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**ODESSA NATIONAL ACADEMY OF  
FOOD TECHNOLOGIES**

International Competition of  
Student Scientific Works

**BLACK SEA  
SCIENCE 2020  
PROCEEDINGS**



**ODESSA, ONAFT 2020**

Ministry of Education and Science of Ukraine  
Odessa National Academy of Food Technologies

International Competition of Student Scientific Works

# **BLACK SEA SCIENCE 2020**

**Proceedings**

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# **1. FOOD SCIENCE AND TECHNOLOGIES**

## MAP OF DEFECTS AND DISEASES OF FRESH APPLES OF LATE MATURATION

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**Abstract.** *The map of defects and diseases is a method of regulating the quality of fresh apples of late ripening, depending on defects and diseases, their characteristics. The research paper analyzes the requirements for commercial varieties of fresh apples of late ripening in accordance with the requirements of technical regulatory legal acts (hereinafter TNLA) in force on the territory of the Republic of Belarus. The classification is considered in accordance with TNLA, dividing apples into several groups depending on the quality, size and color of the fruit.*

*The aim of this work is to develop a map of defects and diseases with illustrations and explanations for identifying permissible and unacceptable defects that occur during the transportation and storage of fresh apples.*

*The result of this work is visualization of defects and diseases of fresh apples and presentation of results in the form of a map of defects, as well as classification of defects into permissible defects within the commercial class and unacceptable defects.*

**Key words:** *apples, defects, diseases, commercial grade, appearance, quality.*

### I. Introduction

In the modern world, the quality of products is very important. But consumers are not always able to determine for themselves with commercial grade this or that batch belongs, which defects occur in apples and which of them are acceptable. Map of defects and diseases in apples is an easy-to-use tool to recognize, understand and solve this problem.

Apples are used both in fresh form and for industrial processing: for making jam, juices, compotes, marmalade, also for drying, souring and freezing. The nutritional value of apples is based on the content of easily digestible sugars, vitamins, mineral salts, organic acids and other substances necessary for the human body. Storage of fresh apples can be carried out in warehouses, including RGS, up to 9-12 months. Depending on the variety of apples storage temperature should be from minus 2 °C to 4 °C. Relative air humidity during storage of apples is 85-95%. During storage of apples, in addition to the main process of metabolism (breathing), maturation and aging, because of incorrect or prolonged storage conditions there is bitter pit, browning of pulp and skin.

The expiration date and storage conditions for fresh apples are set by the manufacturer. There are two TNLA in Belarus, according to which apples are fresh for sale must comply with the requirements of the quality indicators.

### II. Analytical review

The chemical composition of apples depends on the variety, growing conditions and degree of maturity. The nutritional value of apples is due to the content of easily digestible carbohydrates (11,3%), mono - and disaccharides (9%), starch (0,8%), proteins (0,4%), fiber (0,6%), ash (0,5%), vitamins ( $\beta$ -carotene 0,03 mg, B1 0,01 mg,

B2 0,03 mg, PP 0,30 mg, C 13 mg), minerals (Na 26 mg, K 100 mg, Ca 16 mg, Mg 9 mg, P 11 mg, Fe 2,2 mg) and organic acids (in terms of malic acid 0,7%) [1]. In the laboratory, several indicators of the quality of fresh apples were studied and it was found that apples mainly contain 7-12 % of sugars, 0,2-1,1 % of organic acids (in terms of malic acid), and vitamin C (up to 20 mg/100 g).

On the territory of the Republic of Belarus there are two TNLAs: GOST 34314-2017 “Fresh apples sold in retail trade. Technical conditions” [2] and STB 2288-2012 “Fresh apples of late maturation. Technical conditions” [3], according to which apples must comply with the requirements of the quality indicators.

According to GOST 34314-2017 “Fresh apples sold in retail trade. Technical conditions” fresh apples are divided into three commodity grades depending on quality: the highest, first, second. Depending on the color of the whole surface or part of it, they are divided into four color groups:

- group A – red color ( $\frac{3}{4}$  or  $\frac{1}{2}$  of the total surface area of the red color);
- group B – non-uniform red color ( $\frac{1}{2}$  or  $\frac{1}{3}$  of the total surface area of non-uniform red color);
- group C – pinkish color, non-uniform red color or with red stripes ( $\frac{1}{3}$  or  $\frac{1}{10}$  of the total surface area of pinkish color, non-uniform red color or with red stripes);
- group D – no color requirements.

Fresh apples are calibrated by the largest transverse diameter (not less than 60 mm) or weight of the fruit (not less than 90 g).

**Table 1 – Permissible deviations by weight of fruit**

Quantity (pcs.)	For all grades of apples, arranged in rows and layers	For apples of the first grade, packed in bulk or in a single consumer package
Over 70 to 90 incl.	15,0 g.	35,0 g.
Over 90 to 135 incl.	20,0 g.	35,0 g.
Over 135 to 200 incl.	30,0 g.	70,0 g.
Over 200 to 300 incl.	40,0 g.	70,0 g.
Over 300	50,0 g.	100,0 g.

In STB 2288-2012 “Fresh apples of late maturation. Technical conditions” classification of pomological varieties of apples of late maturation, zoned in the Republic of Belarus, is made depending on the quality: the highest, first and second commercial grades.

**Table 2 – Classification by fruit size**

Fruit shape	Group I (large fruit grades)	Group II (medium and small fruits)
Round	not less than 60-70 mm	not less than 50-60 mm
Oval	not less than 55-65 mm	not less than 45-55 mm

The commercial grade of fresh apples of late maturation is established taking into account the following indicators:

- Appearance: the fruits are whole, clean, without excessive external humidity, for the highest and first grade - with the typical form and color of the pomological variety, with a stalk.

- defects: for the highest grade - very insignificant skin defects are allowed, for the first grade - minor defects of form, development, skin, for the second grade - defects of form, development, coloring, skin.

Apples of the highest grade must be clean and intact, with the whole stalk. The batch must consist of fruits of the same pomological variety, uniform in shape and color. Apples of the first and second grades may be heterogeneous, without a stalk.

The presence of spoiled, rotten, overripe and damaged apples, signs of withering, browning the pulp and the presence of a weed impurity are not allowed.

### III. Object, subject and research methods

The object of research is fresh apples of late maturation.

The subject of research is the quality of fresh apples.

Research methods: observation, comparison, measurement, analogy, generalization and analysis. The appearance, maturity of the fruit, and damage within the fruit are determined organoleptically; the size, mechanical, and other damages are measured.

### IV. Work results

The requirements of the TNLA have been analyzed and a comparative characteristic of the descriptors described in GOST 34314-2017 “Fresh apples sold in retail trade. Technical conditions” and STB 2288-2012 “Fresh apples of late maturation. Technical conditions” has been carried out.

**Table 3 Characteristic of descriptors**

Characteristic and norm for commercial grade	GOST 34314-2017	STB 2288-2012
<b>Appearance</b>		
Highest grade:	Fruits of the same pomological variety with typical shape and color, whole, clean, with a stalk and without excess moisture.	Fruits of one pomological variety, typical in shape and color, dry, clean, with a whole stalk, without excessive external humidity.
First grade:		Fruits of the same pomological variety, typical in shape and color or with slight deviations, dry, clean, with or without a whole stalk, but without damage to the skin and excessive external humidity.
Second grade:	The shape, the color of the fruit, the presence of a pedicel is not normalized.	Fruits of one or more pomological varieties, typical and atypical in shape and color, but not ugly, dry, clean, with or without the whole fruit stalk, but without damage to the skin of the fruit and excessive external humidity.
<b>Defects</b>		
Highest grade:	Very minor skin defects are allowed.	Mechanical damage: - at places of shipment: not allowed; - at the destination: light pressure with a total area of not more than 20 mm <sup>2</sup> is allowed; - a weak grid is allowed, a strong grid is not; The absence of a stalk is permissible when selling fruit after storage (December-June).

Continuation of table 3.

Characteristic and norm for commercial grade	GOST 34314-2017	STB 2288-2012
First grade:	<p style="text-align: center;">Allowed:</p> <ul style="list-style-type: none"> <li>- Minor defect in shape and development;</li> <li>- Minor skin defects not exceeding 2 cm in length for oblong shaped defects and 1 cm<sup>2</sup> of total surface area, except for apple scab (not exceeding 0,25 cm<sup>2</sup>).</li> </ul>	<p style="text-align: center;">Allowed:</p> <ul style="list-style-type: none"> <li>- no more than two hailstones, light pressure and abrasion (total area not exceeding 40 mm<sup>2</sup>);</li> <li>- weak, strong mesh (not more than 1/4 on the surface area of the fruit).</li> </ul>
Second grade:	<p style="text-align: center;">Allowed:</p> <ul style="list-style-type: none"> <li>- defects in shape, development, coloring;</li> <li>- slight damage not exceeding 1,5 cm<sup>2</sup> with a slightly changed color;</li> <li>- skin defects not exceeding 4 cm in length for oblong shaped defects and 2,5 cm<sup>2</sup> for other defects, except for apple scab (total area not exceeding 1 cm<sup>2</sup>).</li> </ul>	<p style="text-align: center;">Allowed:</p> <ul style="list-style-type: none"> <li>- At the destination: no more than five hailstones, pressure and abrasion of the total area of no more than 1/4 of the fruit, no more than two fresh punctures of the skin;</li> <li>- weak and strong mesh are allowed.</li> </ul>
<b>Browning of the skin</b>		
Highest grade:	Brown spots are allowed that do not extend beyond the cavity of the stem, slight isolated signs of browning.	Not allowed: browning of the skin (tan), bitter pit and withering.
First grade:	<p style="text-align: center;">Allowed:</p> <ul style="list-style-type: none"> <li>- not rough brown spots slightly beyond the cavity of the stem;</li> <li>- weak browning, not exceeding 1/5 of the total surface area of the fruit and not sharply contrasting with the general color;</li> <li>- strong browning, not exceeding 1/20 of the total surface area of the fruit, weak netting and strong browning together not exceeding 1/5 of the total surface area of the fruit.</li> </ul>	<p style="text-align: center;">Allowed:</p> <ul style="list-style-type: none"> <li>- slight skin browning in the area not exceeding 1/4 of the fetal surface;</li> <li>- bitter pit with the total area not exceeding 3 mm<sup>2</sup>;</li> <li>- mild withering without signs of wrinkles;</li> </ul>
Second grade:	<p style="text-align: center;">Allowed:</p> <ul style="list-style-type: none"> <li>- rough brown spots that may extend beyond the cavity of the stem;</li> <li>- weak browning, not exceeding 1/2 of the total surface area of the fetus and not in sharp contrast to the overall colouring;</li> <li>- strong browning, not exceeding 1/3 of the total surface area of the fruit, weak netting and strong browning together, not exceeding 1/2 of the total surface area of the fruit.</li> </ul>	<p style="text-align: center;">Allows:</p> <ul style="list-style-type: none"> <li>- slight skin browning on the area of no more than 1/3 of the fruit;</li> <li>- bitter pit with the total area not exceeding 10 mm<sup>2</sup>;</li> <li>- withering with slight wrinkling;</li> </ul>

Continuation of table 3.

Characteristic and norm for commercial grade	GOST 34314-2017	STB 2288-2012
<b>Smell and taste</b>		
Highest grade:	Must be typical for the pomological variety, without foreign smells and flavors.	The flavor should be sour-sweet, sweet-sour or sweet, the aroma is light. No foreign smell or flavor.
First grade:		
Second grade:		
<b>Degree of maturity and condition of the fruit</b>		
Highest grade:	Fruits are removed at a removable degree of maturity, capable of withstanding loading, transportation, unloading and delivery to their destination.	The condition should be homogeneous, removable - at workpiece, at realization - a consumer degree of maturity. Green and overripe fruits are not allowed.
First grade:		
Second grade:		Homogeneous, removable state is acceptable at the workpiece, consumer maturity - at realization. Green and overripe fruits are not allowed.
<b>State of the pulp</b>		
Highest grade:	The pulp is benign.	Browning of the pulp is not allowed.
First grade:	Without significant defects.	Browning 1/4 of the cross-section surface is allowed.
Second grade:		
<b>Mass fraction of fruits that do not meet the requirements of this variety, but meet the requirements of lower varieties, %, not more than</b>		
Highest grade:	5,0 %	10%
First grade:	10 %	15%
Second grade:	10 %	15%
<b>Presence of agricultural pests, apples, damaged by agricultural pests</b>		
Highest grade:	Not allowed.	Not allowed.
First grade:	Not allowed.	Fruits with 1-2 healed injuries not exceeding 20 mm <sup>2</sup> are allowed.
Second grade:		Fruits with 1-2 healed injuries not exceeding 40 mm <sup>2</sup> are allowed.

All fruits, regardless of the variety of fruit, have the following requirements: the apples must be whole, healthy, without a foreign smell and free of excessive moisture; the degree of maturity must be removable (in which the fruit is fully developed and formed, able after harvesting to ripen and reach consumer maturity), to withstand transportation, loading and unloading and ensure delivery to the destination in a satisfactory condition. Immature apples are those which, after harvesting, are not able to acquire the appearance and taste typical of this pomological variety under optimal conditions.

### **V. Conclusions**

At the analysis of TNLA it is established that the requirements to fresh apples differ in terms of defects, mass fraction of fruit that do not meet the requirements of a certain commercial variety, the presence of agricultural pests and damage from them.

While selling fresh apples on the price tag, in addition to information about a pomological variety, it is necessary to specify a commercial grade or information about non-standard products [4], which affects the price, as well as the choice of consumers and ensures food safety of the population of the Republic of Belarus.

While researching the quality of fresh apples sold in retail networks in Minsk, it was found that the marking of fresh apples contains only information about the pomological variety and does not contain information about the commercial grade. The following defects were also found: bitter pit, Jonathan spot, puffiness (browning pulp from over-ripe), sunburn (tan), withering, sunburn (tan), withering, beatings with darkened pulp, hailstones, rough cracks and rubbing, apple scab. The most common mechanical defects are pressures, beatings, hailstones and apple scab.

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