TECHNICAL AND ECONOMIC CONSIDERATIONS REGARDING THE ESTABLISHMENT OF A FRUIT AND VEGETABLE DEHYDRATION BUSINESS

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ABSTRACT: This paper aims to highlight the importance of the dehydration process, its technological evolution, and the sustainable development prospects of this market segment, in the context of a continuously growing global demand for healthy and convenient food products.

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KEY WORDS: fruit, vegetable, dehydration, business

1. INTRODUCTION

In the current context of global agri-food development, the dehydration of fruits and vegetables represents one of the most dynamic and sustainable directions of the food industry. The increasing demand for natural, healthy products with a long shelf life has led to significant growth in the market for dehydrated fruits and vegetables, which is estimated to reach, for fruits alone, a global volume of approximately 4 million tons by 2025. This upward trend is driven by changing consumer behavior, as people increasingly prefer nutritious alternatives to sugary and processed foods, due to their benefits for health and modern lifestyles.

Fruits and vegetables play an essential role in maintaining nutritional balance, being natural sources of fiber, vitamins, minerals, and antioxidants. Unlike products with high sugar content, they provide a constant energy supply and a complex nutritional intake, helping to prevent metabolic diseases and improve overall well-being. At the same time, dehydration not only extends the shelf life of these products but also increases their added value by more than 90%, making this process an economically attractive solution for producers and processors.

The process of dehydration has a long history, being one of the oldest food preservation methods, used since ancient times in civilizations such as Egypt, Mesopotamia, and China. Over the centuries, dehydration technology has evolved continuously — from natural sun drying to modern methods such as lyophilization, spray drying, and osmotic drying — adapting to market demands and the quality standards required by contemporary consumers.

Today, the global market for dehydrated fruits and vegetables is characterized by steady annual growth, with a compound annual growth rate (CAGR) estimated at 5–7%, supported by related industries such as healthy snacks, dietary supplements, and instant foods. Leading regions, including North America, Europe, and Asia-Pacific, differ in technological development levels, consumption patterns, and cultural preferences, yet they all share the same goal: achieving high-quality, sustainable products with a reduced environmental impact.

Therefore, analyzing the current trends, historical evolution, and market characteristics of fruit and vegetable dehydration provides a deeper understanding of this sector's role in the global agri-food economy.

2.DESIGN OF THE TECHNOLOGICAL UNIT FOR FRUIT AND VEGETABLE DEHYDRATION

2.1. Fruit dehydration technologies

a) Dehydration of plums

The final product, *dried plums*, is obtained through a rigorous technological process:

- Raw material reception involves verifying the quality of plums (freshness, maturity, appearance, taste, smell, and sanitary condition) according to STAS and ISO standards.
- Sorting eliminates damaged, diseased, or foreign objects.
- Washing removes impurities and a large part of the microflora. Potable water, compliant with sanitary regulations, is used. The process is carried out in aerated washing machines that continuously remove impurities to maintain water cleanliness.
- Final sorting and grading ensure product uniformity based on size and quality, using sieves with different diameters.
- Cleaning consists of manually removing the fruit stalks.
- Blanching and cooling aim to remove the natural waxy coating (pruina) and form micro-cracks that facilitate drying. Plums are blanched at 90–95°C for 1–2 minutes and then cooled to 30°C.
- Actual dehydration takes place in convective or tunnel dryers under controlled

conditions: air temperature decreases gradually from 70–72°C to 45–50°C, while humidity increases from 20–25% to 60–65%. Air velocity should be maintained at 3.2–3.5 m/s.

- Conditioning involves temporary storage (10–12 days) to equalize humidity and perform the final selection.
- Packaging is carried out in sealed polyethylene or polypropylene bags, or in food-grade plastic containers, to protect the product from moisture and contamination.
- Storage occurs in dry spaces at temperatures not exceeding 15°C and humidity of 65–75%.

b) Dehydration of apples

The process is similar to that used for plums but adapted to the specific structure of apples:

- Reception and sorting follow the same quality criteria as for plums.
- Washing is performed in aerated or brush-type machines to remove impurities.
- Final sorting and grading ensure product uniformity.
- Cleaning and cutting involve removing the stalks, seed cores, and optionally the peel. Peeling can be mechanical or chemical (alkaline treatment followed by acid neutralization).
- Slicing produces uniformly thick slices or rings using specialized equipment.
- Color preservation treatment is achieved through:
  - Blanching in citric or ascorbic acid solution (3–3.5%) at 95–97°C, or
  - Sulphiting in sulfur dioxide solution (0.6–1%) for 2–3 minutes to prevent enzymatic browning.
- Dehydration takes place in convective dryers with parameters similar to those used for plums (initial temperature 68–72°C, final 45–50°C).
- Conditioning includes the removal of seeds and fragments, followed by visual inspection.
- Packaging and storage are performed under the same hygienic conditions as for plums.

Through these operations, uniform, microbiologically stable dried apples are obtained, characterized by low water content and long shelf life.

2.2. Vegetable dehydration technologies

The technological flow is similar to that for fruits, but adapted to the denser structure of root vegetables:

- Reception follows the same freshness and quality criteria according to STAS and ISO standards.
- Primary sorting removes diseased or moldy specimens and foreign materials. Special attention is given to eliminating vegetables affected by white rot (*Sclerotinia*), gray rot (*Botrytis*), or blue mold (*Penicillium*).
- Washing is carried out in drum or brush machines using potable water and is

considered effective if the microbial count is reduced by at least tenfold.

- Final sorting is performed manually to remove remaining impurities.
- Cleaning involves removing the collar, lateral roots, and outer layer, either mechanically or manually. Equipment must be thoroughly sanitized to prevent contamination.
- Secondary washing with cold water removes remaining residues.
- Cutting is done into slices, cubes, or strips using universal cutting machines. The thickness and dimensions are carefully controlled to ensure uniform dehydration.
- Blanching (in some cases) precedes drying to inactivate enzymes and preserve color.
- Dehydration is performed in convective or tunnel dryers with hot air, maintaining optimal temperature and humidity parameters for each type of vegetable.
- Conditioning and packaging are similar to those used for fruits, ensuring microbiological stability and organoleptic quality.
- Storage is done at temperatures not exceeding 15°C in dry and well-ventilated spaces.

3. ECONOMIC ANALYSIS – PRODUCTION OF DEHYDRATED FRUITS AND VEGETABLES

3.1. Market and consumption

- Global value: several billion EURO
- Annual growth: 5–7%
- Target consumers: health-conscious individuals, families, travelers
- Trends: sugar-free, organic, sustainable

3.2. Market segmentation

- Products: Apples, prunes, apricots, root vegetables, powders
- Dehydration methods: hot air, freeze-drying, solar, spray drying
- Applications: food industry, nutrition, HORECA (hotels, restaurants, catering)
- Geography: North America, Europe, Asia-Pacific

3.3. Competition and advantages

- Major producers: Olam, Sunsweet, Paradise Fruits
- Local producers: traditional and regional
- Advantages: high-quality raw materials, advanced technology, premium branding

3.4. Trends and innovations

- Sustainability: solar drying, renewable energy
- Freeze-drying for premium products
- Customized fruit and vegetable mixes
- Modified atmosphere packaging

3.5. Distribution channels

- Retail: supermarkets, organic stores
- E-commerce: global sales

- HORECA: restaurants, catering services

3.6. Investments and Costs

Type	Value (Lei)
Equipment	292,519
Inventory	55,000
Raw materials	60,000/year
Utilities	12,587/year
Additional expenses	6,000/year
Total expenses (Tc)	371,106

3.7. Prices

- Production price: 87.31 lei/kg
- Delivery price: 124.69 lei/kg

3.8. Economic efficiency

- Revenue: 529,939 lei
- Annual profit: 74,221 lei
- Profit rate: 14%
- Investment payback period: 5 years

4. CONCLUSIONS

- The global market for dehydrated fruits and vegetables is rapidly growing, driven by increased consumer demand for natural, healthy, and long-shelf-life products.
- Dehydration not only extends the shelf life of fruits and vegetables but also significantly increases their added value, making it economically attractive for producers.
- Fruits and vegetables remain essential for nutritional balance, providing fiber, vitamins, minerals, and antioxidants, which support overall health and prevent metabolic diseases.
- Modern dehydration technologies, such as convective drying, freeze-drying, and spray drying, ensure high-quality products while meeting contemporary consumer standards.
- The production processes for dehydrated fruits and root vegetables involve careful reception, sorting, washing, cutting, blanching, drying, conditioning, packaging, and storage to maintain quality and microbiological safety.
- The target market includes health-conscious individuals, families, and travelers, reflecting a trend towards sugar-free, organic, and sustainable food products.
- The industry is competitive, with major global producers (e.g., Olam, Sunsweet) and local/regional producers, where advantages are gained through quality raw materials, advanced technology, and premium branding.
- Innovations such as solar drying, renewable energy use, freeze-drying for premium products, customized mixes, and modified atmosphere

packaging are shaping the sector's growth and sustainability.

- The economic analysis shows that production is profitable, with a production cost of 87.31 lei/kg, a delivery price of 124.69 lei/kg, a profit rate of 14%, and a payback period of approximately five years.
- The dehydration sector plays a strategic role in the global agri-food economy, offering both economic and nutritional benefits while aligning with contemporary trends in healthy, sustainable, and convenient food consumption.

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