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Raw Materials for Food and Health Care Applications: An Overview on the Role of Oxygen, Moisture, and Temperature on their Stability

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Abstract

Raw materials have been used in different branches of biotechnology (food, nutrition, pharmacy and health care). These materials are sensitive to several factors particularly oxygen, moisture, and temperature. The stability and quality of raw materials during their storages depend on these factors. This study provides a very short view on the effects of oxygen, moisture, and temperature on the stability of raw materials during storage period using selected literature information.

Keywords: Raw materials; Quality; Stability; Oxygen; Moisture; Temperature

Introduction

Natural materials play a decisive role in biotechnology (food, nutrition, pharmacy and health care). A major research and development on these materials focuses on their stability and storage. In this article, an effort has been made to provide a very short view from some available literature information on the effects of oxygen, moisture (water activity), and temperature on their stability within storage period [1-4].

Discussion

A very short view of each factors on the stability of the raw materials are given in the following:

Oxygen

All constituents of raw materials (proteins, carbohydrates, lipids, vitamins, and colorants) are sensitive to oxygen. Lipids are more susceptible to attack by oxygen than that of other constituents. Oxidation is a major deterioration process, which occurred in raw materials during the storage period or at high temperatures. This process is promoted by O_2. These effects result in a reduction of the quality for the raw materials. The rate of oxidative reactions depends on storage temperature, time course, and type of materials. Generally, the deterioration of raw materials can be reduced by: exclusion of oxygen; or addition of antioxidants to the raw materials [2,3,5-7].

Moisture

Water (moisture) is the second important chemical reagent involved in the deterioration of raw materials. Naturally occurring materials (carbohydrates, proteins, and vitamins) are susceptible to attack by micro-organisms (bacteria, molds, yeasts) in a water activity, a_w higher than 0.5 The chemical and biochemical deterioration of the materials mainly occur from intermediate to high a_w (0.7-0.9) values. The raw materials are susceptible to

microbiological contamination and the storage period is critical to prevent bacterial and fungal contamination. However the role of bacterial and fungal contamination may continue with a rise in bacterial lipopolysaccharides and mycotoxin content. Most of reactions proceed only with very low rates in very dry materials ($a_w \leq 0.2$). Deterioration by water is catalyzed by acids or bases. Raw materials (carbohydrates, proteins, or lipids) are also susceptible to acid/ base hydrolysis. The oxidative and hydrolysis of enzymatic and non-enzymatic reactions depends on water activity. Moisture can move from the external environment into the headspace via the packaging systems for the raw materials. An increase in relative humidity in the headspace results in a shorter shelf-life for higher sensitive materials to moisture than that of lower sensitive materials. To ensure adequate shelf-life, the moisture movement from the external environment to the headspace of a package must be reduced [5-9].

Temperature

The deterioration of raw materials over time course depends on temperature. A decrease in temperature generally decreases the rate of chemical reactions. Therefore, reduction of temperature as well as freezing process is frequently used to extend their shelf life. However, freezing is not a perfect method of storage and preservation. This is because the deterioration of the quality of materials at low temperatures may still occur. The level of deterioration of materials can be minimized by using optimum temperature; controlling rate of temperature reduction; and maintaining the temperature constants during storage [6-9].

Conclusion

The following conclusions were made:

A. raw materials particularly natural materials are sensitive to oxygen, moisture and temperature;

B. the raw materials are susceptible to microbiological contamination and the storage period is critical to prevent bacterial and fungal contamination. However, the role of bacterial and fungal contamination may continue with a rise in bacterial Lipopolysaccharides (LPS), and mycotoxin content;

C. the rate of materials deteriorations by oxygen (0xidative); and moisture (hydrolysis) depend on the level of oxygen, water activity and storage temperature; and

D. the chemical, biochemical and physical changes can be minimized, if optimal conditions of storage are respected, i.e., low and stable storage temperature; optimal values for water activity and oxygen availability; use of preservatives; and antioxidants.

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