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METHODS AND PROCEDURES FOR DETERMINING THE QUALITY OF FOREST FRUIT, BOTH FRESH AND CONSERVED BY DEHYDRATION

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Abstract: *The paper highlights several aspects related to the determination of the quality of both fresh and dehydrated forest fruits, with application on sea buckthorn, which is representative for this category of excessively perishable fruits. Maintaining the qualitative value of fresh fruits is related both to their intrinsic value, characterized by a high perishability degree, and to the technology used throughout their capitalization, namely to their mode of covering the path from producer to consumer. With a view to preserving forest fruits during the period when they cannot be found and when there are no harvests, it is necessary to create optimum conditions to maintain their quality for a long time, with minimum weight losses and qualitative depreciation.*
Keywords: *quality, forest fruits, fresh, dehydrated.*

1. INTRODUCTION

Fruit quality is determined by: variety, cropping technology, climatic conditions, maturation degree, harvesting time and technique. After the detachment from the plant, quality maintenance is influenced by the way of performing the transportation, conditioning, packaging, temporary or long-term storage technology, delivery and display conditions.
In terms of the capacity to maintain quality, the fruits are divided into 4 groups with a different perishability degree. According to this classification, fruits are grouped as follows:

- excessively perishable fruits: strawberries, blueberries, raspberries, blackberries, cranberries, gooseberries, sea buckthorn;

The fruits in this group undergo rapid loss of quality, due to some peculiarities: the presence of a thin epidermis, of very high respiratory intensity. Their keeping time is very short, and only in optimal humidity and relative-humidity conditions they manage to maintain their appearance and freshness for 3-4 days. They are harvested when they have reached the size and have the colour characteristic to their species;

- very perishable fruits: apricots, cherries, sour cherries, peaches, nectarines, plums;

The general characteristic of these fruits is their fine epidermis which cannot protect the fruit pulp, and as a result of blows or shocks, they become slightly brown. In order to maintain their quality, and to resist manipulation, transport etc., the fruits in this group are harvested in the dough-ripeness phase, when they have a structo-texture which allows performing the successive operations of the exploitation process;

- perishable fruits: summer and autumn apples and pears, grapes;

With a view to maintaining the quality of the fruits in this group, it is preferable to comply with a certain degree of maturation, considered optimal, at which the harvesting takes place;

- less perishable fruits: winter apples and pears, quinces, nuts;

The fruits with this perishability degree are harvested at a certain maturation level, which extends the quality-maintenance duration.

2. MATERIAL AND METHOD

2.1. Fruit quality norms

The quality of a product is defined by the sum of its physical, chemical and technological properties, which determine its usefulness, to wit the extent to which it can fulfil the consumption requirements. However, in order to comply with these consumption requirements, there are used fruits which meet some quality conditions. In the case of fruits, these conditions become more complex, inasmuch as, in addition to the physical and chemical characteristics, the quality requirement includes the capacity to withstand transport, storage, of being uniformly pigmented etc. Thus, the notion of quality, for these food products, has a dynamic character, depending also on the product destination: fresh immediate consumption, industrialization, storage for long-term keeping etc..
Fruit quality is determined by the characteristics stipulated in state standards, internal norms, resorting to the organoleptic analysis, and as regards certain properties, by means of physical, chemical, phyto-pathological etc. conditions, for more complex determinations [1].

2.2. Criteria for assessing fruit quality

In order to assess fruit quality, various criteria are used, which are specific to each product, and which highlight the most important characteristics for establishing their qualitative value.
The methods to analyse the quality of plant products can be classified into two large groups: organoleptic and of laboratory.

- **Organoleptic methods:**

Organoleptic or sensory methods are performed by the senses and they have the advantage of being easy to do, of being fast; they do not require special working conditions or appliances, and they do not affect product integrity; the disadvantage of this method consists in its subjective character, given that the determinations depend on the expertise and knowledge of the people performing the analyses.
The most important quality-assessment characteristics are described below.

- ✓ ***Variety authenticity*** is verified based on typical characteristics (form, size, peel aspect, pulp consistency, type and number of seeds, etc.) by comparison with the varieties in the reference samples;
- ✓ ***Form*** varies depending on the species, variety, maturation degree, environment conditions, being given by the nature of the plant organ (cylindrical, oval, spherical etc.). Knowing the form is important for preparing the conditions of packaging, sorting, calibration, transport etc.;
- ✓ ***Fruit size*** shows larger variations, in contrast to the other characteristics. Although specific to some varieties, it can vary widely, depending on the pedo-climatic conditions or applied technologies. These variations change the relations between the structural parts of the fruit, modifying the nutritional value and processing efficiency. Size is considered a quality criterion for selling or industrializing fruits, by sorting them and fitting them into quality classes that take into account the fruit size. Size is defined, where appropriate, by diameter, length, width, thickness, weight, number of pieces per kilogram etc. [4];
- ✓ ***Peel colour and aspect*** is a quality index, according to the variety. It is generally required for the peel to be clean, without cracks or blows, smooth, without flare, free of insecto-fungicides, and for the colour to be specific to the variety [2].

The colour is due to the presence of various pigments in the fruit peel or even pulp. They can be found in various proportions according to the species, variety, agro-pedoclimatic conditions, maturation degree.
Moreover, the pigmentation intensity can be influenced by some external factors, such as light, temperature, atmosphere humidity, nutritional profile of the soil. Colour serves to determine the authenticity of the varieties and to assess the maturation degree;

- ✓ ***Structuro-textural consistency or firmness*** is the resistance opposed by fruits to mechanical actions and it evolves as the fruits ripen, diminishing towards harvest time. It serves to establish the time and mode to harvest, pack, transport, to establish the duration of storage in a fresh condition and the method of industrial processing [4];
- ✓ ***Taste*** must be characteristic of each species and variety. For some fruits, it is positively assessed if it is sweet, well aromatized, with fine astringency and acidity. The sour, stringent, vapid or herbaceous taste is considered negative [2].

Taste is one of the most important characteristics of fruits. It is specific to each species and variety, being determined by the content and ratio between sugars, organic acids, tanning substances etc. The maximum taste intensity is obtained only if at harvest time, the fruits have obtained the maximum maturity degree, which subsequently favours the biochemical processes responsible for the accomplishment of taste [4];

- ✓ ***Aroma*** must be agreeable. The products with a weak flavour, with a strange or unpleasant smell are not adequate;
- ✓ ***Pulp succulence*** is appreciated as a positive feature if it is juicy, enjoyable, and as a negative feature if it is watery or non-succulent [2].

Pulp succulence is conditioned by the maturity degree, turgor, species, variety, harvesting and storage conditions, and it constitutes an important criterion for orienting the fruits towards certain consumption and industrial processing forms;

- ✓ ***Freshness*** is assessed by senses, according to the turgor, firmness and aspect, being determined by the duration and way of keeping the fruits;
- ✓ ***Phytosanitary condition (health and cleanliness condition)*** are particularly important quality conditions [4].

The presence of an attack produced by microorganisms or by some physiological disturbances determines the removal of the respective products from their capitalization in a fresh condition [2].
Fresh fruits must be healthy, not attacked by diseases or pests, clean, free of foreign bodies;

- ✓ ***Presence of the pedunculus*** is a quality characteristic for some fruit species. Its absence allows the loss of succulence, the damage to the pulp integrity, and favours the faster spoilage of fruits [4];
- ✓ ***Maturation degree*** is recognizable by peel colour, pulp firmness, taste, aroma etc. This fruit feature has an important role, inasmuch as according to it, one can state whether or not the products correspond to the purpose for which they are received;
- ✓ ***Pulp colour and firmness*** are generally related to the maturity degree of the fruit, as well as to their health condition. Pulp colour must be characteristic of the variety, and firmness is considered adequate, when it is compact, crispy or fine.

Internal flaws are determined by cutting the fruits. Flaws are considered to be: insects, pulp rot, fruit blackening [2].

- ➢ **Laboratory methods:**

The laboratory methods used to analyse the quality of plant products can be:

- ***physical methods,*** used to determine some qualitative indices of agricultural raw materials, such as: moisture, mass structure and product homogeneity, their microstructure etc.;
- ***chemical methods,*** used to determine the chemical composition of the products, and to perform the quantitative analysis of the product compounds;
- ***physicochemical methods,*** which allow the determination of certain characteristics of plant products, such as: the content of dry matter, sugar, mineral substances and total acidity etc.;
- ***technological methods,*** which suppose processing the products, the quality of which is to be determined as a result of processing, as well as making appreciations on the global qualitative features of products and on their content of useful substances;
- ***biological methods,*** which are practiced with a view to determining the composition of the microflora and to highlighting the mycoses and bacterioses of different product batches etc.

Laboratory methods, due to their scientific character, offer real, rigorous and comparable results, regardless of the place and time in which the analyses are conducted. However, in many situations, especially when smell, taste, colour etc. are analysed, they must be combined with the organoleptic ones [3].

An exemplification of how to apply the methods to analyse and determine the forest-fruit quality on fresh sea buckthorn, considered representative for this product category, is provided below.

Figure 1: Fresh sea buckthorn fruits

Sea buckthorn is delivered in two quality classes and must meet the following conditions:

Table 1: Quality classes of sea buckthorn

Extra	I-st Quality
Fruits of a size and colour characteristic of their variety, whole, healthy, without traces of rot or alterations which make them unfit for consumption, without traces of insect attack, clean, without visible traces of other products, without abnormal external humidity, without oher aromas, taste or smell. Sea buckthorn must be very carefully harvested and must be completely and normally developed. The maturity degree must allow transport, manipulation and storage of the sea buckthorn to the place of destination.	
Sea buckthorn of a very good quality, uniformly	Fruits of a good quality that show the

ripened, of a size and colour characteristic of their variety. Slight superficial flaws which do not however affect the general aspects of the product, its quality, storage capacity and display, are admitted.	characteristics of the variety. Fruit quality must be perfectly intact: ❖ max. 2% fruits with coloration defects; ❖ max. 5% over-ripened fruits.

The quality tolerances of sea buckthorn are the following:
- max. 5% (mass) I quality sea buckthorn in extra quality buckthorn;
- max. 10% (mass) for the I quality buckthorn which do not comply with the minimum quality conditions, yet without faults which would make them unfit for consumption [5].

2.3. Influence of the drying process on the qualitative features of fruits

The fruit drying process is influenced by a series of physical, chemical, enzymatical and microbiological processes and reactions. The qualitative changes during the drying are complex, as long as a series of processes occur simultaneously. All chemical reactions contribute to changing the initial qualitative properties of the product to be dried: colour, taste, smell, nutritional value and validity period. An important influence on the quality parameters is related to the temperature undergone by the product during the drying processes.
Quality is the sum of product characteristics referring to their proneness to meet certain criteria related to: form, colour, aroma, taste, smell, texture, consistence, type and concentration in carbohydrates, proteins, vitamins, minerals, their proneness to storage, the type and concentration of toxins. Throughout the drying process, a series of physical and processes occur, which may entail the change in the value of some constituents, determining a certain degree of qualitative deterioration of the product.
The qualitative changes which may be noticed in the fruit undergoing drying, are:

- *structural changes:* a slight shrivelling of the fruit can be noticed, accompanied by a reduction in volume, due to the decreased water content;
- *colour changes:* a slight change in the product colour can be noticed, according to the temperature of the air which runs through the installation, to the type of drying, to the possible presence of heavy metals and of reducing sugar content, and also as a result of oxidative processes;
- *taste and aroma changes:* an important loss of aromas specific to the respective product can be noticed, following their being carried away with the vapours, during the drying process;
- *food-value changes:* during the drying process, changes in the chemical composition can occur, which influence the food value of the finite product obtained [3].

As regards dehydrated sea buckthorn, the following specifications can be made.

Figure 2: Dehydrated sea buckthorn fruits

The product “Dehydrated sea buckthorn fruits”, made of fresh, healthy fruits, from the species Ripophae rhamnoides, having reached industrial maturity, packed in polyethylene or polypropylene bags, hermetically sealed by welding, in tightly closed plastic casseroles for food, or in other packages that would ensure the product conservability.
The product “Dehydrated sea buckthorn fruits” is achieved in the following assortment: dehydrated whole sea buckthorn fruits.
The product “Dehydrated sea buckthorn fruits” is delivered in three quality classes: class extra, I-st class, II-nd class.
The technical quality conditions of the sea buckthorn fruits to be dehydrated aim at their being whole, healthy, fresh, free from mold, without signs of fermentation, without mechanical lesions or caused by diseases, insects or other pests, without foreign taste/smell.
The product “Dehydrated sea buckthorn fruits” is manufactured according to the technological instructions elaborated by the Institute of Food Bio-resources, in compliance with the applicable sanitary norms.

Table 2: Organoleptic properties

Characteristics	Admissibility conditions		
	Class extra	**I-st Class**	**II-nd Class**
Aspect	Dehydrated whole seabuckthorn fruits of a close size (within the same quality class), healthy, clean (virtually free of visible foreign matter), without signs of mold or fermentation, without mechanical damage, without traces of insects, mites or other pests, without foreign bodies, without toxical phytopharmaceutical products. The presence of living insects or mites, regardless of their development stage, is not admitted.		
	Dedydrated whole sea buckthorn fruits of higher quality, virtually free from any flaw, except slight superficial alterations, provided they should not influence the general aspect, quality and conservability of the product, and they should fall within the maximum admissible limits for the flaws.	Dedydrated whole sea buckthorn fruits of good quality, with slight flaws, provided they should not influence the general aspect, quality and conservability of the product, and they should fall within the maximum admissible limits for the flaws.	Dedydrated whole sea buckthorn fruits which do not fall under classes extra and I, yet which correspond to the common characteristics above. Dedydrated whole sea buckthorn fruits with flaws which fall within the maximum admissible limits for the flaws, yet keep the essential quality characteristics are admitted.
Colour	Yellow-orange to dark orange, dark-rusty, characteristic of the variety.		
Consistency	Dedydrated whole sea buckthorn fruits, moderately hard.		
Taste and smell	Pleasant, characteristic of dedydrated whole sea buckthorn fruits, without foreign taste or smell (fermented, moldy, burnt etc.).		

The main flaws shown by dehydrated sea buckthorn are:

- *stale sea buckthorn:* sea buckthorn fruits which are crushed, affected by incipient rotting, fermentation or mold;
- *fermentation:* flaws caused by the fermentation process, which alter the aspect and/or aroma characteristic of the dehydrated whole sea buckthorn fruits;
- *incipient rotting:* decomposition caused by bacteria or fungi which affect the mesocarp (pulp) of the dehydrated whole sea buckthorn fruits, thus making them improper for consumption;
- *mold:* mold filaments visible to the naked eye;
- *foreign matter of plant origin:* leaves, stems, twigs, woody fragments or similar materials;
- *dehydrated sea buckthorn fruits infested by insects and mites:* sea buckthorn fruits which show flaws caused by insects and/or mites.

Table 3: Maximum admissible limits of the dehydrated sea-buckthorn flaws

Admitted flaws	Admissibility conditions		
	Clasa extra	**I-st Class**	**II-nd Class**
Stale sea buckthorn fruits, % (m/m), max.	2	3	4
Sea buckthorn fruits attacked by insects and mites, % (m/m), max.	1	2	3
Deviations from the main colour, % (m/m), max.	2	5	10
Broken dehydrated sea buckthorn fruits, % (m/m), max.	1,0	5	10
Pieces of dehydrated	1,0	3	6

sea buckthorn fruits, % (m/m), max.			
Foreign matter of plant origin, % (m/m), max.	0,25	0,50	1,0

Table 4: Physicochemical properties and microbiological properties of dehydrated sea buckthorn

Characteristics	**Admissibility conditions**		
	Extra class	**I-st Class**	**II-nd Class**
Physicochemical properties			
Moisture, %, max.	5	5	5
Insoluble ash in hydrochloric acis HCl 10 %, g/kg, max.	0,5	1,0	1,0
Microbiological properties			
Coliform bacteria, NCP/g	max.10	max.10	max.10
Escherichia Coli, NPC/g	absent	absent	absent
Salmonella, present/25g	absent	absent	absent
Staphylococcus coagulosis-positive, ufc/g	absent	absent	absent
Bacillus Cereus, ufc/g	max.10	max.10	max.10
Yeasts and molds, ufc/g	max.100	max.100	max.100

The content of heavy metals and pesticides of the dehydrated sea buckthorn fruits must fall within the maximum limits, according to the applicable regulation. [5]

3. CONCLUSIONS

- Fruits are food products of plant origin, and due to their nutritional value, to their taste qualities and to their high degree of assimilation by the human body, they are recommended and widely used in alimentation, both fresh and preserved in different ways;
- Dehydrated fruits must show uniform pieces in terms of size and colour, they must be sufficiently dried, with slightly elastic consistency, must reabsorb the same water quantity which was eliminated by drying;
- Vegetable products, especially horticultural ones, have a lower content of energy substances, nevertheless they are important for their intake of minerals, vitamins etc., contributing thereby to the good development of the metabolic processes in the body.

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