

## Research on preservation packaging technology of fruits and vegetables under the background of intelligence

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**Abstract:** Fruit and vegetable fresh-keeping packaging technology is a kind of modern fresh-keeping technology with strong application, which can better maintain product quality and reduce the loss rate of fruits and vegetables. In recent years, with the emergence and rapid development of fresh e-commerce, consumers' requirements for the quality of fruits and vegetables continue to improve, which makes the market put forward new demands for the performance of fresh-keeping packaging, which makes the technology of fresh-keeping packaging of fruits and vegetables present a more diversified development trend. Through the design cases of intelligent interactive technologies such as interactive technology, new packaging materials and two-dimensional code, the basic functions of fresh fruit and vegetable packaging can be guaranteed, the good interactive experience between consumers and fresh fruit and vegetable packaging can be enhanced, and the emotional needs and consumption experience of consumers can be met or even stimulated. In the new era, designers need to remain sensitive to design, adhere to the user-centric approach, integrate information intelligent technology, realize the upgrade of consumer packaging interactive experience, and explore the multiple possibilities of future intelligent interactive packaging design.

### 1. Introduction

In recent years, integrated design, as an important theoretical idea leading the packaging design industry chain, has attracted extensive attention in the packaging design field. With the development of science and technology and social progress, intelligent packaging is more and more used in packaging design with humanization and convenience, and its technical principles and forms of expression are diverse, such as color changing packaging, voice packaging and so on [1]. Packaging is ubiquitous and closely related to life. Food packaging represented by fresh fruits and vegetables plays a vital role in people's daily life. At present, the annual output of fruits and vegetables in China ranks first and second in the world [2]. Due to the strong seasonality and regional nature of fruit and vegetable production, and the weak processing capacity of fruit and vegetable, sales are basically based on fresh sales. However, in the process of fresh sales, due to insufficient storage and transportation capacity of fruits and vegetables, and backward equipment, China's annual problems The direct economic loss caused by the deterioration of fruits and vegetables amounts to about 35% of the total output, and some products have reduced the commodity value due to poor packaging technology, causing tens of billions of economic losses to the country, farmers and commercial sectors [3]. Therefore, the preservation and packaging technology of fruits and vegetables has become an important problem to be solved. Postnatal storage and processing of agricultural products is very important, which is the continuation of agricultural production. After picking fruits and vegetables, complex physiological, biological and physical changes still occur in the fruit body [4]. During breathing, fruits and vegetables will inhale oxygen, exhale carbon dioxide, produce ethylene and reduce water content. In order to keep the freshness of fruits and vegetables to the maximum extent and prolong the ripening process of fruits and vegetables, it is necessary to create an environment with low temperature, high humidity, low oxygen, high carbon dioxide, low ethylene and sterility. At present, countries have adopted some new technologies and methods in the preservation of fruits and vegetables, which are worth learning from [5].

## 2. Intelligent fruit and vegetable fresh-keeping packaging

Regarding the concept of intelligent packaging, it is a perfection of the traditional packaging concept. The definition of smart packaging was given at the “Smart Packaging” conference held in London in 2016: “It refers to the integration of integrated components or the use of new materials, a certain special structure and technology in packaging, so that the packaging can simulate human behavior. A certain function, and can replace part of human behavior steps in the process of packaging use. On the basis of satisfying the functions of traditional packaging, it actively intervenes and guarantees the quality, circulation safety and convenient use of products, so as to better realize the functions of use and management in the process of packaging circulation [6]. ” The proposal of this concept clarifies the goal of future packaging design, especially for intelligent transportation packaging design. High technology and excellent structure have a great positive effect on the storage and transportation of products.

### 2.1. Analysis on the present situation of fresh fruit and vegetable packaging design

The effective application of modern intelligent technology can enhance the interaction between fruit and vegetable packaging design and consumers, and increase the stickiness of packaging brand. At present, the packaging design status of fresh fruits and vegetables market, to a large extent, restricts the application of intelligent technology in fruit and vegetable packaging design and the realization of consumers' interactive experience of product packaging:

(1) Due to the limitation of scene and cost, plastic bags and cartons are generally used to replace finished product packaging in the sale of fresh fruits and vegetables in farmers' markets. Intelligent technology is not applied in the design and application of online shopping packaging of fresh fruits and vegetables, which brings a lot of inconvenience to logistics and transportation. Improper design of packaging information also reduces users' trust in products and consumption experience.

(2) In order to reduce costs, some illegal businesses fill the corrugated space with cement, lime and other materials to increase or decrease the hardness index of the packaging. This kind of opportunistic behavior has brought packaging damage, cumbersome disassembly, and fruit and vegetable production to logistics and terminal retail. Problems such as fresh rot and deterioration have seriously affected the interactive experience of customers on packaging.

(3) Making exquisite and gorgeous packaging with unique shape can increase consumers' satisfaction with the sensory interactive experience of packaging design, but excessive packaging is a waste, which increases the interactive burden of consumers. The interactive practical, intelligent and efficient fresh fruit and vegetable packaging design is what consumers really need.

(4) Primary fresh fruit and vegetable packaging lacks humanistic consciousness and pays no attention to the important role of intelligent interactive design of fresh fruit and vegetable packaging in quality pursuit and emotional interaction. There are many problems in the design of consumers' psychological and physiological needs. How to solve the problems existing in fresh fruit and vegetable packaging and the design of entertainment interactive experience between packaging and consumers are the key topics for designers to study intelligent interactive packaging in the future.

Table 1 Principles, Purposes and Techniques of Fruit and Vegetable Fresh-keeping

Principle	Purpose	Technology
Cryopreservation	Suppress breathing	Pre-cooling
Low temperature circulation	Suppress evaporation	Cryopreservation
Regulate moisture	Prevent weight loss and stickiness	Package
	Prevent condensation and corruption	Packaging, coating
Atmosphere	Inhibit respiration and metabolism	Package
	Inhibit browning and odor	Packed gas cold storage car, decompression
Remove ethylene	Inhibit metabolic maturation	Adsorption to remove or decompose to remove ethylene
Suppress ethylene production	Inhibit metabolic maturation	Physiologically active substance

Foreign countries currently adopt methods of cooling them immediately after harvesting, storing them at low temperatures, and keeping them fresh. They rely on cooling and low temperature to

inhibit respiration, evaporation, and metabolism, and packaging to inhibit evaporation and drying. From the mechanism point of view, it is indeed a reasonable preservation method. Table 1 lists the principle, purpose and technology of fruit and vegetable preservation.

### 3. Intelligent packaging technology of fruits and vegetables

Information intelligent technology is mainly realized by two-dimensional code. Based on the powerful information storage and reading function of two-dimensional code technology, we store the detailed information and circulation information of the product. When there is a reading demand, staff or consumers only need to scan the two-dimensional code area to accurately obtain the information they need. In order to highlight the characteristics of fresh fruits and vegetables more intuitively, some fruit packaging designs adopt the design method of combining transparent packaging with labels of fruits and vegetables, and the packaging design of fresh fruits and vegetables gives consumers pleasant visual enjoyment. The packaging design of this fresh fruit and vegetable product pays great attention to the visual interaction between consumers and fresh fruits and vegetables, which can stimulate consumers' strong desire to buy. See Figure 1 for the fruit packaging design.



Figure 1 Fruit packaging design

In addition, the use of this two-dimensional code in the sales packaging of organic vegetable and fruit products also has functions such as facilitating smart shopping, assisting in brand concept promotion, and encrypting anti-counterfeiting. The fresh-keeping active packaging technology of fruits and vegetables uses absorption, release, migration of gases or substances to change the storage conditions of fruits and vegetables, so as to achieve the purpose of maintaining the quality of fruits and vegetables and extending the shelf life. Usually, the active packaging technology of fruits and vegetables is to put the active materials into the packaging bag in the form of small bag or composite paper, spray them on the inner surface of the packaging film, and implant them into the packaging film in some way. According to the functions of active materials, food active packaging can be divided into O<sub>2</sub> absorption/release packaging, CO<sub>2</sub> absorption/release packaging, C<sub>2</sub>H<sub>4</sub> absorption/release packaging, humidity control/anti-fog packaging, antibacterial packaging, odor removal/fragrance release packaging, ultraviolet absorption packaging and ethanol release packaging, etc. The active packaging that can be used for the preservation of fruits and vegetables mainly includes O<sub>2</sub> absorption/release packaging, CO<sub>2</sub> absorption/release packaging, C<sub>2</sub>H<sub>4</sub> controlled packaging, humidity control/anti-fog packaging, and antibacterial packaging.

There are some advantages in intelligent packaging design, such as:

- (1) Intellectualization saves human resources to a certain extent and increases product functions.
- (2) Intelligent packaging can reduce management cost.
- (3) Intelligent packaging can effectively avoid mistakes.
- (4) Intelligent packaging can trace the source of products.
- (5) Intelligent packaging has a powerful information storage function, allowing staff to quickly and conveniently obtain the required information.

Therefore, in the transportation packaging design, taking the advantage of intelligence as the direction not only ensures the quantity and quality of products, but also, more importantly, improves the efficiency of team cooperation in product packaging design, and follows the systematic and sustainable design principles. In the future, the packaging design of fresh fruits and

vegetables should pay more attention to the intelligent interactive design of packaging, both in transportation and emotional experience. The application of intelligent technology increases the interaction between consumers and packaging, and enriches the emotional needs of consumers.

To prevent cold or freezing damage, we must first understand the habits of different fruits and vegetables, adopt appropriate refrigeration temperatures, and at the same time strictly control the storage temperature to reduce temperature fluctuations. In addition, pre-cooling is done in the early stage of fruit and vegetable storage, and methods such as gradual cooling can also reduce or eliminate chilling damage.



Figure 2 Refrigeration and fresh-keeping technology of fruits and vegetables

With the aid of artificial intelligence technology, modern packaging design of fresh fruit and vegetable transportation reduces the packaging processing procedures, reduces the material loss of packaging technology, optimizes the structure, and complies with the principle of "form is the natural growth of function". According to the attributes of fresh fruits and vegetables, market environment and consumer demand, the packaging design was finally determined and optimized.

#### 4. Conclusions

In today's society, drinks have become an indispensable drink in people's lives. Especially with the accelerated pace of life and the growth of economic income, people have changed from pursuing food and clothing to pursuing nutrition. With the rapid development of science, technology and economy in today's society, consumers' requirements for the quality and safety of fresh fruits and vegetables are constantly improving. In the past few decades, the fresh-keeping packaging technology of fruits and vegetables has been developed rapidly, and researchers have developed a series of technical achievements. This has prompted a diversified development trend of fruit and vegetable preservation packaging technology in the future. In China, the loss caused by improper storage and transportation after harvest is higher than that of developed countries, and the direct economic loss is up to billion. Therefore, the transportation packaging design of fruit and vegetable products not only leads to an alarming loss ratio of Chinese fruit and vegetable products, but also restricts Chinese fruit and vegetable products from entering the international market. The establishment of fresh fruit and vegetable trading platform and e-commerce has become an important trading mode of modern fresh fruit and vegetable. The application of artificial intelligence technology in the design of fresh fruit and vegetable packaging has brought new development impetus to it, brought many possibilities to modern packaging design, and solved the current uneven, interactive dislocation, and excessive packaging of fresh fruit and vegetable packaging. As well as the lack of human awareness, it explored the possibility of intelligent interactive sharing packaging, green packaging, and technology, while also satisfying the intelligent interactive experience and emotional appeal of consumers and packaging. To sum up, our combination of technology and art not only brings more convenience and fun to people's healthy

life, but also further enhances the international competitiveness of China's fruit and vegetable products transportation and packaging, and finds a breakthrough for fruit and vegetable products to enter the international market. This design is really made for the market demand, and it will show its great value and significance in practice in the future, so it has broad development prospects.

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