

Assessing Quality of Fruit Raw Material for Developing a Method of its Identification in Food Products

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Abstract

For the purpose of identifying and confirming authenticity of wild fruits, berries, nuts, assessing conformity with the requirements or specific information about them, identification is used. For the fruit raw materials, species identification, i.e. identification of the type of products in the assortment, is important. During an expertise of quality of the fruit raw materials, confirmation of quality and safety conformity with the regulatory requirements is the primary goal. However, the existing base of normative documents is not sufficient for full expertise of quality of fruit raw materials, due to the lack of documentation about certain types of raw materials; the existing instruments do not contain a complete list of requirements to quality and safety, regulatory documents are neither updated nor harmonized, given the current economic state. The article shows the results of assessing the quality of the studied fruit raw materials, for example: *Rubusidaeus* (raspberry, variety Nagrada), *Ribesúva-crispa* (common gooseberry, Cooperator variety), *Fragaria* (remontant strawberry, the Early Berdsk variety), *Rosa majalis Herrm* (cinnamon rose), *Prunusfruticose* (steppe cherry, variety Altai swallow), *Músaparadisiaca* (banana, variety "extra"), *Actinidiadeliciosa* (gourmet kiwi) for organoleptic, physico-chemical parameters, according to the existing State Standards. It has been revealed that the content of toxic elements (cadmium, mercury, arsenic, lead) does not exceed the allowable level. It has been established that indicators of quality of the studied types of the fruit raw materials meet the regulatory requirements and may be used for further tests aimed at developing the method of identifying the type of fruit raw material in food products.

Keywords: fruit raw materials, vegetable raw materials, quality assessment, expertise of food raw materials, product counterfeiting, identification.

INTRODUCTION

Recently, the use of natural plant food resources has been increasingly studied in both our country and abroad [1].

Raspberry (*Rubus*) belongs to the Rosaceae family. Red raspberry (*Rubusidaeus*) is a shrub up to 2 m high. The fruit is a round crimson drupe that consists of numerous drupes and juicy pulp. Blooms in June to July, bears fruit in July to August [2].

Red raspberry is Euro-Siberian specie with a discontinuous areal. The main part of the areal covers the forest and adjacent forest-steppe zones of the European part of Russia and Western Siberia.

All listed species of raspberry are used for food and in folk medicine; however, the normative documentation envisages the use of only raspberry for medicinal purposes. In the work, the Nagrada specie was used, which is widely regionalized in Siberia, frost-resistant, with sweet berries.

Strawberry (lat. *Fragaria*), Rosaceae family. The genus includes a huge number of wild species and species that are not met in the nature.

Strawberry is a herbaceous plant with fibrous root system, the main bulk of roots of which reaches the depth of 20-25 cm. In the central part of Russia, strawberry blooms from the third decade of May to early July. One plant can have both berries and flowers. The fruit contains ascorbic acid, carotene, vitamins B1, B2, B6, E, P, folic acid, sugar (up to 9.5%), citric, malic, salicylic and other

acids, small amounts of tannins, essential oil (that gives strawberries their nice flavor), anthocyanin compounds, phenolic compounds, flavonoids, quercetin and quercitrin, and microelements [3].

In the study, a remontant strawberry variety, Berdsk Early, which is widely regionalized in Siberia, was used; the berries are large, transportable, and delicious. It is resistant to mites and rot.

Garden gooseberry, aka English gooseberry, aka European gooseberry (lat. *Ribesúva-crispa*) is a species of plants of the Gooseberry family (Grossulariaceae), of genus *Currant* (*Ribes*), of subgenus *Grossularia* (Gooseberries); it is sometimes regarded as a separate genus: *Grossularia* Mill [4].

Gooseberry is a multicaulis bush or shrub, with the height varying from 0.5 to 2 m. Gooseberry may be of several types: creeping, erect and sprawling. The fruits contain up to 9.5% of sugars (fructose, glucose, sucrose), about 2% of organic acids (citric, malic, tartaric), pectins, tannins, nitrogenous substances, vitamins: C, A, B group. The fruits contain 85% of water and about 5% of ash consisting of salts of phosphorus, iron, magnesium, calcium, sodium, potassium, sulfur, silicon, and chlorine. The roots and leaves contain flavonoids [4, 5].

In the study, the Cooperator variety of gooseberry was used, which is winter- and heat-resistant, highly resistant to *Sphaerotheca*; the berries are large (7-9 g), dessert (4.8 points), the yield is high. The shoots are almost without thorns.

Cherry (lat. Prúnus subg. Cerásus) is a subgenus of plants of the Plum (*Prunus*) genus of the Rosaceae family. Cherry is a perennial shrub in the form of a tree or a bush. Shrubs reach the height of 3 m. They may be formed with one, two or three trunks. The fruit (drupe) is smooth, without spew; the leaves in the aestivation are folded lengthwise; the flowers are umbrellate, sometimes enclosing two flowers; developed simultaneously with the leaves or prior to them. The fruit contains organic acids (citric acid, malic acid, succinic acid, salicylic acids), microelements (copper, iron, zinc, iodine, manganese, chromium, fluoride, molybdenum, boron, vanadium, cobalt, nickel, rubidium), macroelements (potassium, calcium, phosphorus, magnesium), as well as pectin, sugars, vitamins A, C, E, B1, B2, PP, and folic acid [6].

In the study, a variety of steppe cherry (*Prunus fruticosus* Pall.) – the Altai Swallow – was used. The fruit is medium sized (3.5 g), round, flattened, and dark red. The pulp is dense and juicy. The juice is intensely colored. The taste is sour-sweet. The stone weighs 0.14 g, can be easily separated from the pulp and the pedicel. The fruit ripens in the second half of July.

Briar (*Rósa*) of the Rosaceae family. These are deciduous or evergreen shrubs, or, more rarely, shrubs with erect, climbing, or creeping branches, usually topped with thorns, whereby they are often called briars. Briar fruits contain vitamins C, A and B2; considerable amount of sugar, citric acid, and tannins [7].

In the work, cinnamon rose (*Rosamajalis* Herrm) widely spread in the wild flora of Kuzbass was used.

Kiwi, (lat. *Actinidia*) is a genus of woody lianas of the Actinidiaceae family. The Actinidiaceae genus includes about 40 species of woody lianas, which are widespread from Southeast Asia to Northern Sakhalin. Most popular are Chinese Gooseberry (lat. *Actinidiachinensis*) and Delicious actinidia (lat. *Actinidiadeliciosa*), which was used in this work [8].

Banana (lat. *Músa*) is a genus of perennial herbaceous plants of the Banana (*Musaceae*) family, which come from the tropics of the Southeast Asia and, in particular, the Malay archipelago. The pulp of the dessert varieties is very sweet, it contains a lot of carbohydrates, vitamin C and some essential minerals such as phosphorus, iron, potassium, calcium and magnesium [9].

In the work, the edible banana type, *Musa acuminata* of the "extra" variety was used.

One of the most effective ways of removing deficiency of essential nutrients in human nutrition is enriching food products of mass consumption with biologically active components of natural origin [10]. Food plants are of great value, primarily due to the specific combinations of biologically and pharmacologically active components [11]. Such substances are difficult to create artificially; they are well absorbed by the human organism, and have preventive action. Thanks to the natural harmony and diversity of the macro - and micronutrients (carbohydrates, vitamins, minerals, etc.) contained in them, the use of this raw material allows improving the nutritive and biological value of food products [12].

The fruit raw material used in production of food products has positive effect on the consumer properties of the finished product. In particular, it improves the organoleptic characteristics of finished product: taste, aroma, and color. Vegetable components are used as natural colorants and flavorants.

In assessing the quality of fruit raw materials and products based thereon, monitoring adherence to the scientifically substantiated formulations and determining the content of raw material in the finished products play an important role. It is known that the State Standards and Technical Requirements determine the indicators, regulations and requirements to the quality of raw materials and finished products. The normative documentation developed and approved for each type of product describes the composition of the used raw materials, and their ratio. Raw materials and products that contain components of plant origin different from the declared content of components in the regulatory documents (technical specifications, national and international industry standards) are considered to be falsified [13].

Currently, development of efficient methods for detecting counterfeited products is becoming especially relevant [14]. The article shows the results of assessing quality of the following fruit raw materials: *Rubusidaeus* (raspberry, variety Nagrada), *Ribesíva-críspa* (common gooseberry, Cooperator variety), *Fragaria* (remontant strawberry, the Early Berdsk variety), *Rosa majalis* Herrm (cinnamon rose), *Prunus fruticosus* (steppe cherry, variety Altai swallow), *Músaparadisiaca* (banana, variety "extra"), *Actinidiadeliciosa* (gourmet kiwi), which will form the basis for developing a method of identifying the type of fruit raw material in food products.

OBJECTS AND METHODS OF RESEARCH

The theoretical and experimental research has been completed at the Department of Bionanotechnology of the Federal State Budgetary Educational Institution of Higher Education "The Kemerovo Technological Institute of Food Industry (University)".

Individual stages of the work have been completed in the framework of the Federal Target Program "Scientific and Pedagogical Human Resources of Innovative Russia in years 2009-2013", State Contract No. 14.740.11.1219 on the topic: "Molecular and genetic analysis of DNA of plant origin with the aim of developing PCR-test systems for identifying counterfeited products on their basis", Agreement No. 4.B37.2. 968.

In our work, the following fruit raw materials have been studied: *Rubusidaeus* (raspberries, variety Nagrada), *Ribesíva-críspa* (common gooseberry, grade Cooperator), *Fragaria* (remontant strawberry, variety: Early Berdsk), *Rosa majalis* Herrm (cinnamon rose), *Prunus fruticosus* (steppe cherry, grade Altai swallow), *Músaparadisiaca* (banana of variety "extra"), *Actinidiadeliciosa* (gourmet kiwi).

Berries harvested in 2015 (July-August) were studied.

All fruit raw material used in the work was studied in terms of the organoleptic and physico-chemical quality

indicators in accordance with the requirements of the relevant normative documents.

Samples were taken according to GOST 26313-2014 "Products of processing fruits and vegetables. Rules of acceptance, methods of sampling".

Raspberry was assessed for compliance with GOST R 54691-2011. Indicators of gooseberry quality were assessed according to the requirements of GOST 6830-89. Indicators of strawberry quality were assessed according to GOST 6828-89. Rosehips were assessed according to GOST R 53956-2010, cherries - to GOST 21921-76, banana and kiwi - to GOST 31823-2012.

Appearance, ripeness, condition, odor and taste of berries, the presence of pests and presence of berries affected by pests, rotten, and spoiled berries were assessed organoleptically. The presence of ill, damaged berries was determined visually. The size of berries and white spots was measured with the accuracy of ± 1 mm. The combined sample was weighed and separated into fractions manually in accordance with the indicators set forth in the respective GOST for berries. The fractions were weighed, and the results were recorded after rounding them to the first decimal digit.

The mass share of each fraction as percentage of the total weight of the berries in the combined sample was calculated by formula:

$$K = \frac{m_i}{m} \times 100;$$

where m_i is the weight of the fraction of berries with indicators that do not meet the requirements of GOST, g;

m is the total weight of berries in the combined sample, g.

The calculations were made up to a tenth of percent, then the results were rounded up and recorded as integers.

Defining the quality of bananas. Appearance, smell, taste, the ripeness of bananas, pulp color, more or less acceptable fruit size, deformed shape, conrescent, stained with earth or plant residues, with surface skin defects: mechanical or caused by agricultural pests, stains of latex, broken, with skin torn close to the stalk, with deep cuts, with severely bruised and cracked skin with pulp affected, severely damaged by pests and diseases, were determined organoleptically, and the fruits were sorted into fractions in accordance with the requirements of GOST.

Banana length was measured with a ruler along the middle fruit in the outer row of the raceme, measuring from the peduncle to the flower end along the convex line. The greatest cross-section diameter of the fruit was measured in the middle part of the fruit with a caliper.

According to the results of measurement, the number of fruits of more or less acceptable size was calculated as percentage, and allocated to certain quality classes with regard to the tolerance. The area of skin surface damage and stains of latex on one fruit were

determined after measurement with a ruler (a ruler made of transparent material).

The share of banana with deviations for each fraction according to GOST R 51603 was calculated in % from the total weight or number of fruits in the combined sample by formulas:

$$K = \frac{m_i}{m} \times 100 \text{ or } K = \frac{Q_1}{Q} \times 100;$$

where m_i is the weight of fruits with deviations, kg;

m is the total weight of fruits in the combined sample, kg;

Q_1 is the number of fruits with defects, pcs;

Q is the total number of fruits in the combined sample.

Defining the quality of kiwi. Appearance, smell, and flavor were assessed organoleptically. The internal structure of kiwifruit was determined on cross-section of 3.0% of fruit from the weight of the combined sample. The size of the fruit was measured with a ruler. The weight of the fruit was measured by weighing. Each fraction of the fruit was weighed separately. The obtained value was recorded with the accuracy of up to 0.01.

By the results of weighing, the share of defective fruits according to GOST 31823-2012 in percent was determined.

The content of the mass share of the kiwi fruit with deviations in quality and size for each fraction, in percent of the weight of the fruit in the combined sample, was calculated by the ratio of the weight of the kiwi fruit with quality and dimension deviations to the total weight of the fruit in the combined sample. Calculations were made with the precision of up to 0.01%.

The content of toxic elements in berries and fruits was assessed according to GOST R 51301-99 «Food products and food raw materials. Inversion-voltammetric methods of determining the content of toxic elements (cadmium, lead, copper and zinc)». The content of mercury - according to GOST 26927-86 «Raw materials and food products. Method for mercury determination». The content of arsenic - according to GOST R 51766-2001 «Raw materials and food products. Atomic absorption method for arsenic determination».

DISCUSSION AND RESULTS

Being vegetable objects with the predominance of water in the composition, the fruits and berries studied in the work do not have high energy value: 100 g of the edible part yield the total of 30-100 kcal. The main energetic materials in the composition of fruits and berries are easily digested carbohydrates prevalent in the dry residue. Fruits and berries are most valuable as the source of biologically active vitamins, macro - and microelements, substances of specific action, and food fibers. Due to the presence of these groups of compounds, fruits and berries improve digestion, activity of the cardiovascular system, nervous and emotional state, therefore many fruits and berries are irreplaceable in nutrition. The average annual requirement of fruits and berries for a human is 7 kg [12].

Indicators of raspberry quality are shown in Table 1.

Table 1. Indicators of *Rubusidaeus* fruit quality (raspberry, grade Nagrada) n=5

Indicator name	Characteristics and norms according to GOST	Actually
Appearance, size, and structure	The fruit is polythalamous - complex roundish or cone-shaped drupes that have not stuck together into lumps. They consist of many (30-60) separate, concrescent drupes. Fruit size is 7.5 to 12 mm. Individual drupes are small, ball-shaped or ellipsoid, with pitted stones inside.	Fruits are round and do not stick together. They consist of individual concrescent drupes (48-60). Fruit size is 9 to 17 mm. They meet the requirements.
Color: surface pulp stones	Grayish-crimson Pinkish Dark yellow	Crimson red
Odor	Specific, pleasant	Pleasant, suitable
Taste	Sour-sweet	Mostly sweet
Humidity, %, not more than	15.0	13.0±0.5
Mass share of total ash, %, not more than	3.5	1.5±0.1
Mass share of blackened fruit, %, not more than	8.0	4±0.2
Mass share of fruit stuck together in lumps, %, not more than	4.0	2±0.5
Mass share of fruit with unseparated pedicels and flower disks, %, not more than	2.0	0.5±0.3
Mass fraction of crushed particles of the fruit that pass through a 2 mm sieve, %, not more than	4.0	1.5±0.5
Mass share of leaves and parts of raspberry stems, %, not more than	0.5	0.0
Mass share of extraneous impurities, %, not more than:		
organic (fruit and other parts of non-poisonous plants)	0.5	0.0
mineral (soil, sand, pebbles)	0.5	0.0
Presence of poisonous plants and their parts	Not allowed	Absent
Presence of mold and rot	The same	Not found
Presence of constant extraneous smell that does not vanish after airing	Not allowed	Absent

The quality of the studied raspberry meets the requirements of GOST, the content of toxic elements did not exceed the permissible level (Table 9), samples of raspberries may be used for further study.

Information about quality indicators of gooseberry is shown in Table 2.

Table 2. Quality indicators of *Ribesúva-crispa* (common gooseberry, variety Cooperator) n=5

Indicator name	Characteristics and norms according to GOST	Actually
Appearance	The berries are fully developed, healthy, whole, clean, without mechanical damage, not damaged by pests and diseases and excessive external moisture	The berries are developed, healthy, clean, without mechanical damage, not damaged by pests and diseases, or excessive moisture.
Color	Uniform	Uniform
Taste and smell	Characteristic of this pomological variety, free of any foreign smell and (or) taste	Sour-sweet
Ripeness	Consumptive	Consumptive
Content of berries % by weight, not more than:		
Mechanically damaged:	3.0	1.5± 0.3
At the point of dispatch	5.0	1.5± 0.2
At the point of destination	Not allowed	absent
With minor influence of powdery mildew		
Impurities of vegetable origin, % of weight, not more than	0.3	0.1± 0.05

It has been established that samples of gooseberry are typical by shape and color, their taste is sour-sweet, which is typical for the variety, without extraneous flavor.

The content of toxic elements in the berries did not exceed the permissible level (Table 9).

The data about strawberry quality is shown in Table 3.

It has been found that samples of strawberries are typical in appearance, color, taste and smell, and comply with the requirements of premium grade. The content of toxic elements does not exceed the permissible level (Table 9), the berries may be used for further testing.

Indicators of rosehips quality are shown in Table 5.

Samples of rosehips meet the requirements of GOST in terms of all indicators, and may be used for further testing. The content of toxic elements does not exceed the permissible level (Table 9).

Indicators of cherry quality used for the study are shown in Table 6.

It has been established that cherry samples correspond to the quality indicators of the first grade, have typical shape and color, the content of toxic elements does not exceed the allowed level (Table 9).

Indicators of banana quality used for further study are shown in Table 7. Post-ripened bananas were studied, i.e. bananas of consumer ripeness, of extra quality, made in Ecuador.

Analysis of the table data shows that samples of bananas meet the commercial grade extra, the content of toxic elements does not exceed the permissible level (Table 9).

Indicators of quality of the studied kiwifruits are shown in Table 8.

It has been found that samples of kiwifruit belong to the premium grade, and may be used in further studies. The content of toxic elements does not exceed the permissible level (Table 9).

Table 4. Indicators of quality of *Fragaria* (remontant strawberry, variety *Early Berdsk*) n=5

Indicator name	Characteristics and norms according to GOST	Actually
Appearance	The berries are fully developed, healthy, fresh, whole, ripe, clean, without mechanical damage and not damaged by excessive external moisture, with peduncle or without it, but with flower cup. Individual berries without flower cup are allowed	The berries are developed, healthy, whole, ripened, clean, without mechanical damage, not damaged by excessive moisture, with a peduncle
Taste and smell	Characteristic of this pomological variety, free of any foreign smell and (or) taste	Characteristic, without extraneous flavors and odors
Color of the berries	Uniform	uniform
Ripeness	Berries ripeness is uniform	
The size of the largest diameter, mm, not less than:	25.0	29±0.5
to be consumed fresh		
for processing	25.0 (premium) unlimited (1 grade)	-
Content of berries % by weight, not more than:mechanically damaged:		
at the points of dispatch	2.0 (premium), 5.0 (grade 1)	1.0± 0.2
At the points of destination	5.0 (premium), 10.0 (grade 1)	1.5± 0.5
damaged by pests and birds	2.0 (premium), 3.0 (grade 1)	1.0± 0.1

Table 5. Quality indicators of fruit of *Rosa majalis Herrm* (May Briar) n=5

Indicator name	Characteristic and norm for the raw material	Actually
Appearance	Whole, cleaned from sepals and peduncles false fruits of various shapes: from spherical, ovoid, or oval to very elongated fusiform; the length of fruit is 0.7 - 3 cm, the diameter is 0.6 - 1.7 cm. On the top of the fruit, there is a small round hole, or a pentagonal plate. The fruit consists of an enlarged thalamus (hypanthium) that contains numerous fruitlet nuts in its cavity. The walls of the fruit are hard, brittle, the outer surface is shiny, sometimes matte, more or less wrinkled. Inside, the fruits are profusely lined with long, very stiff bristles. The nutlets are small, oblong, with slightly pronounced edges.	Whole, clean, spherical to oval, fruit length is 1.8-3.2 cm, the diameter is 0.8-1.8 cm. On the top of the fruit, there is a round hole, the fruit consist of a hypanthium that contains fruitlet nuts in its cavity. The walls are rigid, the outer surface is shiny, wrinkled. Inside, the fruits are lined with long stiff bristles. The nutlets are small, oblong, with slightly pronounced edges.
Color: of the fruit of nuts	Orange-red to brownish-red	Orange-red
	Light yellow, sometimes brownish	Light yellow
Odor	Characteristic of this raw material, without extraneous odors	Characteristic, without extraneous odors

Indicator name	Characteristic and norm for the raw material	Actually
Taste	Sour-sweet, slightly astringent	Slightly astringent, sour-sweet
Humidity, %, not more than	15.0	12±0.5
Mass share of ascorbic acid, %, not less than	0.2	0.4±0.01
Mass share of total ash, %, not more than	3.0	1.0±0.1
Mass share of other parts of the plant (pieces of twigs, leaves, sepals and peduncles), %, not more than	2.0	0.5±0.1
Mass share of blackened, burnt, or damaged by pests and diseases fruit, %, not more than	1.0	0.3±0.1
Mass share of crushed particles of the fruit, including nuts, passing through a 3 mm sieve made to ToR 23.2.2068, %, not more than	3.0	1.0±0.5
Mass share of unripe fruit (of green to yellow color), %, not more than	5.0	1.0±0.5
Mass share of extraneous impurities: organic (parts of other non-poisonous plants), %, not more than	0.5	Absent
mineral (soil, sand, pebbles) %, not more than	0.5	Absent

Table 6. Quality indicators of *Prunusfruticosa* (steppe cherry, grade Altai Swallow) n=5

Indicator name	Characteristic	
	According to GOST	Actually
Appearance	Fruit of typical shape and color for this pomological variety (grade 1). Fruit of typical and untypical shape and color for this pomological variety (grade 2)	Fruit of typical shape and color for this pomological variety.
Ripeness	The fruits are of uniform ripeness, but not green, and not overripened (grade 1) Fruits of non-uniform ripeness are allowed, but not green, and not overripened (grade 2)	Fruit ripeness is uniform
The size of the largest diameter, mm, not less than	15 (grade 1) Unlimited (grade 2)	17±0.5
including for small-fruited varieties (Vladimirskaya, Samarkandskaya, Rastunia, Carthulialubali, Shubinka), and for the steppe and the felt cherry	12 (grade 1) Unlimited (grade 2)	13±0.5

Table 7. Quality indicators of *Músapardisiaca* (bananas of variety "extra") n=5

Indicator name	Characteristics and norms for grades		Actually
	Extra	first	
Appearance	Fruits of the same pomological variety. Fruits in the racemes are solid, fresh, clean, whole, healthy, developed, not disfigured, without flower remainders, with well expressed ribbed side faces. Crown of green color, cuts of the crown are smooth, healthy, and not over-dried		Fruit of the same pomological variety. The fruit in the racemes are solid, fresh, clean, whole, healthy, have well-defined ribbed side faces. Crowns of green color, cuts of the crown are smooth, healthy, and not over-dried
Taste and smell:	Specific smell of ripe bananas, sweet taste, without extraneous taste and aroma		The taste is specific, sweet, without extraneous taste and aroma.
Ripeness:	Cut fruit very well discharge laticiferous. The fruit of consumer ripeness with greenish-yellow, yellow color of the skin, but not overripened,		Cut fruit very well discharge laticiferous. The fruit of consumer ripeness with yellow color of the skin, not overripened,

Indicator name	Characteristics and norms for grades		Actually
	Extra	first	
	solid, round, with creamy pulp		solid, round, with creamy pulp
Fruit size:			
- by the greatest transverse diameter, cm	3.0-4.0		3.0±0.3
- by length, cm, not less than	20.0	19.0	21.0±1.2
Number of fruit in the raceme, pcs;	4-8	4-9	7±1.0
Number of racemes in a single packing unit, pcs;	15-18	14-18	17±0.9
Allowed deviation			
Content of bananas with deviations from the specified dimensions, not more than:			
- in diameter by 0.5 cm, %, not more than	2.0	5.0	1.0±0.2
- in length by 1.0 cm, %, not more than	3.0	5.0	2.0±0.7
Surface skin defects that do not affect the pulp due to mechanical damage and caused by agricultural pests in one fruit with the total area of, cm ² , not more than	1.0	2.0	0.5±0.02
Content of fruit with stains (spots) of latex, %, not more than:			
- with the area of not more than 10 cm ²	Unlimited		0
- with the area of more than 10 cm ²	1.0	2.0	0
Content of broken fruit, with skin torn close to the peduncle, with deep cuts, severe bruising, cracked skin, with affected pulp, affected by anthracnose, fusarium blight, sigatoga; decayed, rotten, steamed, overcooled 3-4 th degree, frozen, crushed, with severe damage by agricultural pests (skit pits, deep red spots of thunder flies nesting), overripened, with dark brown, black or mottled skin color	Not allowed		Absent

Table 8. Quality indicators of the fruit of *Actinidiadeliciosa* (gourmet kiwi) n=5

Indicator	Characteristic and norm for commercial varieties			actual
	premium	First	second	
Appearance	The fruit is fresh, whole, clean, healthy, firm, in the stage of commercial ripeness, well-formed, without stem, not over-ripened, not damaged by pests and diseases, without excessive external moisture, of the shape and color typical of the pomological variety.			The fruit is fresh, whole, clean, healthy, in the stage of commercial ripeness, not damaged by pests and diseases, of elongated oval shape, and green color
	Slight superficial skin defects that do not compromise quality are allowed	Fruit with slight defects of shape are allowed, but without warts and deformations, slight defects of color, slight skin defects, with the total area not exceeding 1 cm ² , with small traces of removed labels in the shape of longitudinal lines without rumples	Defects of shape, coloring, skin defects in the form of slight healed cracks or scarred/grazed tissue are allowed, the total area of which does not exceed 2 cm ² , with more pronounced traces of removed labels, with small rumples, and minor dents	
Smell and taste	Characteristic of this pomological variety, free of any extraneous smell and taste			Characteristic, without extraneous smell and taste
Internal structure	The pulp is firm, juicy, elastic, not damaged			The pulp is firm, juicy, elastic, not damaged
The ratio of the minimum to the maximum diameter of the fruit,	0.8	0.7	Unlimited	1.0± 0.1

measured at the transversal section, not less than				
Fruit weight, g, not less than	90.0	70.0	65.0	91±2.5
Degree of ripeness	Uniform	Uniform	Uniform, fruit of non uniform ripeness are allowed, but not overripened	uniform
Mass share of soluble dry substances, %, not less than	15.0			17.7± 0.8
Mass fraction of fruit with deviations from defined weight, by more than 10%, % of weight, not more than	Not allowed	5.0	10.0	-
Mass fraction of fruit with minor defects of shape and color, with minor dents, with small rumples, %, not more than	Not allowed	5.0	10.0	1.0±0.5
Mass fraction of fruit with surface skin defects, the total area of which does not exceed 1 cm ² , %, not more than	Not allowed	5.0	10.0	-
Mass fraction of fruit with surface skin defects in the form of slight healed cracks or scarred/grazed tissue, the total area of which does not exceed 2 cm ² , %, not more than	Not allowed	Not allowed	5.0	-
Mass fraction of faded, soft, watery, overripened, moldy, decayed fruit, damaged by insects, mechanically damaged, with affected pulp, with excessive external humidity, %, not more than	Not allowed			absent
Mass share of fused fruit, %, not more than	Not allowed			absent

Table 9. Content of toxic elements in berries and fruits

Raw material	Name of the element			
	lead	arsenic	cadmium	mercury
Raspberry	0.023	Less than 0.02	0.011	Less than 0.00002
Gooseberry	0.029	Less than 0.02	0.012	Less than 0.00002
Strawberry	0.030	Less than 0.02	0.013	Less than 0.00002
Cherry	0.075	Less than 0.04	Less than 0.01	Less than 0.00002
Briar	0.040	Less than 0.04	Less than 0.01	Less than 0.00002
Bananas	0.030	Less than 0.03	Less than 0.005	Less than 0.00002
Kiwi	0.030	Less than 0.03	Less than 0.005	Less than 0.00002
Allowed level, mg/kg according to SanPiN 2.3.2.1078-01	Not more than 0.4	Not more than 0.2	Not more than 0.03	Not more than 0.02

CONCLUSION

Analysis of the data in the tables shows that the quality of the studied types of fruit raw materials meet the regulatory requirements, and may be used for further tests aimed at developing a method of identifying the type of fruit raw material in food products.

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