Appearance Optimization Design for Fruit and Vegetable Storage Box

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Abstract. There's a great demand for fruit and vegetable storage in Chinese kitchens. However, the storage boxes and shelves have many problems. By analyzing the design of the existing fruit and vegetable storage boxes, the paper sums up the shortcomings of function, appearance, man-machine relationship, material and color. On the basis of this, the design idea is optimized and the new fruit and vegetable storage box is designed which is multi-functional, environmental friendly and humanized.

Introduction

China is a fruit and vegetable production and consumption power. Vegetable and fruit consumption has become an important part of the expenditure of urban residents in China. Studies have showed that China's Annual per capita consumption of major fruits and vegetables has showed a gradually increasing trend since 2002 [1]. Fruits and vegetables contain a variety of nutrients needed by human body. They are indispensable food in our life. But there are strong seasonal and regional problems in the production and fruits and vegetables them selves are perishable, which is in contradiction with consumers’ demand for the diversity of them [2]. Therefore, the storage and preservation of fruits and vegetables has become one of the most important problems in today’s family life. However, the existing fruit and vegetable storage boxes have few species, limited functions, which cannot meet the requirements in many aspects. Moreover, the existing products can’t merge the product into indoor environment because of their appearances, materials and colors. Therefore, it is very necessary to design a new fruit and vegetable storage box with good appearance, good functions and based on Ergonomics.

The Analysis of the Existing Products

Refrigerator. In general, many families put most fruits and vegetables in refrigerator. However, some fruits and vegetables are not suited to be stored in refrigerator. Because:

(I) Generally speaking, the optimum temperature for the preservation of fruits and vegetables is between 0℃ to 10℃ [3], but different fruits and vegetables have different requirements for temperature. For example, bananas, lemons and melons are sensitive to low temperature. If the temperature is low, it will result in browning and affect the appearance and the quality. If blindly put this kind of fruits and vegetables into refrigerator for low temperature preservation, we will accelerate the decay of them.

(II) Some fruits in the storage process require a certain humidity as well as free ventilation. But it is usually difficult to keep a well ventilated environment in refrigerator.
(III) There are a number of special types of fruits and vegetables: Root vegetables such as potatoes and carrots have a lot of dirt and bacteria on their surfaces, which will dirty other food in refrigerator and cause some health problems. However, the soil on the surface should be kept since it is conducive to the preservation.

(IV) Some fruits and vegetables need special storage methods. Such as scallions and some leafy greens should be placed vertically to keep on their vegetable growth, which is more conducive to their preservation.

These kinds of fruits and vegetables are not suitable for keeping in refrigerator and leaving them in refrigerator is a waste of space and resources. However, having them placed in the kitchen casually is not a good idea either, since this will mess up the room and the fruits and vegetables will be easy to dry because of lacking moisture.

**Kitchen shelf.** Kitchen shelf has the storage function of fruits and vegetables, as shown in Fig.1. But most of them are short of appearance design and modeling language usage, monotonous in type and function and unreasonable in the usage of material and resource. All of the reasons above show that the in the process of the kitchen shelf design today, relationship between man, machine and environment usually has not been considered from the point of environmental protection and ecological protection. Therefore, the design should be optimized from every aspect to reduce the waste of material and materialize the multiple use of resource, in order to achieve the harmonious co-existence among man, machine and environment.

Figure 1. The Existing Kitchen Shelves.

**Problems of the Original Product Design**

Based on the analysis of the existing kitchen shelves, the author finds that there are many problems with the design of them. Those products usually have single function, poor appearances and monotonous language modelings. Moreover, the designers who designed them probably didn’t consider the comfort and safety of using and the integration of the product and the surroundings. The analysis of the problems is shown in Tab. 1.

<table>
<thead>
<tr>
<th>Elements of design</th>
<th>Problems</th>
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<tbody>
<tr>
<td>Function</td>
<td>can only store goods and can not provide a certain moisturizing, cooling function</td>
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<tr>
<td>Appearance</td>
<td>The modeling languages are monotonous and can’t integrated with the surroundings</td>
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</table>
Man-machine relationship

Lacking consideration of anthropometric data makes the product inconvenient.

Material and color

The materials are easy to age, the colors are monotonous and can’t integrate with the surroundings indoor.

Optimization Design Ideas of the Product

To solve the above problems, when doing optimization design of fruit and vegetable storage box, designers need to focus on the environment, and design from the aspects of function, ergonomics, materials and colors. The objective is to design an environmental friendly fruit and vegetable storage box which has reasonable functions and is integrated with the surroundings.

Optimization Design Idea of Function and Appearance

The fruits and vegetables not suitable for storing in the refrigerator can only be placed on shelves on the temporary. However, due to the single function and monotonous modeling languages of the existing kitchen shelves, keeping them in the room all day long makes users produce aesthetic fatigue easily. If we can enrich the functions of the product, refine its appearance and make it become a decoration in the room, it will bring users a new feeling and a pleasant experience, thereby increasing the market competitiveness of the products.

Optimization Design Idea of Man-Machine Relationship

The design of the existing kitchen shelves lacks the study of anthropometric data. For example, the sizes of handles don’t match human hands, which is inconvenient to use; Since the manufacturers of this type of products are often small commodity processing plants, the details of the products can’t be handled well; And since most of the storage shelves and storage boxes are not designed for storage of fruits and vegetables only, there is a waste of space when storing fruits and vegetables.

Optimization Design Idea of Material and Color

Good color design and material selection can bring users a good emotional experience. In order to give users a better experience, the materials and colors of household products should be integrated with the indoor surroundings. Therefore, when doing product optimization design, colors should be selected based on aesthetics principles to make the overall color clean, gentle and suitable for the environment; Selections of materials should consider natural, environmentally friendly materials appropriately to improve the affinity of the product.

Optimization Design of the Product

Rich and Reasonable Function Setting

It is possible to stand out in the complex market competition only by functional innovation [4]. Therefore, when setting the product functions, the recycling of kitchen water and the purifying of indoor air are added in addition to the original storage function. With the application of the computer aided design method, the final modeling scheme of the fruit and vegetable storage box is finished, as shown in Fig. 2. The board at the upper end of the box can be placed washed vegetables or fruits, and the water on the surfaces of vegetables or fruits will flow into the water storage tank through the board, as shown in Fig. 3. The water stored in the water storage tank plays a certain role in cooling and...
moisturizing the indoor air by evaporation. And the extra water spilled from the tank can flow into the plant boards around the box to water the plants. The three plant boards placed around the fruit and vegetable storage box are covered by pitaya seedling of soilless culture, as shown in Fig. 4. The usual watering of the plants and the growing of the plants themselves can both cool down the food and moisturize the air in the box. Moreover, the growth of plants can beautify the indoor environment and purify the air at the same time. The water flowed from the plant board will enter the other water storage tank at the bottom of the box, as shown in Fig. 5.

Figure 2. The Final Modeling Scheme.

Figure 3. The Board and the Upper Water Storage Tank.
Environmental Friendliness

The design combines the product design with ecological concepts, which reflects on the function setting of the product is to optimize the product functions to reduce the waste of the resources during use as far as possible. After meeting the versatility demand, the design of the fruit and vegetable storage box breaks through the existing kitchen shelf design, integrates with the surroundings and beautifies the room. The biggest innovation point in this design is that the author uses green plant to decorate the fruit and vegetable storage box, moisturizing and cooling the inner and outer box, purifying the air and beautifying the indoor environment in a natural eco-friendly way. The plant selected in this design is Pitaya seedling. Researches show that Pitaya seedling is green, dense and drought tolerant. And it is easy to grow without other plant growth regulator as long as there is sufficient moisture [5]. These meet the requirements of the plant used as the decoration of the fruit and vegetable storage box.

The board at the upper end of the box is made of bamboo based panel coated with waterproof material. China is one of the world's leading producers of bamboo, and it is abundant in bamboo resource[6]. Bamboo is fast-growing, low-cost, environment friendly and easy to recycle. The use of bamboo can reduce the waste of resources and protect the environment from the choice of materials. Besides, bamboo also has the excellent characteristic of hard and durable texture; The material of the main box is green ABS (Acrylonitrile-butadiene-styrene) boards. Green ABS is non-toxic, harmless
and biodegradable, suitable for family environment. The use of the material can reduce the environmental pollution to the minimum.

**Ergonomic Design**

Better Ergonomic design makes the product more convenient and comfortable for users. In the process of the fruit and vegetable storage box design, the sizes of the box and the drawer handles are limited to the specific scope based on the national standard of anthropometric data. The sizes of the drawers are designed according to the sizes of different fruits and vegetables, and the space in the storage box is divided into a large part and two small parts by the drawers. In addition, a tall, narrow drawer is designed for storing scallion and some leafy greens; the concern of humanization is reflected in the details too. For example, the rounded corners on the drawer handles allow users to grasp more comfortable, the caster wheels at the bottom of the storage box make it easy to move.

**Summary**

The optimization design of the fruit and vegetable storage box takes function integration and appearance design as the breakthrough point. The objective is to optimize the relationship between man, machine and environment. The design improves the appearance, optimizes the usage and makes the product integrated with the surroundings from the aspects of function, man-machine relationship, material and color. The method is not only suitable for the optimization design of the fruit and vegetable storage box, but also can provide references for the optimization design of the related household products.

**Acknowledgement**

The current study was supported by the Fundamental Research Funds for the Central Universities (YX2013-25).

**References**


