Environmentally friendly technology for the production of powder for the food industry by drying the technically ripe fruits of the caper plant

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Abstract. The paper describes the innovative technology for the production of powder for the food industry by means of drying ripe fruits. It is shown that drying methods have a significant effect on the composition of the fruit when dried. Experiments have shown that the composition of the fruit changes when dried in the shade, and that these parameters do not change only when dried by lyophilization. The authors show that the composition of the fruit changes due to the high temperature in the cabinet dryer.

1 Introduction

Nature is a unique and unique source that meets all the vital needs of man. The existing balance between humanity and nature is so delicate, interdependent and so weak that sometimes it is very difficult to trace the beginning of a crisis, disaster or catastrophe.

It requires extraordinary scientific approaches and practical solutions for a common sustainable future in our century. Humanity is confronted every day with global problems, such as global climate change, water and air pollution, extinction of biological species and ecological systems, loss of soil fertility and declining crop yields. This, in turn, is closely linked to food insecurity, hunger, the economic crisis, profound social change, human health, and so on.

According to some estimates, by 2050 the population of the planet will reach 8.0 billion. Under the current non-environmental technologies, it is not difficult to understand that this will lead to a sharp deterioration of environmental quality, severe pollution of water and air, depletion of natural resources, many complex economic, energy, food and socio-political problems.

In the "Action Strategy of the Republic of Uzbekistan on 5 priority areas of development for 2017-2021", approved by the Decree of the President of the Republic of Uzbekistan dated February 7, 2017 No PD-4947, number of tasks have been determined to modernize and accelerate the development of agriculture [1].

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In particular, the expansion of research work on the creation of varieties of agricultural crops that are suitable for the soil and climatic conditions of the country, resistant to drought, salinity, heat and disease [2].

2 Materials and methods

Caper is a member of the Capers family, an herbaceous plant and shrub. They are simple or claw-like complex, located one by one, often without side leaves. The flowers are bisexual, solitary or in clusters. The calyx has 4 leaves and the corolla is 4 located diagonally. The stamens are unlimited; the carpel has 1-2 ovaries on the top, one or more cells and many seeds. The seed pods are bent, the fruit is cup-shaped or berry-shaped, the fruit is cracked and pollinated by insects [3].

The Caper family includes 150 species. Two species, *Capparis spinosa* and *Capparis rosanova*, that grow in Uzbekistan. The experiments used cultivars of caper that were cultivated and grown in extreme wild conditions.

In the wild plants of Caper, the stems are erect or semi-horizontal, many-branched, the leaves are small, the stems are covered with thorns, the number of fruits in single plant is 20-22, the average weight is 12-13 grams. The plant assimilation leaf surface is between 8040-9700 cm^2, absorbs moisture from the soil quickly and evaporates water less because the leaf plates are covered with a thin layer, so it is a very tolerant of droughts.

The number of fruits of the variety "Uzbekistan-20" was 40-45, with an average weight of 15 g or 675-700 grams per plant; 260-300 grams fruit yielded the naturally growing plant at this age, which is 400-420 grams less than the cultivated variety [4].

Due to its biological and physiological properties, caper can be grown even in steppe and waterless areas. This plant naturally grows and develops well in such conditions. But their productivity is not high. They, along with other vegetable crops, require agro-technical measures to obtain high yields. These include preparing seeds for planting, setting planting dates, preparing the ground for planting, and pest control [5].

3 Results and discussion

In view of the above, the caper fruits ripened in extreme conditions and grown in irrigated areas were selected for experiment according to drying methods. The experiments were carried out at the RustamaliKarimov farm in Chust district. The experiments were performed in two variants and in four plots.

Options were selected for drying two varieties of 10 kg, from wild-grown and cultivated crops of the cultivar "Uzbekistan-20". The plots were analyzed for drying methods. (Table 1).

Table 1. Influence of wild and cultivated caper fruit drying methods on output.

№	Varants	Product, kg	Drying methods in plots, kg.			
			1-sun drying	2-shadow	3-llyophilization	4-cabinet
1	Wild	10	2.69	2.75	1.80	2.84
2	Uzbekistan-20	10	2.95	3.10	1.97	3.07

During the experiment, the effect of wild and cultivated caper drying methods on the yield was studied. The technically ripe fruits of caper were harvested, sorted, calibrated and inspected. After preparation, the fruits were cut to a thickness of 3-4 mm, and the sliced fruits were weighed from 10 kg and selected for drying in four plots.

The first and second options in first plot ten kilograms of sliced fruit were dried in the sun. The first and second options in the second plot were dried in shade. In the first and second options we used the technology of drying by the method of lyophilization in the third plot. In the first option, the fourth plot fruits were dried using a cabinet dryer. During the drying process, the drying time of the product, the quantity of the product output and the quality indicators of the product were taken into account.

Fig. 1. Sample of powder made from dried fruit of caper. Figure 2. Sample of dried fruit from capers.

In the course of the observations, fruits ripened in extreme conditions and cultivated fruits "Uzbekistan-20" were selected. During the experiment, 26.9% of dried fruits in the first plot in the first option, 27.5% in the second plot, 18.0% in the third plot first option, and 28.4% in the fourth plot were obtained.

Taking into account the organoleptic quality, the differences in color properties from each other in terms of branding have been studied. All information below were belong to first option. In the first plot, the sun-dried fruit turned brown, with some bumps on the surface and edges of the fruit. In the second plot the fruits are dark green when shaded, and the surface of the fruit is wrinkled. In the third plot, it can be seen that the color and shape of the fruit did not change completely in the fruits dried by lyophilization. in the fourth plot, we can see that the color of the fruit did not change and there was a slight change in shape when using a cabinet dryer. Let's see the second option.

According to the results of drying the fruits in the second plot of the second variant, we can see that the quality of the product changed slightly compared to the first plot of the first variant, but there are color changes. In the second plot, there are bumps on the edge of the dark green fruit when dried in the shade. In the third plot, the shape of the fruit was preserved by lyophilization, no color change was observed, and it was considered an acceptable option.

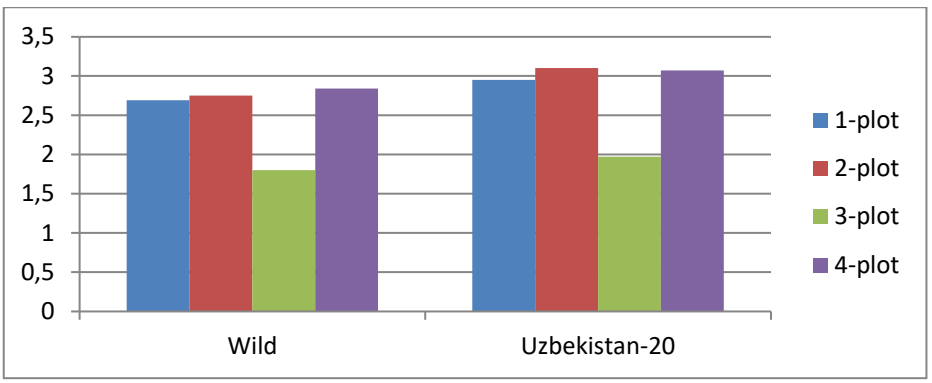

Fig. 2. Influence of the amount of product yield on the methods of drying when drying technically ripe caper fruit.

According to the results of the study, during the drying of caper fruit, the amount of vitamins and minerals in dried fruits by lyophilization did not change, and macro and micro elements remained in their natural state. In other variants, laboratory analysis revealed that the results of the third plot were completely consistent with the composition of the naturally grown fruit. The following diagram shows the yield of caper fruit in different ways of drying technically ripe fruit:

- development of early-maturing and high-yielding agricultural varieties suitable for different soil-climatic zones, proving the negative impact on consumer health on the basis of gennokaut biotechnology;
- creating new types of products that can replace exports and using local raw materials instead of import.

In view of the above, we have chosen curative specie-capers (Capparis spinosa). Capers is a plant that grows in arids, hills and steppes.

Capers fruit contains many vitamins and substances necessary for the human body, which help to strengthen the immune system. According to research and some sources, it contains 0.32-0.35% of rutin, 130-150 mg% of C, P, E and other vitamins, 12% of sugar, 18-20% of flavonoids, 29 -30% glycosides, 35-36% fat in seeds, 25% protein in buds and 27-30 mg of iodine in fruits.

Based on these characteristics, it is clear that it really needs to be widely used for the prevention and treatment of various diseases.

According to folk medicine and research, the potion from the root can be used to treat jaundice, neurosis, paralysis and trauma.

Flowers and leaves are used to treat rashes, salivary glands, otitis media, skin wounds and white spots on the body; In the treatment of liver and spleen diseases; buds- in the treatment of diseases of the teeth, gums, epilepsy, paralysis, hemorrhoids and goiter; fruit- in the treatment of asthma and gastrointestinal diseases; The seeds can be used as a natural remedy in the treatment of gastrointestinal diseases, worms and white spots on the body [6].

Based on the above considerations, the chemical composition of the products obtained during the experiment was studied and the variant was developed in the laboratory for analysis of variable applications.

Table 2. The total amount of chemicals in capers fruit, mg%.

Chemicals	Average amount	Naturally grown	Cultivated
Rutin	0.32	0.29	0.35
Vitamin C	150	147	154
P	136	131	140
E	128	126	130
Quartzetin	043	039	0.48
Sugars	8.12	8.0	12.0
Glycosides	21-29	21.0	29.0
Seed oil	36	34.0	37.0
Protein	25	24.0	26.0
Iodine (in 100 grams of dry mass)	27 mg	24.0	29.0

From the data in the table, it can be seen that the naturally grown capers fruit differs in content from the cultivated fruit.

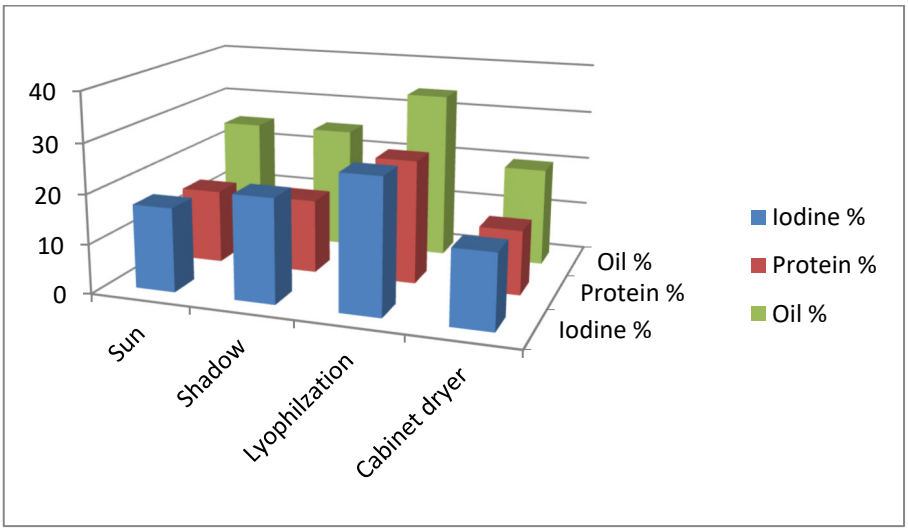

Fig. 3. Influence of drying methods on changes in fruit composition.

4 Conclusion

In addition to growing conditions, drying methods also have a significant effect on the composition of the fruit when dried. When dried in the sun, the fruits undergo a number of changes in metabolism due to environmental factors and direct sunlight. Experiments have shown that the composition of the fruit also changes when dried in the shade, and that these parameters do not change only when dried by lyophilization. We can see that the composition of the fruit has changed due to the high temperature in the cabinet dryer.

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