Free essay on smart food packaging technologies

Environment, Water

The following paper describes the current developments and advances in the use and application of smart packaging technology in food packaging processes. The paper focuses on the application of the technology through various methods of smart food packaging, process designs, equipment used and the current applications. The paper also gives the various applications for the smart food packaging technologies.

Oxygen Absorbers

Oxygen absorbers/scavengers refer to smart packaging technologies that work by absorbing oxygen from foods while reducing oxygen metabolism in the packaged food (Latou et al. 2010). The process is designed to decrease oxidative rancidity and stop any unintended oxidation of the food's minerals such as vitamins. Also by absorbing oxygen from food stuffs, the oxygen scavengers significantly block the growth of microorganisms.

This smart food technology comes in the form of tiny sachets that contain various catalysts and powders rich in iron. This product is put in the food packaging so that it can react with the water produced by the food, forming a reducing agent that then converts the present oxygen into a stable oxide. The sachets containing iron powder are usually labeled with a warning that one should not ingest it since it is poisonous when eaten. These scavengers can minimize the level of oxygen to 0. 01%, and it becomes more effective when used together with the modified atmosphere packaging (Brandon et al. 2010). Nowadays, non metals (organic reducing agents) and unique polymers are being used to reduce the probability of metals contaminating food products. They come in the forms of catechol, enzymes' scavengers, and ascorbic acid among others (Brandon et al. 2010). Oxygen scavengers originated from Japan, and they were quite successful due to the innovation behind its technology and the Japan’s climate that is hot and humid enough to cause food spoilage. New areas of applications for this technology include the beer industry, wine manufacturing and beverages industries (for example, The Pure Seal oxygen scavenging crowns). It is important to note that sachets and labels containing iron may not be used for beverages since water lessens their scavenging properties leading to total loss of scavenging. However, experts have realized that non metallic agents can be placed in the crowns and caps of the beverage bottlers, and they are very effective.

Carbon Dioxide scavengers and emitters

Just like the oxygen scavengers, carbon dioxide scavengers or emitters are usually packaged in the form of sachets. They operate by either absorbing or emitting carbon dioxide gas in food packs. Some food products are known to emit significant amounts of carbon dioxide that may lead to their spoilage or bursting while in their packs. To prevent this problem from occurring, the packaging may be done in such a way that the carbon dioxide escapes through a valve once it is released by the food products (Netra & Leon 2011). The other way to avoid spoilage due to the carbon dioxide gas is the usage of carbon dioxide scavenger that can circumvent this problem. The sachets are usually filled with activated charcoal and calcium oxide. The effectiveness of the scavenger is increased by using a dual action scavenger that contains oxygen and carbon dioxide scavengers. The application is formed by using one sachet that contains iron powder for dealing with oxygen and calcium hydroxide that handles any emitted carbon dioxide. Carbon dioxide emitters are used to replace any carbon dioxide absorbed by fresh foods so as to prevent the pack from collapsing. Some emitters consists of a standard modified atmosphere packaging with sodium bicarbonate (an anti microbial gas) positioned at the perforated bottom (Nettra & Leon 2011). Carbon dioxide scavengers are increasingly being used in freshly roasted nuts and sponge cakes that tend to release too much carbon dioxide into the surrounding (Pradeep et al. n. d).

Ethylene Scavengers

Ethylene scavengers are used to stop or suppress the effects of ethylene in horticultural situations. In fruits such as bananas, tomatoes and various citrus fruits, ethylene is usually vital for their color development. Thus, ethylene is important in fruits and vegetables but sometimes it is important to reduce the effects of ethylene in those food products. Ethylene scavengers are created using potassium permanganate that converts ethylene into ethanol and acetate. As it works on the ethylene, it changes its color to brown, a process that is used to show how much of the scavenger is left in the sachet. The sachets are usually placed in tubes that can then act as storage places for vegetables and other horticultural products (Pradeep et al. n. d). Some carbon- based scavengers too have been seen to remove ethylene from food products, and they can either be used in storage warehouses or storage packs. Some companies have started using dual action scavengers whereby they combine ethylene scavengers and moisture absorbers. Sometimes ethylene is scavenged by the use of various minerals such as pumice and ceramics. The minerals may be placed in packaging bags or films, whereby they work in three- dimensional aspect since the minerals are usually found all over the package. Ethylene Scavengers are extensively being used in the preservation, packaging and transportation of fruits, vegetables and flowers in many countries world wide (Cava et al. 2006).

Ethanol Emitters

Ethanol emitters are usually used as antimicrobial agents whereby they protect foods from moulds and inhibit the occurrence of bacteria and yeast. Apart from the use of sachets, some manufacturers usually spray ethanol all over baked products as a means of preserving them. Ethanol emitter sachets are smart food packaging technologies that have been patented by Japanese producers. The ethanol in these sachets or films is usually absorbed in a carrier material that allows gradual supply of ethanol (usually in the form of vapor) in the packaging. According to Latou et al., (2010), each single sachet consists of approximately 55% of alcohol, 35% of silicon dioxide and 10% of water, whereby the unpleasant alcohol odour could be masked by vanilla flavors. There is always an illustration showing the warning message for people not to ingest the ethanol. The amount of ethanol used for a specific food product depends on the weight of the food and the corresponding expected time frame before the sale of the food product. Nowadays, there are dual action ethanol emitters that work together with oxygen scavengers. When ethanol sachet is put in the packaging, it releases ethanol into the surrounding to counteract the moisture that has been absorbed by the food. It is more expensive than most of other smart food technologies. Ethanol packaging is more costly as compared to other smart food packaging processes and most of its applications are done on premium food products.

Preservative Releasers

Preservative releasers refer to the use of antioxidants and antimicrobial films that preserve a wide range of products. They are usually used to increase the duration of time taken from manufacture to the sale of a food product. However, some experts have argued that the preservatives may sometimes mask the certain food spoilage activities that may end up harming the consumer. An example of preservative releasers is the synthetic silver zeolite that creates antimicrobial ions on the surface of the food item enhancing preservation and a long shelf- life of the product. There are many other natural and artificial preservatives, and numerous tests have been done to examine their efficiency as preservatives. Examples of preservative releasers include organic acids, chloro-organic acids, herb extracts, antifungal agents and volatile inorganic acids. This technology is enhanced by the interest shown by plastic manufacturers to use natural antioxidants instead of artificial ones during polymer stabilization. For example, some manufacturers use vitamin E as a natural food antioxidant that creates a benefit for both film manufacturers and the food manufacturers. Preservative releasers are being used mostly in cereals (break fast cereals) and snacks since the Vitamin E found in these products is considered safe and a very efficient antioxidant (Rangaprasad & Vasudeo 2008).

Moisture and water Absorbers

Excess moisture usually leads to food spoilage in very many instances. This is why moisture absorbers are being used extensively to maintain the quality of products and lengthen their shelf life. Moisture absorbs work by inhibiting moisture that may cause damage to food flavor or texture and other related microbial growth. Moisture absorbers in the market usually come in the form of sachets containing calcium oxide, silica gel and clays, and others come in the form of dual-action absorbers that contain iron powder and carbon. Moisture absorbers usually deal with water moisture, and manufacturers have devised ways to absorb liquid water too from certain foods by the use of absorbent pads, blankets and sheets. These gadgets usually consist of two micro porous films like polypropylene and a superabsorbent polymer placed in between the two films that can absorb up to 500 times its current weight (Rangaprasad & Vasudeo 2008). Such polymers may include salt, cellulose and starch co polymers. The moisture drips are usually put under the packaged food product while larger blankets may be used to absorb traces of melted ice in sea food. Currently, moisture absorbers are the greatest selling smart food packaging technologies for many applications. Japan has already produced a film that has two layers of PVA plastic and a layer of propylene glycol and humectant carbohydrate right between the two layers to act as a moisture absorber. A moisture absorber is mostly used in the packaging of fish, poultry and meats.

Smell Absorbers and Flavor releasers

Just like preservative releasers, these packaging technologies may mask various spoilage activities that can totally mislead customers when determining food conditions when buying. That is the reason why some regions have banned the usage of these absorbers and releaser totally especially in Europe and the US. However, some regions like Japan have continued to use this technology in the creation of aroma and flavor-releasing films that are usually applied in making ready to eat food much more appealing. The reason why this technology is preferred is because some foods may be healthy and desirable, but the odour coming from the some of the food components may be significantly unappealing (Pereira de Abreu et al. 2012). This is why the flavor and aroma releasers are used to enhance consumers' appetites. For example, amines from fish proteins and aldehydes created from autoxidation of fats may lead to significantly unappealing smell, and there is a need to ensure that these unpleasant smells are removed completely. Amines odour can be removed by using acidic components in decreasing the alkalinity found in the food product. The aldehydes can be neutralized using artificial aluminosilicate zeolites for odor absorption and DuPont's Odour and Taste Control for molecular odor sieve (Pereira de Abreu et al. 2012). The absorbers or releasers may be used in the form of powders that are placed inside the packs used for storing food items.

Temperature Control Technology

Temperature control packaging refers to smart food packaging process that incorporates self heating and self cooling properties in packaged foods. To control the heat and temperature, manufacturers use insulators, self cooling/ heating containers to store foods. An example of such packaging is the Thinsulate that uses some special insulating materials (non woven plastic) and very many pores for free air to circulate in the container. Some manufacturers usually use this method by increasing thermal mass of the food product such that it can thrive in high temperatures. In Japan (Adenko Company), this technology has been used extensively such that they created Cool Bow that makes use of an insulating gel in a double walled pack. Self heating cans are usually made of aluminum or steel materials, and they work by exothermic reaction by mixing water and quick lime at the bottom of the container. Self cooling cans usually make use of endothermic reactions created by chloride, water and ammonium nitrate, but some manufacturers make Chill cans that use hydrofluorocarbon gas refrigerant. The Chill Can is more sophisticated and it uses a button at the bottom of the container that triggers the reaction. The basic application for this technology is the beverages industry to enable self-cooling and self-heating properties for a packaged food item (Nettra & Leon 2011).

Temperature compensation technology

Temperature compensating film consists of crystallisable polymers that change controllably depending on the temperature rises or falls. Intellimer polymers have the ability to convert their viscosity, adhesion by making them hot or cool for just a few minutes. The changes that occur in these polymers is usually controlled and predicted by an in built switch and the conversion of the polymers states is usually physical not chemical. The technology works depending on the rate of fresh food respiration while in the package and changes accordingly. Thus, temperature compensating film ensures that the temperature inside the sealed can or container remains optimum. Even when temperatures fluctuate in the surrounding, the polymers ensure that the correct respiring rate is maintained through out the packaging period. It acts according to the changes in temperature such that if the food requires more amounts of oxygen, the material reacts by becoming much more permeable. When the temperatures become relatively low, the polymer reacts by reducing its permeability. Currently, the application has extended to fresh vegetables, cauliflower, straw berries, and even Chiquita Brands already came up with a packaging for some bananas using Landec’s technology regardless of the high costs (Nettra & Leon 2011).

Conclusion

The above paper has described the current developments and advances in the use and application of various smart packaging technologies such as Oxygen absorbers, Carbon dioxide scavengers, and temperature controlling packaging, compensating films, odour absorbers, moisture absorbers, preservative releasers, ethanol emitters and ethylene scavengers in food packaging. The paper has focused on the application of the technologies through various methods of process designs, equipment used and the current applications. The paper has also explained the various applications for the described smart food packaging technologies. There is technological advancement in the various smart food packaging technologies and each of the methods is applicable to many foods and beverage industries.

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