

## DRYING AND DRYING SYSTEMS IN VEGETABLES

**M. Salih ALAKAŞLI**

Siirt University Agriculture Faculty, Department of Horticulture, Turkey  
e-mail: malakasli@hotmail.com

**M. Zeki KARİPÇİN**

Siirt University Agriculture Faculty, Department of Horticulture, Turkey  
e-mail: [zkaripcin@siirt.edu.tr](mailto:zkaripcin@siirt.edu.tr)

### ABSTRACT

Vegetable or fruit to be dried to remove the water is called drying process. Since the moisture content of vegetables or fruits will be very low, the shelf life is increased parallel to the reduced moisture content. Because the microorganism activities in food is minimized. As a result, the shape and color of the food change. With the removal of the water forming the weight, the weight of the food in unit weight is reduced. Again, the amount of dry matter of the same food increases with the removal of water. The main purpose of drying is to ensure that the food is delivered to human nutrition in a healthy way outside the season. Therefore, drying methods are important for health. In the drying stage, the risk of transmission of the disease pathogen and the risk of virus transport by the effect of different insects and rodents indicate that this sector should not be randomized. An infected plant with an alpha toxin or a dried apple dried under high radiation, or any food infected by mice and other animals, will have a very negative impact on our health. Drying for the helping of the family economy or for the taste of the palate has become a big sector today. It is said that vegetables and fruits grown outside of the season are not hormone. A food to be consumed outside the season is more desirable than dried. Figs and grapes in fruits and tomato and pepper in vegetables are the essential foods can be dried. But how are our drying methods and storage conditions correct in terms of health? We can demonstrate the feasibility of this sector by using old technology, using new technology and taking into account new demands. Only dried tomato vegetables have an export potential of approximately \$ 70 million. The sector which will be formed by drying various vegetables in Siirt province which has natural drying sources (Sun, wind) will contribute to the economy of the province.

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**Keywords:** Dried Vegetable, Drying System , Vegetable.

### INTRODUCTION

Different methods have been developed and applied to obtain dried vegetables. Each method has its own characteristics. One method is less costly, and another can be dried in less time. Drying methods can be listed as follows; Drying in hot air, frying, drying by vacuum dehumidification, freeze drying [1, 2, 3, 4, 5]. Since the frying drying process will be carried out in oil, the health

value of the dried vegetables decreases due to the use of oil. Also fry raises the cost. Drying in the open air is a very healthy method if you pay attention to the cleaning conditions, as well as the frying method is quite cheap cost. Outdoor drying is the oldest known method of drying. However, drying outdoors requires quite a long time. During removal of the water contained in the food, the color and shape of the food in question also change in an undesirable direction. Nutritional value of vegetables, especially vitamin C decreases [6].

Vegetables are used in almost every part of human nutrition and are healthy nutrition arguments. Stems and stems (celery), roots (carrots), bulbs (onions), leaves (spinach, lettuce), flowers and flower trays (broccoli, artichoke and cauliflower), immature fruits (tomatoes, peppers, eggplant, etc.), seeds (beans, peas) and are indispensable foods in human daily diet [1]. Fruit and vegetable poor diets are among the factors that negatively affect health by the World Health Organization [2]. Almost all vegetables provide negligible amounts of saturated fat, trans fat and cholesterol. On the other hand, these vegetables contain plenty of vitamins, potassium, dietary fiber and iron. Vegetables can be physically damaged as well as being exposed to environmental conditions and chemical (effects of various pathogens) damages [7, 8].

Dried vegetables are among the indispensable foods preferred by people in many countries including China and the United States [9]. In China alone, the amount of dried vegetables is valued at approximately 800 million US dollars and about 60-70% (230,000 tons) of production [10]. At the beginning of the twenty-first century, the dried vegetables market in Europe was estimated to be around US \$ 260 million, but it should not be surprising that this figure is now close to US \$ 1 billion [11, 9]. Perhaps the most accurate foods of vegetables and fruits (because other foods such as yogurt, fish, etc.) are dried to increase the preservation time and have been carried out since ancient times [12, 13]. It is said that the Incas have discovered both the drying of the foods and the lyophysis process carried out with today's technology. Incas have dried the fruit and vegetables directly in the sun, as we do now. They freeze these foods in high places (due to low air pressure). Thus, they had the opportunity to use the food for a long time.

In fact, drying is to ensure that the moisture (water) in the desired food is removed from the food [14]. If there is not enough moisture in the food in question, it means that there is no microbial activity in that food. In the absence of microbial activity, there is no progress (maturity, coloration, etc.) in development. Again, the growth environment required by pathogens is also degraded [15]. In addition, since it has a capacity to invest in the economic markets, the drying sector is important even on the basis of developed countries. For example, approximately 65% of dried products are exported in our country [16]. Dried foods are concentrated foods. Drying processes are less costly than other processes. Dried foods can be consumed directly or used in different fields such as instant soup, compote, ready meals and baby food [15]. In general, the use of dried vegetables can be listed as follows;

- Instant Soup (green pepper, pumpkin, broccoli, tomato, garlic, onion, parsley, radish, cabbage, carrot, spinach, zucchini, mushroom)
- Turkish delight (rose, orange peel, lemon peel, strawberry)
- Used in rice and bulgur (pepper, eggplant, tomato, mushroom etc.)

- Used in Meat, Chicken, Fish, Raw Meatballs (onion, garlic, pepper, parsley etc.)
- Used in Tea, Herbal Tea, Diet Tea, Winter Tea, Fruit Tea (apple, fig, pear, lemon, orange, apricot, rosehip etc.)
- Used in Sweet Pudding and Chocolate
- Medication and Herbal Treatment (orange, lemon and pomegranate peel, rose, rose hip etc.)
- Used for making biscuits, cakes and crackers (strawberries, figs, apricots, grapes, etc.)
- Used in Pasta and Noodles (tomato, carrot, mushroom, leek, spinach)
- Used as Natural Color and Aroma Emitter (beet powder, orange-lemon peel etc.)
- Used in bread, pastry, cake mixes and bakery products
- Used in Pet Food (cabbage, fig, apricot, etc.)

It is understood that the drying of foods arises from necessity rather than a style. Another example in history is found in the travel book of the Venetian traveler Marco Polo [17]. The traveler lived in China under the patronage of the empire by meeting with the grandson of Genghis Khan, the founder of the Mongol Dynasty, the Mongol emperor Kublai Khan (1259 - 1294). When he returned to Venice (1295), he wrote that Mongolian soldiers carried milk powder in their daily accommodation. Marco Polo found that the Mongols boiled the milk and evaluated the remaining lean portion very well after taking the cream, and dried this portion in the sun. During the drying of all kinds of food, various changes occur, including physical, chemical, biochemical and microbiological. With the effect of these changes, the loss of nutritional value of foods, especially quality loss, leads to the loss of allure, which is a very important criterion in terms of marketing, and not to be demanded by consumers. Depending on the type of food and the amount of moisture it contains, storage conditions and duration, the effect of spoilage in foods is seen [18]. Variations in dried foods; Physical (dry matter accumulation, scaling, shrinkage in structure, changes in mass density and rehydration ability), chemical (changes in color, flavor, texture, viscosity, nutritional value and storage stability), Biochemical changes (bitter taste and odor formation) and microbiological changes (developments in *Alternaria*, *Aspergillus*, *Colletotrichum*, *Fusarium*, *Mucor* and *Rhizopus*, *Oospora* and *Penicillium* type mold microflora) [19, 20, 21, 22, 23].

Drying systems; The intersection point of obtaining low cost and healthy dried food passes through drying systems. Dried food with a high market value is a product that is dried in a healthy system and has high nutritional value. At the same time, the profit margin will satisfy the high dried food producer. Because of these, various drying systems have been researched and tried. These;

**Drying in the sun;** The beginning of this method, which is known and practiced by almost everyone, is very old. However, various contamination causes many adversities especially.

The fact that solar heat and light is unstable, cannot be applied everywhere, does not show continuity, and being completely uncontrolled by various factors, it maintains its economic advantage only. Solar sourced dryers are divided into two as *active solar drying systems* and *passive solar drying systems*. Controlled from these systems, harmful UV rays are prevented, the temperature is constant and the system is advantageous in a continuous continuum.

**Air Blowing Drying Systems;** It is a cheap and easy system. It can be used for drying different species according to the season, and hygienic and quick drying are the other superior aspects [24].

**Cabin type dryers;** in these systems with shelves, more granular products are dried. Foods are dried quickly [24].

**Vacuum drying;** it is especially used for drying fruits that need a long time to dry.

**Microwave Drying;** The principle of this system is to enable the conversion of electromagnetic energy to thermal energy by affecting the polar molecules in the product [25].

**Freeze drying;** this technique, also known as lyophilization, is based on the principle of removing water contained in the product without damaging the product. It is mainly used in sensitive products or biological products. In other words, unwanted water is removed by evaporation. In this system, product shape is protected from deterioration [26].

The most important aim of the combined dryers of these systems is to increase energy efficiency.

### Various drying machines;



Figure 1, 2. Vegetable and Fruit Dryer [27]



Figure 3, 4. Oven drying and Solar Dryers [28, 29]





Figure 5, 6. Industrial Drying Machines [30, 31]

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