Principles of indicators of modified atmosphere composition

Identification

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How does it work?

Primary objective: To control the composition of modified atmosphere in packages.
Indicators for modified atmosphere packaging are available for different food products and atmosphere compositions. The basic indicators are time temperature indicators (TTI) or integrators and gas and freshness indicators. Modified atmosphere packaging (MAP) [1] is a shelf-life enhancing method which is growing rapidly on an international scale. The correct gas mixture and film in MAP can maintain high quality with extended shelf-life. However, the initial gas composition in the package headspace often changes as a result of the activity of the respiration of the product, the nature of the package, or the environmental conditions. It is necessary to consider that MAP does not only deal with gas mixtures and films. New packaging concepts such as active and intelligent packaging technologies with MAP [2] are available in order to monitor gas change, storage temperature, quality of packed product, and maintain the initial gas level during the whole storage time. Indicators or sensors in the form of a package label or printed on packaging films can monitor changes in the gas composition, storage temperature and quality of the product (smart packaging concept). Some sensors can also release gas to compensate for gas losses in the package (active packaging concept). Thus, the initial gas mixture could be maintained in the MA applied package during the storage time. In addition, gas indicators such as oxygen and carbon dioxide indicators could be used to monitor maturity stage of fruits based on the gas change in the package. Another application of these indicators is to determine package leakage which not only causes change in internal atmosphere but also microbial contamination from the environment. Intelligent indicators (TTI, gas and freshness indicators) and active packaging technologies (ethylene and moisture absorbers) can be used to control MAP properties. MAP combined with active and intelligent packaging concepts will provide means of monitoring the quality and safety of respiring products. For quality control reasons, as well as to enhance food safety, the concept of optical on-pack sensors [3] for monitoring the gas composition of the MAP package at different stages of the distribution process is very attractive. Oxygen sensing is achieved by detecting the degree of quenching of a fluorescent ruthenium complex entrapped in a sol-gel matrix. TTI are indicators [4] of food quality changes based on time-temperature history. In this context, the predicting power of a TTI greatly depends on the accuracy of the description of the kinetics of the food quality changes, the accuracy of the description of the kinetics of the TTI and the similarity of the temperature dependency of the quality change under consideration and the TTI developed. In many cases, the color of the TTIs attached to food packages will give an indication on the perceived time-temperature history. Intelligent packaging [5] has enabled to monitor and communicate information about food quality. This technology also helps to trace a product's history through the critical points in the food supply chain. In general, occurrence of elevated CO2 gas level is the prime indicator of food spoilage in packed foods and also its maintenance at optimal levels is essential to avoid spoilage in foods packed under MAP conditions. Hence, a CO2 sensor incorporated into food package can efficiently monitor product quality until it reaches the consumer. Although much progress has been made so far in the development of sensors monitoring CO2, most of them are not versatile for food packaging applications and suffers from limitations such as high equipment cost, bulkiness, and energy input requirement, including safety concerns.

**Images**

**Additional effects**

Indication of possible spoilage or undesirable growth of microorganisms.

**Important process parameters**

stability of packaging material, stability of composition of the modified atmosphere

**Important product parameters**

correct calibration of indicator, low sensitivity to storage temperature
What can it be used for?

**Products**
Sliced fresh meat, bakery products, sliced fruit and vegetables, fresh vegetable salads.

**Operations**
Packaging.

**Solutions for short comings**
Gas composition in MAP often changes over time, due to gas release through the packaging material. This can be monitored and/or controlled by using indicators. Indicator design has to be proposed to specific packaging material and to a specific food. Germination of microorganisms in packed food can change the composition of modified atmosphere. Such change has to be eliminated and indicated properly by indicators.

What can it NOT be used for?

**Products**
Stable solid foods due to complicated contact with modified atmosphere.

**Operations**
Penetration of air into packed product to influence of the internal atmosphere composition.

**Other limitations**
Incorrectness of the indicators, problems with relations between kinetics of quality and safety of the food product on time temperature history of food.

**Risks or hazards**
Spoilage of the packed product, growth of spoilage microorganisms or pathogens without indication of the changes by indicators. Changes in composition of modified atmosphere due to non-ideal tightness of the packaging film.

Implementation

**Maturity**
Applied indicators are not frequently placed on packaging materials (only used for more niche markets as well as brand products).

**Modularity**
Special indicators are related to special packaging material design and packed product.

**Consumer aspects**
Indicators are very convenient for consumers. They can judge the safety and quality of the packed product is stable and safe during shelf life.

**Legal aspects**
Food regulation is valid also for modified atmospheric packaging.

**Environmental aspects**
Prolonged shelf life of the unstable food products saves the energy necessary for sterilization.

Facilities that might be interesting for you

Further Information

**Institutes**
CSIC - IATA, University of Copenhagen, Dublin City University, Graz University of Technology, University of Regensburg, Queen's University Belfast, University of Strathclyde, Leibniz Institute for Agricultural Engineering, TU Berlin, Federal Research Institute of Nutrition and Food, CRYOLOG, Kyrgyzstan Turkey Manas University

**Companies**
Sigdopack S.A
References


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