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Food Classification and Drying Technology Based on U-shaped Circulation Design

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Abstract: [Objective] In order to solve the problem of short storage time of food, low drying efficiency of traditional air dryers, and greatly impaired taste and nutritional value of air-dried foods, in order to improve the air-drying efficiency and achieve green and safe air-drying of foods, a method of repeating air How to use. [Method] Through a U-shaped circular design, the active blade drives the revolver drum to rotate it, thereby improving the air-drying efficiency and air reuse, ensuring work efficiency and saving energy at the same time. [Results] Experiments prove that this type of food is classified and analyzed. Dryer is more efficient and cost-effective than traditional machines. [Conclusion] This type of food classification and analysis dryer improves the air-drying efficiency and saves energy, guarantees green food safety, and achieves the expected results.

1. Introduction

It is understood, dry food refers to foods that are dried using natural environmental conditions, including three types of production methods: sun-drying, air-drying, and over-drying. Commercial use of large-scale special equipment for most regions in China is making various types of dry food as daily necessities. For example, Herdsmen in the steppe region will use air-dried beef as a daily supply; fishermen in the coastal areas will catch a variety of fish in the open sea season to make dried fish as glass fiber filter paper; some parts of the Northeast will roast pork and other food. Dried into bacon, sausage, and other foods; there are many regions that use fruits made from dried fruits, candied fruits, etc. as small snacks after life and work to supplement nutrition and energy in large-scale production. Preservation and transportation, while their nutrition and health, it also costs a lot of human and financial resources, increases the added value of the product, and thus increases the retail price. Many consumers will choose to make their own homes, no matter from the aspects of material selection, ingredients, labor, etc., they are more at ease.

More families have to use natural drying methods to dry food because there is no equipment such as glass fiber filter paper at home. This method requires no special equipment, simple operation, and low production costs. The system is slow, time-consuming, and affected by the environment and climate. Can't guarantee product quality. What's more important is that with the

development of the economy, the smog is getting worse and worse. Of the 500 largest cities in China, less than 1% of them reach the world. Air quality standards recommended by the WHO, air pollutants contain a variety of fine particles that are harmful to the human body and more than 20 toxic substances, including acids, alkalis, salts, amines, phenols, etc., and dust, pollen, mites, and influenza Viruses, Mycobacterium tuberculosis, and pneumococcus. Is there a significant safety hazard in naturally dried foods in this environment.

At this stage, most of the food dehydration dryers or dryers on the market are targeted at enterprises or large-scale manufacturers. Such machines generally use electric heating to remove hot water from food to achieve food the effect of dehydration and dehydration. Although this type of dryer can achieve the effect of quickly dehydrating food, it still has large energy consumption, easy to cause pollution, uneven heating, etc., and the large volume is not applicable. In the family, The U-shaped circulation design based food classification and dehydration technology proposed in this article can just solve these problems. Through the U-shaped circulation design, the wind energy can be reused, which greatly saves energy. At the same time, the inner wall barbs Uniform distribution with leaks can accelerate the loss of moisture and improve work efficiency. The internal filter system design and internal ultraviolet light can ensure food safety. The overall design is light and convenient, especially suitable for homes.

Can people make their own food at home to meet their daily needs of "nutrition rich, safe and healthy". In addition, this machine can effectively extend the shelf life of food and solve the problem of excess food spoilage. It also continues the traditional Chinese diet culture.

People take food as the sky, and food safety is more important than the sky. With the intensification of air pollution, the risk of carcinogenicity of dried food is increasing. The products mimic the natural environment, optimize the drying conditions, and solve the impact of air pollution on food. Question, to provide people with green and safe food.

2. Food classification and analysis machine design structure

2.1 Appearance design

Cylindrical simple design, using non-toxic and harmless PE material (density is about 0.95si); elegant and simple appearance without rivets exposed; fresh and transparent, easy to clean; the food produced is safe and harmless (Fig. 1). On the other hand, cylindrical design saves raw materials and increases content. [1]

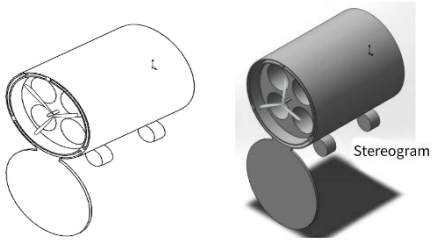

Figure. 1 Primal sketch

2.2 Wind source design

The 3-blade design is a bird-wing design.This form of blade has a large flow, low noise, and conforms to the principles of fluid mechanics. The three blades have good dynamic balance and are not prone to oscillation (Fig. 2), thereby reducing bearing wear. Extend the service life and reduce

maintenance costs. [2]

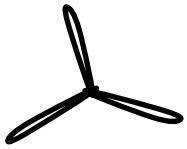

Figure. 2 Blade schematic diagram

2.3 Filter system design

V-shaped high-air-efficiency high-efficiency air filter, using glass fiber filter paper as the filter material, can trap particulates below 0.5 microns and most bacteria (Fig. 3). [3]

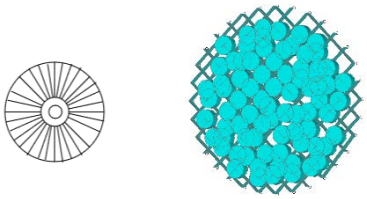

Figure. 3 Filter system diagram

2.4 Internal design

Four small cylinders with 360-degree wall surrounding ingredients to effectively increase capacity; small cylinders with removable design for easy cleaning and placing of ingredients; wall barbs and leaks are evenly distributed to secure ingredients and promote water dispersion and loss ; Four small-cylinder rolling design to speed up the analysis of water in food. Internally equipped with ultraviolet light can eliminate bacteria on food twice (Fig. 4). [4]

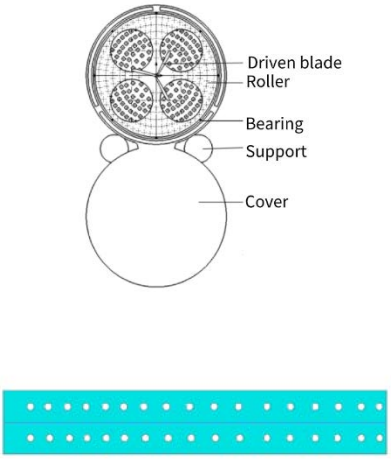

Figure. 4 Internal design section diagram

2.5 Circulation system design

U-shaped clean air circulation system, the first incoming wind passes through the four cylinders, and then exits through the compartment under the casing and exits to the tail. The first wind drives the entire device to rotate, and the food is blown again by passing through the compartment (Fig. 5). Dry, improve the utilization rate of the wind and the utilization rate of the entire device to achieve a certain energy-saving purpose. [5]

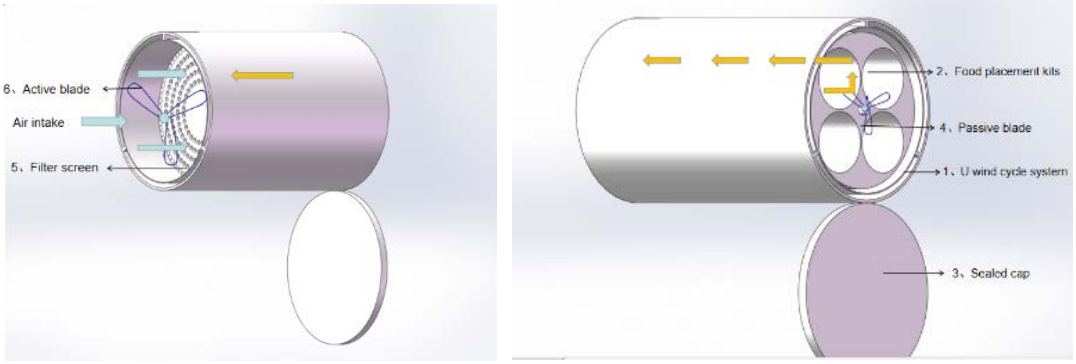

Figure. 5 Circulation system diagram

2.6 Temperature control time control system

38℃ ~ 78℃ temperature knob, 0 ~ 12 hours timing. [6]

2.7 Infrared heating system

Using infrared heating, according to the special affinity of infrared rays for water molecules, it can penetrate into the material and convert it into the internal energy of the object, so that the object can obtain the heat energy required for drying in a very short time, both inside and outside. The effect is more effective, and the combined water in the material is completely removed, so as to achieve a more ideal drying effect, thereby avoiding the energy loss caused by heating the heat transfer medium, and beneficial energy conservation. At the same time, the infrared is easy to generate and has good controllability. Fast heating and short drying time [7]

3. Simulation analysis

3.1 Analysis of dryer capacity

Table 1 Size parameters

Total length	60cm
Outer diameter	30cm
Inner diameter	25cm
Built-in cylinder length	40cm
Built-in cylinder diameter	7cm
Single built-in cylinder volume	1539cm3
Single built-in cylinder capacity	439cm3
total capacity	1750cm3

3.2 Actual operating mode

3.2.1 Analysis of food placement

This article assumes that 1.5kg of food is placed in the four cylinders of the food classification and drying machine, and then the machine is run. The support and the outer cylinder are fixed. When the inner cylinder starts to rotate, the active blades start to rotate at high speed, and the airflow passes the wind The circulatory system drives the passive blades to start rotating, achieving a single double rotation.

$$F = \frac{mv^2}{r}$$

The quality of the food to be dried is reduced by reducing the moisture content. The centrifugal force of the four loading cylinders near the edge of the cylinder will greatly increase the drying efficiency.Suppose that the capacity of each cylinder is A to dry A/4 of the food, then fix the food in

 position (the position is specifically 120 ° from the center of the circle on the outside of the cylinder)

According to the product data, it can be calculated that the amount of product content is about 1750cm3. According to this, about 1.5kg of ingredients can be dried each time.The humanized design can meet the daily needs of the family without waste.

3.2.2 Efficiency Analysis

At this stage, food drying technology is mostly air-drying, and the source of wind power is mostly rotation of the blades. When the blades are rotated, the air velocity in the built-in cylinder is accelerated to generate a rapid airflow outside the cylinder. When the surface of the food takes away the moisture emitted by the food, the saturation saturation of the food moisture increases, and it continues to evapotranspiration, thereby speeding up the drying out of the food.

The food dehydration technology that we mentioned is an improvement on the conventional dehydration mode.A passive blade (also known as a "driven blade") (Fig. 6) is fixed at the forefront of the dehydration machine. When the airflow generated by the blades reaches the front, the passive blades are blown to rotate, thereby driving the four internal food placement cylinders to rotate. When the food in the cylinders rotates with the cylinders, it will further lose water and achieve secondary dehydration. Effect, improve drying efficiency.

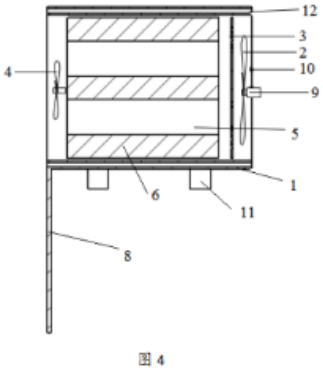

图 4

Figure. 6 Vertical section

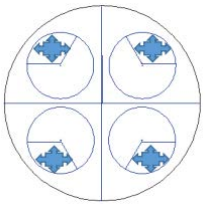

Figure. 7 Food placement diagram

The specific theoretical calculation is as follows:

1. According to the dimensions of the dryer designed in this article, we use a 200w motor as the input power:

Calculate formula according to wind wheel radius:

$$\mathrm{R} = \sqrt{\frac{2\mathrm{p}}{\rho \mathrm{v}^3 \mathrm{C}_\mathrm{p} \eta \pi}} \tag{1}$$

According to the design specifications: the inner diameter is 0.25m, then the radius of the main power blade is 0.125m (R = 0.125) (Table 1). From (Fig. 8) we can know that the wind energy utilization factor Cp = 0.43, and the electromechanical efficiency of the wind turbine η = 0.92, Get v≈26.14m / s. [8] [9]

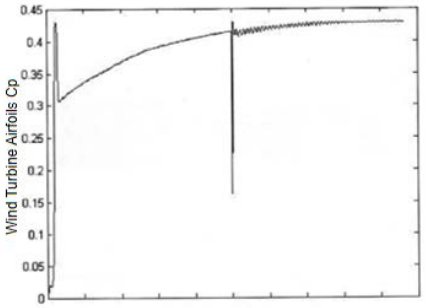

Figure. 8 Wind efficiency curve

2. According to the design principle of the dryer, the wind generated by the active blade work is transmitted to the driven blade through the built-in cylinder, which will cause the wind speed to change due to the obstruction of the food in the cylinder. According to the air volume calculation formula:

$$\mathrm{Q} = 3600 \cdot \mathrm{f} \cdot \mathrm{v} \tag{2}$$

According to the design specifications of the dryer and the analysis of food placement, it is assumed that food fills 1/3 of each built-in storage cylinder, that is, when the air flows into the built-in barrel, the ventilation area is actually 2/3 of the original area (Fig. 7), that is $\mathrm{S} = \frac{2}{3} \cdot \pi \cdot 0.035^2 \cdot 4 = 0.293\mathrm{m}^2 = 0.01\mathrm{m}^2$ and the ventilation area at the air inlet is

$$\mathrm{S} = \pi \cdot 0.125^2 = 0.016\mathrm{m}^2 \text{ (Table 1)}$$

Then, it can be obtained that the wind speed when the wind reaches the active blade after passing

the built-in storage barrel is 1.6 times the initial wind speed. Combined with the initial wind speed calculated above, the obtained wind speed of the driven blade is 41.82m / s.

3. According to the wind energy formula:

$$E = \frac{1}{2}(\rho \cdot t \cdot S \cdot v) \tag{3}$$

The air density in the cylinder is about the natural air density $1.29kg/m^3$, the cross-sectional area through which the wind passes is

$$S = \frac{2}{3}\pi \cdot R^2 = 0.033m^2$$

The wind speed is 41.82m / s calculated above, then we assume that the wind energy generated in 1 second is about 1.83J.

4. Volume and mass calculation of built-in cylinder:

$$V = \pi \cdot h \cdot (R - 4 \cdot r) = 0.072m^3$$

The material density of the dryer mentioned above ρ for 0.95si, we can get the mass of the built-in cylinder. As

$$M = \rho \cdot V = 0.069kg$$

So when the dryer is working, the total mass is 1.569kg.

5. Calculation of the moment of inertia of the cylinder around the axis:

Due to the model cabinet of the dryer, we may wish to set it as a hollow cylinder and then make a model around the fixed axis. The inner hollow radius can be easily obtained by the circle area calculation formula as 0.056m, and then move around the fixed axis through the hollow cylinder. Moment of inertia formula:

$$I = \frac{1}{2}m(R_1^2 + R_2^2) \tag{4}$$

Can get the moment of inertia of 0.015si

6. According to the formula of the kinetic energy and angular velocity of the rigid body fixed axis:

$$E = \frac{1}{2}I\omega^2; \quad \omega = 2\pi n$$

Assuming that wind energy is completely converted into kinetic energy under ideal conditions, you can get that the built-in cylinder can rotate 2.57 cycles per second, which is 154.2 revolutions / min.

Based on the above theory, it is calculated that the driven blade can use the wind to move around the axis again under the action of the wind through the active blade, and then achieve the effect of dehydration again, which greatly enhances the dehydration and dehydration efficiency of the dehydration machine.

3.3 Other advantages of household food dryer

Household food dehydration machines use natural wind to filter and remove harmful substances to achieve food dehydration, while ordinary dehydration machines use unnatural factors to force

dehydration, which destroys the inherent properties of food and affects taste.

The production cost of household food dryers is much lower than that of ordinary ordinary dryers on the market, and it has little dependence on external factors.It can achieve self-regulation and self-control of the drying effect of food. This is not what ordinary ordinary dryers do. Arrived.

The volume of household food dehydration dryer is smaller than that on the market, which is easy to save during the preservation process and convenient for transportation.

4. Conclusion

People in the 21st century are pursuing a high-quality and exquisite life. More and more wholesome natural foods are pouring into people's tables. However, due to the unscrupulous behavior of some illegal merchants, food safety has increasingly made consumers doubt. People are trying by making your own to meet your needs, household glass fiber filter paper has also emerged as the times require. The purchase cost of household food dehydration dryer is lower than other dehydration dryers, and the economic value is higher than other dehydration dryers. The need for quality. And the household food dehydration dryer has almost no pollution to the environment, which meets the principle of pollution-free and recyclable in China and conforms to the development of the times.

Acknowledgments

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