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INTEGRATED INDICATOR OF CUSTOMER VALUE IN FRUITS BERRY CULTURES

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Based on years study quality indexes fruit berry cultures which grown in different conditions and using mathematical processing of the data it have been found optimal indicators of consumer index, that make it possible to determine the assortment of these cultures for a particular climate zone. The maximum value of the index can be used in horticulture as one of the criteria for evaluation the conditions of growth and development berries also quality crop in selection work in the creation and further cultivation and zoning of new varieties.

Tags: *fruit, strawberry, raspberry, black currant, organic matter, growing regions, forecasting consumer index.*

One of the directions of use a new technologies is the creation of systems which maintaining decisions. It is often necessary to make decisions about cost-effective realization of a just received fruit products, with have many contradictory figures for its quality. So, the aim of our research was to create an optimal system of quality evaluation of fruits berry cultures which would provide the best and operative management system realization of received product. To make optimal decisions about the quality of received berry cultures products, was found comprehensive index that represent the contents of major biochemical substances in fruits.

Methods of research. Merchandising, analytical and organoleptic quality indicators for berry cultures we have been studying for eleven years. Over the years, more than 100 varieties of strawberry, raspberry and black currant have studied from different regions of Ukraine. Laboratory researchs were performed according to "Methodological recommendations for research on issues of storage and processing" and "Methods of quality evaluation of fruits and berries» [4]. The

mathematical processing of the results was performed by using regression analysis and according to an existing methodical recommendations with the help of using a personal computer applications P.V. Kondratenko and M.O. Bublik [1]. Meteorological data assembled and processed in meteoposts IH NAAS and its research institutions network.

Results. For strawberry, raspberry and black currant varietal characteristics determine the consumer index within the limits of 14,6-46,3%, and growth conditions, growth retardation in 53,7-85,4%. This indicates, that a number of biochemical substances in fruits of these crop is changing being influenced by biotic and abiotic factors. For strawberry growing conditions determine the consumer index of fruits on 85.4%. Especially it is typical for the content of the amount of pectin and protopectin guestrooms at strawberry that depends on growing conditions, respectively, 21.0 and 24.3% of polyphenols - 10.8%, fruit weight - 14.5%. For raspberry and black currant growing conditions affect the content of organic matter in berries within the limits of 53,7-56,8%. In raspberries for a total amount of pectin by 11.8%, titrated acids and soluble dry matter, respectively, 7.4 and 9.1%. For other biochemical parameters 3-6%. In the fruits of black currants the content of volumetric sugars and acids are determined by the conditions of their growth and development within 7,2-9,0% pectin and protopectin on 9,2-14,3%.

The consumer index of these berry crops is in a wide range from 0.54 to 207.27 points. Thus, the smallest size, regardless of the type of berry cultures, are 0,54-0,82 points. The largest points for black currant is 207.27, and for raspberries and strawberries 67,46-73,65 points. For strawberries the averages consumer index is 16,63 ± 1,55, for raspberry 20,18 ± 1,72 points, and for black currants this indicator maximum 56,93 ± 6,78 points.

Average values of forming the consumer quality of raspberry, strawberry and black currant are given in relative units, that makes possible to assess the impact on the structure of the consumer index not only one indicator, but also compare values between represented cultures.

By the number of organic substances black currant berries are the richest. They contain the most vitamin C - 0.68 relative units (115 mg / 100 g), which is 2.4 times more than in strawberries - 0.28 relative units (47 mg / 100 g) and 4.4 than raspberries - 0.15 relative units (26 mg / 100 g).

Blackcurrants contain the most of the titrated acids - 0.58 relative units (3.05%), polyphenolic compounds - 0.50 relative units (649 mg / 100 g), protopectin - 0.47 relative units (0.68%), dry soluble substances - 0.47 relative units (14.5%), the total amount of pectin - 0.46 relative units (1.00%).

It should also be noted, that over the content of soluble pectin black currant and strawberry are close, their performance within the limits of 0,43-0,45 relative units (0,30-0,31%). The same content of sugar - 0,36-0,42 of relative units (5,7-6,9%) have raspberry and black currant . It is necessary to point, the low content of soluble pectin in raspberry - 0.23 relative units (0.16%), and dry soluble substances in strawberries - 0.29 relative units (8.9%). Therefore, the fruits of black currant in contrast to raspberries and strawberries have the highest consumer index.

The weight of strawberry is 0.91 relative units (16.5 g) significantly different from the weight of raspberry - 0.14 relative units (2.5 g) and black currant - 0.06 relative units (1.06 g), so at modeling this indicator has been improved .

 The optimal indicators of consumer index are different, they are depending on the culture of the fruit. They are minimal for strawberries (13.97 - 15.41 points), and maximum for black currant (39.25 - 51.97 points).
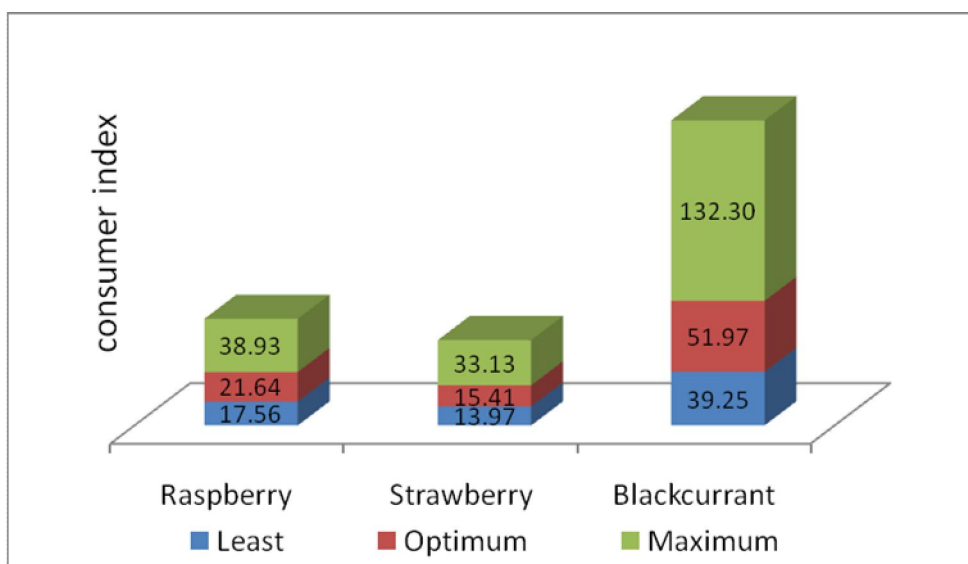
Fig. 1. The limits of the consumer index of fruit berry cultures

The correlation, regression and multivariate dispersion analysis that were obtained, allowed to prepare a range of optimal and maximum levels for the consumer index of strawberry, raspberry and blackcurrant, develop mathematical models for the prediction of it.

The optimal prediction equation with the consumer index of strawberry (1) is a linear dependence, where variable is the average weight of berries, its content of vitamin C and polyphenolic substances. The coefficient of determination the equation is 84.2% that indicates that the arguments-indicators significantly reflect the range of the consumer index. The analysis of each particle of the indicators, that were presented in predicting of the consumer index, showed, that the weight of berries determines it by 36% vitamin C and polyphenolic compounds respectively 31 and 26%.

$$I_{opt.c} = -15{,}3841 + 3{,}9537m - 1{,}3630C + 0{,}1067F, \qquad (R = 0{,}9180)$$

where $I_{opt.c}$ – the consumer index of strawberry, point;

   m – medium weight of berries, g;   (1)

   C – vitamin C mg / 100 g;

   F – polyphenolic compounds mg / 100 g.

The optimal value of the consumer index of strawberries is observed in the such a case, when a particular fruit weight corresponds to content of vitamin C and

polyphenolic substances. Therefore, to achieve a high consumer index for crop of strawberry, conditions of plants growth and development on the background an increase in weight of berries should ensure and increase both vitamin C and polyphenolic compounds in fruits. For example, the consumer index of strawberry is 10 points, that can be achieved by mass 11.0 g of berries, vitamin C - 26 mg / 100 g and polyphenolic compounds - 150 mg / 100 g

For raspberry the optimal consumer index equation (2) has the form of exponential functions, variables of which are arguments-indicators, sugar and pectin. The coefficient of determination the equation is 79.2%, that indicates these biochemical indicators which significantly reflect the rate.

$$I_{opt.\ m} = \ell^{\ (-3,1977\ +\ 0,3345\ x\ g\ +\ 5,7914\ x\ P_3\ )}, \qquad\qquad (\eta = 0,889)$$

where $I_{opt.\ m}$ – the consumer index of raspberry, point;   (2)

g – sugars, %;

P_3 – the amount of pectins, %.

The analysis of the contribution of each of the represented indicators in predicting the consumer index of berries showed, that pectin substances determine its by 32, sugar - 44, and their interaction is manifested by 17%.

Thus, if raspberry consent of sugar and pectins increase, that might cause of the consumer index growth. It is necessary to note a significant increase of consumer index score while increasing the total pectins on the background of increasing sugar content, more than 6.0%. Therefore, if the amount of pectin in berries is 0.45%,the amount of sugar increased to 1.0%, the consumer index score increased to 2.07, for the same indicators, but for the content of the total pectins in berries to 0.75%, the indicator will be 10.76 points.

The optimal equation for prediction the consumer index for black currants (3) is a linear function, variables of which are vitamin C and pectin. The coefficient of determination the equation is 82.4%, it also indicates that the presented indicators represent findings. Pectin substances determined the onsumer quality of black currant fruit at 71, and the content of vitamin C at 21%.

$$I_{opt.S} = -215{,}0400 + 0{,}8047C + 179{,}7112P_3 , \qquad (R = 0{,}907)$$

де $I_{opt.\ S}$ – the consumer index, point;   (3)

$\quad$ C $\quad$ – vitamin C, mg/100 g;

$\quad$ P_3 $\quad$ – the amount of pectin, %.

The high consumer value of black currant is one of the biological features for berry crops. The increase of vitamin C and the total pectins in berries promotes the growth of consumer index. However, it should be noted that for berry cultures a partial decrease of vitamin C on the background of increase the content of pectin substances, also increases the consumer quality of fruit by increasing other biochemical substances in them.

The resulting predictive modules were applied for determining the customer value of investigated berry cultures that grew in different regions of Ukraine. In particular, it was found that the fruits of strawberry have the highest consumer index by average indicator in Artemivsk ESN (14.6 points), and the lowest - in Podolsky HRS (6.2 points), he was an intermediate in Lviv HRS and in the Institute of Horticulture NAAS (9.7 and 12.8 points, respectively) (Table. 1).

Fruits of different varieties of strawberries on Artemivsk ESN accumulate a significant amount of biochemical substances, which form a consumer value. So their integrated index (the consumer index) was at the middle and higher except of sort Olbia. The highest point of the consumer index among the studied sorts have fruits of Festuvalna romashka (22,5 points) in Artemivsk ESN and in the Institute of Horticulture and Podolsky HRS(19,4 points), in Lviv HRS nutrient indicator of this sort was below the average (10,5 points). It is appropriate to point out, that all the studied varieties of strawberry at Podolsky HRS in terms of the consumer index were having a mediocre consumer quality with the limits from 0.4 - sort Zeng Zenhana to 10.5 points - Festuvalna romashka. In the Institute of Horticulture high consumer index, except the Festuvalna romashka, had fruits of sort Shelf (20.7) and Zeng Zenhana (15.6 points), it was below the average in the rest of the sorts(see. Table. 1).

Table 1

The consumer index of berry cultures in different regions of Ukraine (score)

Sort	The region of growing				
	NAAS	Krasnokutskiy SRCH	Lviv HRS	Podolsky HRS	Artemivska ESN
Strawberry					
Olvia	8,2	Undefined	2,5	2,9	10,8
Octave	8,5	The same	2,3	5,6	11,3
Prisvyata	9,3	–//–	8,2	9,9	14,0
Polka	20,7	–//–	8,8	8,3	10,6
Festuvalna romashka	19,4	–//–	19,4	10,5	22,5
Bagrjany	7,6	–//–	14,6	5,5	19,0
Zeng Zengana	15,6	–//–	12,2	0,4	13,8
Average	*12,8*	*–//–*	*9,7*	*6,2*	*14,6*
Raspberry					
Meteor	10,2	51,0	8,0	Undefined	11,7
Lazarivska	20,1	62,2	10,0	The same	7,8
Novokytayivsa	19,5	29,7	11,4	–//–	11,1
Sputnytsya	11,4	38,0	6,9	–//–	13,7
Brigantine	26,0	61,0	9,8	–//–	13,8
Average	*17,4*	*48,4*	*9,2*	*–//–*	*11,6*
Black current					
Suita Kyivska	21,5	60,3	92,4	104,5	Undefined
Vernissage	95,1	71,3	140,0	67,0	The same
Sanyuta	49,0	88,0	87,7	70,0	–//–
Amethyst	120,1	87,4	117,2	65,1	–//–
Sofiyivska	56,8	85,1	110,4	53,4	–//–
Chereshneva	125,0	102,1	135,3	97,6	–//–
Yuvileyna Kopanya	120,4	60,4	127,7	108,4	–//–
Average	*83,9*	*79,2*	*115,8*	*80,8*	*–//–*

The calculation of customer value of raspberry established that the fruits of sort Sputnytsya from Lviv HRS had low nutrient level of the consumer index (6.9 points), berries of the same sort from Krasnokutskiy SRCH for its consumer quality indicators answered to 38.0 points. Raspberry in Lviv HRS and Artemivskiy ESN was characterized low consumer value at the level of 9.2 points on average indicator in the first and 11.6 - from the second institution. These figures correspond to low consumer index, which according to our scale - less than optimum (see. Fig. 7.6). A minor nutritional value fruits had sorts such as

Sputnytsya and Meteor from the Institute of Horticulture, appropriate indicators integrated quality assessment were 10.2 and 11.4 points, appropriate integrated indicators of assessing the quality were 10.2 and 11.4 points, was on the verge of optimum consumer quality of fruits sort Novokytayivska (see. Table. 1).

Average indicator of the consumer index for varieties of raspberry in Krasnokutskiy SRCH was 48.4 points. More than optimal consumer index has been observed in sorts of raspberry Brigantine and Lazarivska (62.2 and 61.0 points), respectively, lower than it was in sorts Meteor (51.0) Sputnytsya (38.0) and Novokytayivska (29.7 points).

The fruits of black currant, among the studied berry cultures, distinguished high nutritional factor, especially the highest (115.8 points) he was in the varieties of Lviv HRS. Almost at the same level nutritiousness was at growing conditions in the Institute of Horticulture NAAS (83.9) Krasnokutskiy SRCH(79.2) and Podolskiy HRS (80.8 points) (see. Table. 1).

The analysis of varietal characteristics of customer value of fruits established that more than the average consumer index had fruits of sorts Vernissage, Amethyst, Chereshneva and Yuvileyna Kopanya under condition of their growing in different regions of Ukraine. Variable and dependent on the growing conditions was nutritional value of berries sort Sanyuta, the lowest consumer index (49.0 points), they had in the Institute of Horticulture, above average it was in other research institutions (see. Table. 1).

Conclusions. On the basis of studies have found, that the most valuable in a food plan for the average nutritive value were fruits of strawberry from Artemivsk ESN, raspberry from Krasnokutskiy SRCH and black currants from Lviv HRS. Regardless of the growing effects of conditions in the region, excellent consumer quality in terms of the consumer index, had fruits of strawberry sort Festival daisy, black currant - Vernissage, Amethyst, and Chereshnev, Yuvileyna Kopanya. As for the raspberries, we have not identified any of the studied sorts of fruits which would have been homeostatic for their consumer qualities.

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ІНТЕГРОВАНИЙ ПОКАЗНИК СПОЖИВЧОЇ ЦІННОСТІ ПЛОДІВ ЯГІДНИХ КУЛЬТУР

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На основі багаторічного вивчення показників якості плодів ягідних культур вирощених за різних умов, та за допомогою математичної обробки отриманих даних встановлено оптимальні показники споживчого індексу, котрі дають можливість визначити сортимент названих культур для певної кліматичної зони. Максимальні показники індексу можна використовувати у плодівництві, як один із критеріїв оцінювання умов росту і розвитку ягід, а також якості врожаю в селекційній роботі при створенні, подальшому культивуванні та районуванні нових сортів.

Ключові слова: *плоди, суниця, малина, смородина чорна, органічні речовини, регіони вирощування, прогнозування споживчого індексу.*

ИНТЕГРИРОВАННЫЙ ПОКАЗАТЕЛЬ ПОТРЕБИТЕЛЬСКОЙ ЦЕННОСТИ ПЛОДОВ ЯГОДНЫХ КУЛЬТУР

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На основе многолетнего изучения показателей качества плодов ягодных культур выращенных в различных условиях, и с помощью математической обработки полученных данных установлены оптимальные

показатели потребительского индекса, которые дают возможность определить сортимент названных культур для определенной климатической зоны Украины. Максимальные показатели индекса можно использовать в плодоводстве как один из критериев оценки условий роста и развития ягод, а также качества урожая в селекционной работе при создании и дальнейшем культивировании и районировании новых сортов.

Ключевые слова: *плоды, земляника, малина, смородина черная, органические вещества, регионы выращивания, прогнозирование потребительского индекса.*