaper technologies. Active packaging can revolutionaries the food packaging industry with shelf stable food products to consumers.

References

1. Agriopoulou S. Active packaging for food applications. EC Nutrition. 2016; 6:86-87.
2. Almenar E, Catala R, Munoz HP, Gavara R. Optimization of an active package for wild strawberries based on the release of 2-nonanone. Food Science and Technology. 2007; 42:587-593.
3. Bilska A. Packaging systems for animal origin food. Log Forum. 2011; 7:1- 4.
4. Brody A, Strupinsky ER, Kline LR. Odor removers, in: Active Packaging for Food Applications (Eds. Brody, A. Strupinsky, ER and Kline LR). Technomic Publishing Company, Inc. Lancaster. ISBN: 978–1-58716–045–5, 2001; 107–117.
5. Brody AL, Bugusu B, Han JH, Sand CK, Mchugh TH. Innovative food packaging solutions. Journal of Food Science. 2008; 73:107-116.
6. Carolina, E, Begonyamarco R. Active and intelligent packaging systems for developing modern society. Meat Science. 2014; 98:404-49.
7. Coma V. Bioactive packaging technologies for extended shelf life of meat based products. Meat Science, 2008; 78:90-103.
8. Day BPF. Extension of shelf-life of chilled foods. European Food and Drink Review. 1989; 4:47-56.
9. Day BPF. Active packaging. Food Packaging Technologies (Eds. Coles, R. McDowell, D. and Kirwan, M.). CRC Press: Boca Raton, FL, ISBN: 9781444392180. 2003, 282–302.
10. De Kruijf NN, van Beest M, Rijk R, Sipiläinen-Malm T, Paseiro LP, De Meulenaer B. Active and intelligent packaging: applications and regulatory aspects. Food Additives and Contaminants. 19:144-162.
11. Dobrucka, R. Cierpiszewski, R. Active and intelligent packaging food – research and development – A review. Polish Journal of Food and Nutrition. 2014; 64:7-15.
12. Gontard, N. Tailor made food packaging concept. In: IUFoST, 13th World Congress of Food Science and Technology. Food is Life, Nantes, France. 17/09/2006 to 2/09/2006. 2006,
13. Hutton T. Food packaging: An introduction. Key topics in food science and technology. Chipping Campden: Gloucestershire, UK. 2003; 7:108.
14. Kapetanakou A. Skandamis PN. Applications of active packaging for increasing microbial stability in foods: natural volatile antimicrobials. Current Opinion in Food Science. 2016; 12:1-12.
15. Kerry JP, O'Grady MN, Hogan SA. Past, current and potential utilization of active and intelligent packaging systems for meat and muscle based products: a review. Meat Science. 2006; 74:113-130.
16. Labuza TP, Breene W. Application of 'active packaging' technologies for the improvement of shelf-life and nutritional quality of fresh and extended shelf-life foods. Bibliotheca Nutritio et Dieta. 1989; 43:252-259.
17. Lopez-Rubio A, Almenar E, Hernandez-Munoz P, Lagaron JM, Catala R. Gavara R. Overview of active polymer based packaging technologies for food applications. Food Review International. 1989; 20:357-387.
18. Moraes AR, Gouvela LR, Soares NF, Santos MD. Goncalvesi MC. Development and evaluation of antimicrobial film on butter conservation. Ciênciae Tecnologia de Alimento. 2007; 27:33-36.
19. Patel R, Prajapati JP. Balakrishnan, S. Recent trends in packaging of dairy and food products. National seminar on Indian Dairy Industry - Opportunities and Challenges. 2015.
20. Quintavalla S. Vicini, L. Antimicrobial food packaging in meat industry. Meat Science. 2002; 62:373-380.
21. Randell K, Ahvenainen R, Latva-Kala K, Hurme E, Mattila-Sandholm, T, Hyvonen L. Modified atmosphere packed marinated chicken breast and rainbow trout quality as affected by package leakage. Journal of Food Science. 1995; 60:667-684.
22. Rice J. Fighting moisture – desiccant sachets poised for expanded usage. Food Processing. 1994; 63(8):46-48.
23. Rooney ML. Introduction to active food packaging technologies. In: Innovations in Food Packaging (Ed. Han, J.H.). Elsevier Ltd: London, UK, 2005, 63-69.
24. Suppakaul P, Militz J. Sonneveld K. Active packaging technologies with an emphasis on antimicrobial packaging and its applications. Journal of Food Science. 2006; 68:408-420.
25. Vermeiren L, Devlieghere F. Debevere J. Effectiveness of some recent antimicrobial packaging concepts. Food Additives and Contaminants. 2002; 19:163-171.
26. Yadav KS, Prabha R, Renuka K. Active packaging: concepts and applications. International Journal of Food and Nutritional Sciences. 2015; 4:194-200.