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Objective organoleptic, structural-and-mechanical parameters of vegetables depending on their degree of ripeness

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Abstract. Organoleptic, structural-and-mechanical indicators determine the suitability of fruiting vegetables for harvesting and preservation, as well as the ratio of separate parts of the fruit. All these indicators affect the quality of products.
Experimental work was carried out in the conditions of the laboratory of the Department of Technology of Storing and Processing of Grain. A complex of organoleptic, commercial, physical and thermophysical indicators of eggplant, sweet pepper and tomato fruits were developed in the work to determine the time of their harvesting.
It was determined that physical density and mechanical strength in the fruits of sweet pepper of technical degree of ripeness were 6% higher than in the fruits of biological degree of ripeness.
Peculiarities of the ripeness degree significantly affected the amount of inedible part of the fruit (seeds, seed cavity and peduncle), which was 1.2 times less in sweet pepper fruits of technical degree of ripeness than biological degree of ripeness.
Considerable varietal difference of eggplant fruits by the amount of edible and inedible parts of the fruit was determined. Peculiarities of the variety also significantly affected the density and hardness of the fruit.
Red tomatoes fruits of Iskorka variety had tender pulp consistency and relatively low fruit density (0.88 g cm^{-3}) and mechanical strength (3.00 kg cm^{-2}).
The objective organoleptic, structural-and-mechanical indicators of fruiting vegetables were determined depending on their degree of ripeness; to determine the optimal time of harvesting the fruits of eggplant, sweet pepper, tomato.

Key words: organoleptic indicators, structural-and-mechanical indicators, variety, degree of ripeness, vegetables.

INTRODUCTION

The main conditions for reducing the loss of fruit and vegetable products are timely harvest, as well as developing and improving the methods of storage. Every year, many products lose their food value because of improper storage, and sometimes it is completely spoiled. One should store food in accordance with scientifically established parameters to ensure that vegetables meet the best biochemical and organoleptic characteristics for a long time.

In a context characterized by a growing consumer's interest in locally produced foods, the safeguard of widely known fruit varieties appears relevant (Darby et al., 2008; Denver & Jensen, 2014; Bartolini & Ducci, 2017).

In all countries of the world, about 247 kinds of vegetables are consumed, 40 of which are consumed Ukraine while 70 are produced in the neighboring countries. Ukraine occupies a leading place in the production of vegetables and fruits among the neighboring countries (Overchenko, 2005). The population has increased interest in consuming exclusively natural food as a way of improving the quality of life (Corbo et al., 2006; Osadcuks & Pecka, 2016). Now both professionals and consumers talk about natural products with special properties (Philipchuk, 2005).

Vegetable ripeness is characterized by such organoleptic characteristics as condition of skin, pulp, and their color according to current standards. Thus, the internal anatomical structure characterizes fruits ripeness and is indicated in the standards as a seed cavity with ripe seeds (sweet pepper of biological degree of ripeness, red tomatoes) or with non-ripe white seeds (sweet pepper and eggplants of technical degree of ripeness), pulp of various density, but not over-ripe. However, these indicators are subjective because the fruits of different varieties have their own peculiarities (Lima et al., 2005; Freitas & Costa, 2006; Leccese et al., 2012).

MATERIALS AND METHODS

The aim of the present work was to determine the objective organoleptic, structural-and-mechanical indicators of fruiting vegetables depending on their degree of ripeness and to determine the optimal time of harvesting the fruits of eggplant, sweet pepper, tomato.

Research Methodology (STN 2659–94, 1995; STN 2660–94, 1995; STN 3246–95, 1997; Rubatzky, et al., 1997; Yeshchenko, et al., 2005).

The area of experimental plots under tomatoes, sweet pepper and eggplants was 20 m^2 each. Repeatability of the experiment was three-times. Planting of seedlings in the age of 60 days was carried out in mid May, when the threat of freezing completely ceased, in the open ground according to the scheme of 70×20 cm. Technological measures were carried out in accordance with the requirements of the crop. Phenological observations – by beginning and passing of the phenological phases of plants development.

The duration of phases of plants vegetation was determined under different weather conditions. The following indicators of fruiting vegetables were defined: objective organoleptic – by form, colour, taste, smell; – internal anatomical structure and biometric – by weight, length, diameter, width, volume of fruit, number of fruits per plant, number of commodity fruits per plant, inedible part of the commodity weight of the fruit. Sample weight for the experiment was 5,000 g.

Hardness of the fruit covering tissues was determined by a penetrometer FT 327 with a plunger of 11 mm in diameter (pre-cutting the skin).

Volume of fruit was assessed by submerging them into water in a measuring cylinder. Volumetric (bulk) weight of vegetables in the volume of 1 m^3 provided free laying, taking into account free space between individual specimens of eggplant fruits, sweet pepper and tomatoes, was determined using a box with dimension of 1 m each

side making the volume 1 m^3. The box was filled to the edges; the mass of fruits was estimated by the difference between the weight of the box and products.

Physical density (specific weight) was calculated by the formula:

$$P_\phi = \frac{м}{V}, \quad (1)$$

where P_ϕ – physical density, kg m^{-3}; м – product weight, kg; V – volume of product, m^3.

Organoleptic evaluation of the quality of fresh fruit was carried out using a five-point system (STN 87561–79, 1979).

Statistical processing of research results was carried out using special program packages (Excel, Statistics). Differences were considered to be significant at validity of $\alpha = 0.95$.

RESULTS AND DISCUSSION

Fruits of sweet pepper of technical and biological degree of ripeness, tomato of green, flesh-colored, brown, pink, red (yellow) degree of ripeness, while eggplant only of technical degree are being used for harvesting, sale, processing and storage. Properties of vegetables of different degrees of ripeness affect their nutritional value, storage capacity and marketable quality.

Objective indicators of optimum degree of fruits ripeness of eggplant, sweet pepper and tomato include colour, appearance, anatomical structure of fruits, amount of seeds, share of edible and inedible part of the fruit, their weight and volume, hardness and density.

Table 1 shows organoleptic characteristics by shape, colour, taste and smell of eggplant fruits of Helios and Almaz variety, tomatoes of Iskorka variety, sweet pepper of Novohohoshary variety of different degrees of ripeness, as well as characteristics of their inner anatomical structure.

Table 1. Objective organoleptic indicators of fruiting vegetables depending on the variety and degree of ripeness

	Eggplant		Sweet pepper		Tomatoes
	variety				
Indicator	Almaz	Helios	Novohohoshary		Iskorka
	degree of ripeness				
	technical		technical	biological	red
Shape	cylindrical	ball-like	ribbed-and-round		oval
Colour	dark-violet	light-violet	green	red	red
Taste and (or) smell	peculiar without a foreign smell	peculiar without any foreign smell, with no strong solanaceous smell	sweet taste with slight flavour strength; with peculiar flavour	sweet taste with tender flavour strength; peculiar, strongly pronounced aroma	taste and (or) smell
Inner-anatomical structure	dense pulp without free space, greenish or white, seed cavity with unripe white seeds		seeds of wax or milk ripeness	ripe seeds	tender consistency of pulp, ripe seeds

Vegetative phases duration of plants under certain agro climatic conditions was established to supplement objective indicators of the harvesting period of tomatoes, eggplants, sweet peppers for further processing. The beginning and duration of the vegetation phases of eggplant, sweet pepper and tomato plants were established according to the indicators given in Tables 2–4.

Table 2. Vegetation period of eggplant plants of Helios and Almaz varieties

No.	Phase	Duration
1.	Term of planting	From the 21st to 31st days of May
2.	Formation of flower buds	From the 1st to 10th days of June
3.	Beginning of blossom	From the 21st to 30th days of June
4.	Mass blossom	From the 11st to 31st days of July (up to 16 flowers per plant)
5.	Beginning of fruit-set	From the 1st to 10th days of July
6.	Ripe	15–20 days after blossom
7.	First formed fruits	From the 11st to 20th days of July
8.	Mass fruit bearing	From the 21st of July to the 10th day of August
9.	Period of vegetation[1]	131 ± 10 days
10.	Duration of fruits being under technical degree of ripeness	to 34 days

Note. [1] – harvest time is up to 63 days.

Table 3. Vegetation period of sweet pepper plants of Novohohoshary variety

No.	Phase	Duration
1.	Term of planting	From the 21st to 31st days of May
2.	Formation of flower buds	From the 1st to 10th days of June
3.	Beginning of blossom	From the 11st to 30th days of June
4.	Mass blossom	From the 1st to 31st days of July
5.	Beginning of fruit-set	From the 1st to 10th days of July
6.	Ripe	10 ± 2 days after blossom
7.	First formed fruits	From the 11st to 20th days of July
8.	Mass fruit bearing	From the 21st of July to the 10th day of August (35–40 days since ovary appearing)
9.	Period of vegetation[1]	125 ± 10 days (144 ± 10 days)
10.	Duration of fruits being under technical degree of ripeness	to 37 days

Note. [1] – fruits of technical (biological) degree of ripeness with the duration of harvest of 72 days.

Table 4. Vegetation period of tomatoes plants of Iskorka variety

No.	Phase	Duration
1.	Term of planting	From the 21st to 31st days of May
2.	Formation of flower buds	From the 1st to 10th days of June
3.	Beginning of blossom	From the 11st to 30th days of June
4.	Mass blossom	From the 1st to 31st days of July
5.	Beginning of fruit-set	From the 21st to 30th days of June
6.	Ripe	10 ± 2 days after blossom
7.	First formed fruits	From the 21st of June to the 10th day of July
8.	Mass fruit bearing	From the 21st of July to the 10th day of August
9.	Period of vegetation	70 ± 6 days

According to the observation, it was found that individual phases: term of planting (last 10 days of May), formation of flower buds (first 10 days of June), mass fruit bearing (last 10 days of July to first 10 days of August) occurred in the same terms regardless of the type of vegetables.

In particular, according to the phenological observations, the phase of plants floral bud formation of eggplant of Almaz variety came 12 days after planting the seedlings, and after 15 days in Helios variety. Thus, the difference between the dates of beginning of the phase of flower bud formation of the experimental varieties was three days.

Eggplant differed in slightly later period of flowering. Instead, the phase of beginning of fruit-set in tomato was at the end of June, while eggplant and sweet pepper began setting fruit in July.

Ripening of eggplant fruits occurred within 15–20 days after flowering, while pepper and tomato – 10 ± 2 days after flowering. The first formed tomatoes were observed in last 10 days of June to first 10 days of July, sweet pepper and eggplant – in mid-10 days of July. The duration of fruits being in the degree of ripeness of eggplant varieties of Helios and Almaz was up to 34 days whereas this duration was 37 days for sweet pepper of Novohohoshary variety.

The harvest frequency and duration of harvest of eggplant and sweet pepper depend on the terms of planting, growing conditions and biological characteristics of the variety. Duration of the harvest period in the studied varieties of eggplant and sweet pepper was up to 63 days and 72 days, respectively.

It was found that the period of plants vegetation was 131 ± 10 days for eggplant, 125 ± 10 days for sweet pepper and 70 ± 6 days tomato. We defined commodity state, structural and qualitative indicators of fruiting vegetables. The shape of vegetables is characterized by length, width and diameter. The research showed that these indicators had varietal characteristics (Table 5).

Table 5. Structural-and-mechanical properties of fruits of eggplant plants

Indicator	Variety		LSD_{05}
	Almaz	Helios	
Length without peduncle, cm	11.30	8.20[1]	*0.49*
Weight of one commodity fruit (g)	144.50	210.80	*8.90*
Volume of fruit (cm^3)	110.50	186.60	*7.44*
Physical solidity (g cm^{-3})	1.31	1.13	*0.06*
Density (kg cm^{-2})	7.90	7.20	*0.38*
Number of fruits on one plant (pcs)	6–9	4–8	*0.3*
Number of commodity fruits on one plant (pcs)	4–8	2–5	*0.2*

Note. [1] – diameter, cm.

Eggplants of Helios variety had a ball-like shape of fruits with an average length of 8.2 cm, and Almaz variety had cylindrical fruit shape with an average length of 11.3 cm.

Average weight of eggplants of the technical degree of ripeness of Almaz variety was 144.5 g, which was 66.3 g or 32% less than Helios variety. Volume of eggplants of the technical degree of ripeness of Helios variety was 186.6 cm^3, which was 76.1 cm^3 or 41% greater than Almaz variety.

Eggplants of Almaz variety had 6–9 fruits on one plant, of which 4–8 pcs correspond to standard (sample) (STN 2660–94, 1995). Eggplant of Helios variety had 1–3 fruits more than Almaz variety.

Structural-and-mechanical and physical properties of sweet pepper fruits are given in Table 6. Six to 12 fruits were harvested from one sweet pepper plant, and 5–8 pcs correspond to standard (STN 2659–94, 1995).

Table 6. Structural-and-mechanical properties of sweet pepper fruits of Novohohoshary variety

Indicator	Degree of ripeness		LSD_{05}
	technical	biological	
Length without peduncle (cm)	7.30	7.45	*0.37*
Width (cm)	5.41	5.70	*0.28*
Thickness of walls (cm)	0.60	0.65	*0.03*
Weight of one commodity fruit (g)	100.50	103.00	*5.09*
Volume of fruit (cm^3)	98.04	105.80	*5.10*
Physical solidity (g cm^{-3})	1.03	0.97	*0.05*
Density (kg cm^{-2})	8.60	8.10	*0.42*
Number of fruits on one plant (pcs)	6–12		
Number of commodity fruits on one plant (pcs)	5–8		

Fruits of sweet pepper of Novohohoshary variety of technical degree of ripeness differed in structural indicators compared with the fruits of biological degree of ripeness. Thus, average length of peppers of technical degree of ripeness was less by 2%, width by 5%, weight by 2.4%, volume by 7.3% than the fruits of biological degree of ripeness and were 7.3 and 5.4 cm, 100.5 g, 98.0 cm^3, respectively.

Variation-and-statistical data processing in Table 5 indicated that the peculiarities of eggplant fruits did not affect their biometric and anatomical characteristics but had a significant effect on density and physical solidity. The reliable difference by the degree of ripeness was observed only for the indicators of length and weight of pepper fruits of Novohohoshary variety (Table 6).

Structural-and-mechanical and physical properties of tomato fruits are presented in Table 7.

Table 7. Structural-and-mechanical properties of tomatoes fruits of Islorka variety

Indicator	Year				LSD_{05}
	2007	2008	2009	average	
Diameter (cm)	5.22	5.48	5.30	5.30	*0.27*
Weight of one commodity fruit (g)	92.65	93.25	93.10	93.00	*4.66*
Volume of fruit (cm^3)	104.10	106.00	105.60	105.50	*5.28*
Physical solidity (g cm^{-3})	0.89	0.88	0.88	0.88	*0.04*
Density (kg cm^{-2})	3.10	2.90	3.00	3.00	*0.16*
Number of fruits on one plant (pcs)	6–18				
Number of commodity fruits on one plant (pcs)	9–12				

We found that the red tomato fruits of Iskorka variety had average diameter of 5.3 cm, weight of 93 g and average fruit volume of 105.5 cm^3. Six to 18 tomato fruits were harvested from one plant, 9–12 pcs correspond to standard (STN 3246–95, 1997).

Variation-and-statistical data processing in Table 7 indicated that the weather conditions in the year of tomato growing did not significantly affect the structural-and-mechanical properties of the fruits.

The development of the fruits occurred from the process of ovary formation to the end of growth. This stage was characterized by synthesis and accumulation of nutrients and intensive activities of metabolic processes (Overchenko, 2005).

Ripening of fruits causes increasing of the cells in size, weakening of intercellular adherence, intercellular spaces become wider, which leads to a change in the consistency of pulp, that is why their density decreases (Overchenko, 2005; Philipchuk, 2005). This changes the physical density of the fruit, which depends on the anatomical structure, the thickness of the fruit walls and the skin.

All these indicators affect the quality of the produce. Thus, the fruits of sweet pepper of technical degree of ripeness had physical solidity of 1.03 cm^3, which is almost 6% more than the fruits of biological degree of ripeness. Similar data were obtained in determining of mechanical strength of fruits – this indicator was reduced from 8.60 kg cm^{-2} in sweet pepper to technical degree of ripeness to 8.10 kg cm^{-2} of fruits of biological degree of ripeness, that was also by 6%. Consequently, fruits of sweet pepper of biological degree of ripeness had greater diameter and weight, but density and hardness were less. Most physical solidity does not worsen the quality of fruit, but obviously improve its transportation.

Peculiarities of the variety significantly influenced the density and hardness of the fruit. Physical density in eggplants of Helios variety was 1.13 g cm^{-3}, which was 14% less than in the fruits of Almaz variety. At the same time, hardness of the pulp of the last variety was 9% higher and was 7.90 kg cm^{-2}. Red tomato fruits of Iskorka variety had a tender consistency of the pulp and relatively low fruit density (0.88 g cm^{-3}) and mechanical strength (3.00 kg cm^{-2}).

Fruits for using in the processing industry often require the implementation of a number of technological operations, one of which is cleaning, which results in the removal of peduncle, seeds and pulp from the fruit. Waste share' indicator has certain economic and domestic value, since it determines the size of the commodity part of the fruit for different types of processing and consumption.

Table 8. Characteristics of separate parts of eggplant fruits

Part of fruit		Variety		LSD_{05}
		Almaz	Helios	
Pulp	(g)	110.20	178.73	*7.32*
	(%)	76.26	84.80	*4.04*
Skin	(g)	20.00	19.00	*0.98*
	(%)	13.84	9.00	*0.58*
Inedible part,	(g)	14.30	13.07	*0.70*
including:	(%)	9.90	6.20	*0.42*
seeds	(g)	4.43	4.05	*0.22*
	(%)	3.07	1.92	*0.13*
peduncle	(g)	9.87	9.02	*0.48*
	(%)	6.83	4.28	*0.29*

The ratio of separate parts of the fruit to the total weight of fruiting vegetables is given in Tables 8–10. We defined a significant varietal difference between the fruits of eggplant by the amount of inedible part of the fruit (seeds and peduncle). Thus, inedible part of the fruit in eggplant of Almaz variety, on average,was 14.3 g, which was about 10% of the fruit weight, while 13.07 g in Helios variety, which corresponded to only 6% of the fruit weight.

Moreover, the proportion of seeds-to-fruit weight was 4–4.5 g, which was about 2% in fruits of eggplant of Helios variety and 3% in the fruits of Almaz variety. The share of seeds in the eggplant fruits of both species under research was about 30% of inedible part.

It was found that the weight of the skin (edible part of the fruit) in eggplants of Almaz variety was 20 g or on average 14%, while it was 19 g in Helios variety, corresponding to only 9% of the fruit weight.

Eggplant fruits of Helios variety differed in hardness of pulp. Taking into account the ratio of the above-mentioned parts of the fruit, pulp in eggplant fruits of Helios variety was on average 85% and only 76% in Almaz variety.

Inedible part in sweet pepper includes seeds, seed cavity and peduncle and it is 15.2% in fruits of technical degree of ripeness and 18% in biological degree of ripeness which is 1.2 times more. At the same time, the share of seeds in the inedible part of the fruit of technical degree of ripeness was about 22%, and it was almost 4% more – 25% in biological degree of ripeness.

Table 9. Characteristics of separate parts of sweet pepper fruits of Novohohoshary variety

Part of fruit		Degree of ripeness		LSD_{05}
		technical	biological	
Pulp and skin	(g)	85.17	84.46	*4.22*
	(%)	84.75	82.00	*4.16*
Inedible part,	(g)	15.33	18.54	*0.86*
including:	(%)	15.25	18.00	*0.84*
seeds	(g)	3.32	4.70	*0.22*
	(%)	3.30	4.56	*0.20*
seed cavity	(g)	4.13	5.01	*0.23*
	(%)	4.11	4.86	*0.23*
peduncle	(g)	7.88	8.83	*0.43*
	(%)	7.84	8.58	*0.42*

Seed cavity in pepper was about 27%, regardless of the degree of ripeness. The seeds of sweet pepper fruits were ripe, and of milk or wax ripeness in technical degree. Pulp in sweet pepper fruits of technical and biological degree of ripeness was on average 82–85%.

The ratio of separate parts of the fruit to the total weight of tomato is presented in Table 10. Inedible part of the fruit in tomatoes is represented by seeds, the weight of which is 3–4 g per fruit, that is about 5% of the weight. Pulp and skin of tomato fruits are considered as edible parts, which in total occupy more than 88% of the fruit.

Variation-and-statistical data processing of Table 10 indicates that the weather conditions of the growing year did not significantly affect the number of separate parts of the tomato fruit of Iskorka variety.

Table 10. Characteristics of separate parts of tomatoes fruits of Iskorka variety

Part of fruit		Year				LSD_{05}
		2007	2008	2009	average	
Pulp and skin	(g)	88.03	88.62	88.40	88.35	*4.34*
	(%)	95.01	95.04	94.95	95.00	*4.80*
Inedible part, including:	(g)	4.62	4.63	4.70	4.65	*0.23*
	(%)	4.99	4.96	5.05	5.00	*0.24*
seeds	(g)	3.20	3.08	3.20	3.16	*0.16*
	(%)	3.45	3.30	3.44	3.40	*0.17*
peduncle	(g)	1.42	1.55	1.50	1.49	*0.08*
	(%)	1.53	1.66	1.61	1.60	*0.09*

CONCLUSIONS

Structural-and-mechanical indicators determine the suitability of fruiting vegetables for harvesting and preservation, as well as the ratio of separate parts of the fruit.

The established biometric parameters of the fruits and yield of tomatoes, sweet peppers and eggplants are aligned with the results of studies in other countries. However, foreign standards do not take into account commercial impact of the density of fruit and the amount of inedible fruit.

We have determined that the fruits of sweet pepper of technical ripeness are superior to the fruits of biological ripeness in terms of physical density and mechanical strength. Eggplant fruits of Almaz variety have higher values of fruit density than those of Helios variety. This will obviously have a positive impact on their transportation and delivery time.

The fruits of sweet biological ripeness have greater values of fruit length, width, weight and size than technically ripe fruits. Considerable varietal difference of eggplant fruits by the amount of edible and inedible parts of the fruit was determined. The inedible part (seeds and peduncle) in the eggplant fruits of Almaz variety was about 10% of the fruit weight, while it was only 6% in the eggplants of Helios variety. This is likely to be commercially viable.

REFERENCES

Bartolini, S. & Ducci, E. 2017. Quality evaluation of local apple varieties: physicochemical and antioxidant proprieties at harvest and after cold storage. *Agronomy Research* **15**(5), 1866–1877.

Darby, K., Batte, M.T., Ernst, S. & Roe, B. 2008. Decomposing local: A conjoint analysis of locally produced foods. *Am. J. Agr. Econ*. **90**(2), 476–486.

Corbo, M.R., Nobile, M.A.D. & Sinigaglia, M. 2006. A novel approach for calculation shelf life of minimally processed vegetables. *International Journal of Food Microbiology* **106**, 69–73.

Denver, S. & Jensen, J.D. 2014. Consumer preferences for organically and locally produced apples. *Food Qual. Prefer*. **31**, 129–134.

Freitas, M.A. & Costa, J.C. 2006. Shelf life determination using sensory evaluation scores: A general Weibull modeling approach. *Computers & Industrial Engineering* **51**, 652–670.

Leccese, A., Bartolini, S. & Viti, R. 2012.Genotype, harvest season, and cold storage influence on fruit quality and antioxidant properties of apricot. *Int. J. Food Prop*. **15** 4), 864–879.

Lima, V.L.A.G., Mélo, E.A., Maciel, M.I.S., Prazeres, F.G., Musser, R.S. & Lima, D.E.S. 2005. Total phenolic and carotenoid contents in acerola genotypes harvested at three ripening stages. *Food Chem* **90**, 565–568.

Osadcuks, V. & Pecka, A. 2016. Electrical field based detection of fruits and vegetables for robotized horticulture. *Agronomy Research* **14**(S1), 1088–1098.

Overchenko, B. 2005. Storage of fresh vegetables. *Vegetable production* **8**, 62–65 (in Ukrainian).

Philipchuk, P. 2005. Honor and praise orange! *Ogorodnik* **3**, 12 (in Ukrainian).

Rubatzky, V.E. & Yamaguchi, M. 1997. Word Vegetables: Principles, Production, and Nutritive Values. *2nd edition. Chapman & Hall, 115 Fifth Ave.* New York, NY. 843 pp.

STN 2660–94. Eggplant freshi. Specifications. Kyiv: Standartinform Publ., 14 pp. 1995.

STN 87561–79. Fruit and vegetable processing product. Methods for determining organoleptic quality assessment. Moscow: Standartinform Publ., pp. 1–12. 1979.

STN 2659–94. Sweet pepper fresh. Specifications. Kyiv: Standartinform Publ., 14 pp. 1995.

STN 3246–95. Tomatoes are fresh. Specifications. Kyiv: Standartinform Publ., 14 pp. 1997.

Yeshchenko, V.O., Kopytko, P.G., Opryshko, V.P., Kostogriz, P.V. 2005. *Fundamentals of Research in Agronomy*: textbook. Kyiv: Action, 288 pp. (in Ukrainian).