SAT–LCR-P-2-BFT(R)-25

ACTIVE PACKAGING – PRODUCING, ADVANTAGES AND TRENDS OF USAGE

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Abstract: *The packaging is the most dynamically changing part of the product, which aims to protect the food from the influence of various factors and to create consumer awareness. The packaging is being modified to fit the needs of consumers and the food industry. The consumer demand for fresh and non-processed products characterized by short shelf life creates the necessity of food manufacturers for seeking and developing new, active, and smart packaging concepts. In addition to the quality, safety and distribution aspects already outlined, active packaging offers significant potential as a marketing tool as well.*

Keywords: Keywords: *active packaging, shelf life, food safety.*

INTRODUCTION

Food products are dynamic systems that easily interact with environmental factors (oxygen, moisture, microorganisms, etc.) that lead to rapid deterioration of their organoleptic properties and safety. The main purpose of packaging is to protect food from environmental influences. They are an integral part of people's daily lives. The development of suitable packaging follows the evolution of science and technology and is shaped by the rising standard of living and changes in people's eating habits. The main functions of the packaging are to store and maintain the product; protect it from mechanical damages, microbiological, chemical, and physical contamination, oxygen, moisture, light, and from the influence of major temperature changes. Therefore, the packaging type plays an important role in determining the shelf life of foods (Yildirim, S., et al., 2018; Mane, K., 2016; Prasad, P., & Kochhar, A., 2014).

EXPOSITION

Active packaging – advantages and trends

In recent years, there has been an increasing demand for fresh and minimally processed foods that are significantly related to shortening the shelf life of food. On the other hand, changes in the food trade, such as the centralization of activities, the entry into the internet commerce (e-commerce), and the internationalization of markets, require an increase in development and supply of foods with prolonged shelf life and the preservation of their quality and safety at the same time. In response to these requirements, new packaging technologies are being developed that improve and enhance the barrier function of packaging, such as modified atmosphere packaging, active, intelligent packaging, and application of nanomaterials (Imran, M., et al., 2010; Dobre L. et al. 2011a; Realini, C., & Marcos, B., 2014; Kuorwel, K., et al., 2015; Bumbudsanpharoke, N., et al., 2015).

Active packaging is one of the innovative concepts in food packaging, introduced as a result of changes in consumer requirements and market trends. It performs some functions that conventional packing systems cannot implement. With this technology, food, packaging material, and the internal gas environment interact to extend shelf life, improve safety and organoleptic characteristics of the end product.

Active packaging systems can be broken down into actively absorbing systems (absorbers) - containing substances that remove undesired components from the food or the environment, such as moisture, carbon dioxide, oxygen, ethylene, or odor and actively releasing systems (emitters) - add components of the packaged product (antimicrobials, carbon dioxide, antioxidants, flavors, etc.).

Oxygen absorption systems are one of the major active packaging technologies that aim to remove oxygen from the packaging. The mechanism of oxygen removal is mainly chemical. The substances used for this purpose are most often iron compounds, the action of which is activated by moisture, whereby the reduced iron is oxidized to a stable iron oxide trihydrate complex (Solovyov, S., 2010). Other oxygen removal systems use photosensitive dyes, ascorbic acid, gallic acid, and unsaturated fatty acids (Miller, C., et al., 2003; Pereira de Abreu, D., et al., 2011). Besides, oxygen in packaging can be biochemically removed by enzymes and also by immobilized bacterial spores or yeasts (Andersson, M., et al., 2002; Anthierens, T., et al., 2011; Gohil, R., & Wysock, W., 2014).

Moisture content and water activity are important factors affecting the quality and safety of food. Increased water content is a major cause of food spoilage. Moisture removal helps maintain quality and extend the shelf life by inhibiting microbial growth and moisture-related processes of destroying the structure and taste of foods. The most commonly used moisture absorbers are silica gel, calcium oxide, activated clays and minerals, moisture-retaining salts (sodium chloride, magnesium chloride, etc.) and other moisture-retaining substances (sorbitol) are usually placed in water-resistant plastic sachets. These moisture absorbers are packaged in sachets, microporous bags or integrated into pads (Pramod Kumar, V., et al., 2018; Yildirim,S. et al., 2018).

Ethylene is a plant growth regulator that accelerates the maturation and aging process by accelerating the respiration rate of fresh and minimally processed plant foods, which shortens their shelf life. Ethylene also accelerates the breakdown of chlorophyll in leafy vegetables and enhances the softening of the fruit. This requires the removal of ethylene from the environment using substances that absorb or degrade it. For ethylene neutralization systems, the absorbent can be placed in small sachets or incorporated in the package. The most commonly used ethylene remover is the potassium permanganate contained in the sachet. This agent cannot be used in direct contact with food because of its high toxicity. Other ethylene absorber systems use finely dispersed minerals such as zeolite, activated carbon or pumice stone. Metals and metal oxides can also be used to remove ethylene in the packaging (Yildirim, S., et al., 2018).

Fat oxidation is one of the most important mechanisms leading to the breakdown of food products, which ranks second after the growth of microorganisms. Lipid oxidation leads to a decrease in the shelf life of foods due to changes in taste, odor, structure and nutritional quality of foods. Recently, much effort has been made to develop active packaging systems containing polyphenols, tocopherols, plant extracts, and essential oils as antioxidants in order to improve the quality and extend the shelf life of foods (Nerín,C., et. al., 2006; Soare, L., et al., 2012a; Soare, S., et al., 2012b).

Antimicrobial packaging

Antimicrobial packaging is defined as a system that interacts with the food or the surrounding environment that aims to destroy the microorganisms that may be present in it or to prevent them from growing. It may offer continuous migration of the agent from the packaging material to the food or space in the package so it may maintain a constant concentration of the antimicrobial substance over the shelf life of the product (Quintavalla, S., & Vicini, L., 2002; Surwade, S., & Chand, K., 2017).

Antimicrobial packaging achieves suppression of pathogenic microorganisms in order to ensure the safety and extends the shelf life of the food, as well as protection against changes in aroma and taste of the product.

The antimicrobial agents that can be used in this type of packaging are divided into three main groups: synthetic, natural (isolated from plants or animals) substances, and probiotics. Antimicrobials occurring naturally in nature have several advantages because they are considered to carry less risk to the consumer.

As the antimicrobial substance comes into contact with food or migrates into the foods, the use of plant extracts and essential oils is preferred both in the development of new food products and nutritional supplements and in the development of new active packaging. Plant extracts of grapefruit, grape, pomegranate, cinnamon, horseradish, and cloves seeds have been added to the packaging and their effective antimicrobial activity against harmful and pathogenic bacteria has been established (Dobre, L., et al., 2011b; Dobre, L., et al., 2011c).

CONCLUSION

The active packaging is an innovative method in which the product and the environment interact and as a result of that interaction lead to extend the shelf life or to improve safety and organoleptic characteristics, and to preserve the quality of the end product. The antimicrobial packaging is a type of active packaging that is based on the inclusion or application of antimicrobial substances on the surface of the packaging material in order to suppress the development of pathogens and to extend the shelf life of food products. The use of plant-derived antimicrobials (plant extracts and essential oils) in antimicrobial packaging enables the use of synthetic preservatives to be significantly reduced.

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