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ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

TECHNOLOGICAL PARAMETERS OF PROCESSING PROCESSES OF TEA GROWN IN AZERBAIJAN (Camellia sinensis L.) INFLUENCE ON THE CHEMICAL COMPOSITION AND QUALITY INDICATOR

Specialty: **3309.01- Food technology**

Field of science: **Technical sciences**

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GENERAL DESCRIPTION OF THE RESEARCH

Relevance and degree of completion of the topic. In recent years, Azerbaijan has carried out a number of targeted activities to stimulate tea production, ensure the restoration and development of the tea economy in the country, create an economic and legal basis for bringing competitive tea products that meet the requirements of international standards to the consumer market.

Studies and forecasts show that by strengthening state support for the development of traditional tea production in the Lankaran economic region and the effective use of available resources for the development of tea growing, the area of tea plantations in the region can be increased to 5.0 thousand hectares by 2030, and the production of green tea leaves-to 14.5 - 15.0 thousand tons.

Tea (Camellia sinensis L.) is the most unique and complex plant in its chemical composition. Studies conducted before the beginning of the XXI century confirm that the number of chemical compounds included in its composition exceeds 300. Some of them have not yet been identified, and the biochemical role of some is not fully understood.

Ready-made dry tea has a more complex chemical composition, which is formed during its processing. Modern interest in the chemical composition of tea is due to the fact that many substances contained in tea have physiological activity, they can be used for the treatment and prevention of a number of diseases.

Tea contains an average of 25% protein and amino acids. The most important amino acid in tea is theanine. It forms the sweet, savory taste of green tea brewing and determines the quality of the tea. Green tea is richer in protein. This does not negatively affect the quality of green tea, but reduces the quality of black tea and worsens its taste. Therefore, the mechanical, biological and chemical properties of the tea leaf play a leading role in the correct selection and processing of its processing methods. In our republic for the study of mechanical, physico-chemical, agrotechnical, biological, chemical, technological, commodity and other characteristics of tea leaves Bagirov A.Y., Guliyev F.A. Nuriyev A.N., Ramazanov S.

Mammadov K. Abdullayev F., as well as a number of Turkish researchers., Ferda S, Kachar B., Tokushoglu O., Turkmen N. and many others, and from other foreign researchers Afonina S.N., Babich D.A., Baraboy V.A., Belous O.Q., Bokuchava M.A., Gogia V.T., Lashkareva S.V., Maisuradze Z. A., Oparin A.I., Tatarchenko I.A., R. Khoperia M.R,, Alasalwar C., Bhuyan L.P., Cheng, M., Hiroshi A., Jiang H.Yaa, Nechuta S., Zhang L., and others conducted research. From the study of these and other existing sources, it is known that the tea leaf (Camellia sinensis L.), grown in the conditions of the Republic of Azerbaijan, the structural composition, its individual fractions, the dynamics of changes in the humidity and density of cell juice by month, the chemical composition, as well as the content of amino acids, including theanine, in green tea leaves and the finished product have been studied almost completely.

Purpose and objectives of the study. The aim of the study is to study the structural and chemical composition of tea leaves grown in the Lenkoran-Astara region, to study the influence of processing processes and technological parameters on the content of amino acids, including theanine, in the tea leaf and the finished product.

In accordance with the set goals, it was considered appropriate to solve the following tasks::

- analysis of scientific and technical literature and patent information in the republic and foreign countries on the chemical composition of tea and the effect of its components on the human body, the basic principles of tea production and the current state of biochemistry;
- to study the influence of the structural and chemical composition of the tea leaf, as well as the processing processes and individual technological parameters of the tea leaf on the content of amino acids, including theanine;
- to study the structural composition of the tea leaf, the dynamics of its changes by month, as well as the relationship between humidity and density of cell juice (DCJ);
- theoretically clarify the scheme of the synthesis and metabolism of theanine in the tea plant and its individual organs;
- study of the content of individual fractions of tea leaves,

chemical parameters of the finished tea product, including amino acids and theanine;

- to justify the feasibility and efficiency of the technology for the production of tea extract from production waste generated during the processing of tea leaves, non-standard and low-grade teas, and leaves and shoots obtained during the pruning of tea bushes;
- study of the level of self-sufficiency in tea and import dependence.

Object and methods of research. As the object of the study, the following tea varieties were used: Kolkhida, Farmanchai, Azerbaijan - 1, Azerbaijan-2, Azerbaijan-4, grown in the farms of the Lenkoran-Astara region, zoned and introduced, as well as fresh green leaf of the local population (LP) and its processed products formed as a result of long-term natural pollination with various varieties and varietal mixtures.

When performing research work, a number of classical and modern research methods (physical, physico-chemical, chemical, biochemical, chromatography, etc.) are used.

Main provisions to be submitted for defense:

- the number of individual fractions in the raw materials supplied to the tea processing plant, and the dynamics of their changes by month;
- dynamics of changes in the humidity of individual fractions of tea leaves and the stiffness of its cells by month and the relationship between them;
- chemical composition of individual fractions of tea raw materials;
- dependence of the mass fraction of the dry substance dissolved in the tea extract, extractivity and viscosity on temperature;
- dependence of the consistency of the tea extract on the extraction time;
- dependence of the density and extractivity of the tea extract on the hydromodule (raw material: water) ;
- synthesis and exchange of theanine in various organs of the tea plant;

- the content of amino acids in tea, including theanine, the influence of processing methods and individual technological parameters on their change.

Scientific novelty of the research. As a result of the conducted research, the following scientific innovations were obtained:

- a new improved method for the determination of polyphenols in tea leaves and products has been developed, which reduces the analysis time, the number of operations and the consumption of reagents;

- Experimental data on the structural composition, humidity and density of the cellular juice of tea leaves received for processing from the farms of the Lenkoran-Astara region, the dynamics of its change by month, and the relationship between them were obtained;

- By studying the chemical composition of tea leaves grown in the Lenkoran-Astara region, the fractions, including amino acids and theanine, experimental data were obtained;

- a theoretical analysis of the process of synthesis and metabolism of theanine in the tea plant and its individual organs was carried out and its scheme was compiled;

-for the first time, the influence of processing processes and its individual parameters on the content of amino acids, including theanine, in tea leaves received for processing from farms in the Lenkoran-Astara region was studied, and the optimal processing time was determined.

Theoretical and practical significance of the study:

- a new improved method for the determination of polyphenols in tea leaves and tea products reduces the analysis time, the number of operations and the consumption of reagents;

- Experimental data on the structural (fractional) composition of tea leaves coming into processing from the farms of the Lankaran-Astara region, the dynamics of its changes over the months allow us to obtain better products by optimizing the processing processes and their individual technological parameters;

- Experimental data on the humidity and density of the cell juice of tea leaves grown in the farms of the Lenkoran-Astara region, the dynamics of their changes and the relationship between them indicate

that hCG and the dynamics of its changes are a universal indicator of the water supply of tea leaf cells, are of great importance for the development of cell metabolism, its change reflects the growth, enzymatic and other physiological processes in the cell of young leaves and, as a result, the state of the plant as a whole;

- the results obtained as a result of studying the effect of tea leaves and their products on the content of amino acids, including theanine, can be used to increase sensory sensitivity (taste, aroma, etc.), which have properties that allow optimizing the processing processes and its individual parameters to obtain high-quality tea products;

- an experimental technology has been developed for the production of tea extract (extract), which has natural and functional properties, from production waste generated during the processing of tea leaves, non-standard and low-grade teas, leaves and shoots obtained during the pruning of tea bushes;

- it is established that the technological parameters of the processing processes have a significant impact on the physical and chemical parameters, chemical composition and quality of the tea extract, and these parameters are optimized;

- tea extract contains a large amount of physiologically and biologically active substances, which allows them to be used as natural flavors and colors and, thus, replace chemical synthesis products, artificial flavors and colors with natural components;

- the social effect of the study is based on an increase in organoleptic parameters and the biological value of the finished product due to the use of tea extracts in the amount of 5-15% of raw materials in the production of a number of food products, the enrichment of the chemical composition of BAM, partial cheapness and accessibility for most segments of the population, their use for therapeutic, preventive and dietary purposes;

- the economic effect of the study is based on the use of production waste generated during the processing of tea leaves instead of the main raw materials (tea leaves) in the production of tea extract, non-standard and low-grade teas, leaves and shoots obtained

by pruning tea bush-es, each ton of product (raw materials) is 207.0 manat.

Approbation and application of works. The results obtained in the course of the dissertation work, as well as individual scientific provisions, were presented at the republican scientific conferences of the faculty and young researchers of Lankaran State University in 2015-2021, as well as at the conference "Scientific achievements of youth - At the 84th International scientific conference of young scientists, postgraduates and students on "Solving human nutrition problems in the XXI Century "(Kiev, MSTU, 2018), the VII International symposium of higher educational Institutions of the Republic of Turkey (UMYOS, Baku, 2018), the International scientific and practical conference on "Current problems of food and light industry" (Azerbaijan Technological University, Ganja, 2019), the conference "Innovative approaches to ensuring regional development" (Trends: realities and modern challenges" (Mingechevir State University, Mingechevir, 2020), the International conference on tourism, gastronomy and culinary arts (Istanbul, Turkey, 2021).

In the course of the study, the experimental experiments and the results obtained were tested at the Lankaran enterprise "Tea LLC".

Samples of processed tea leaf products and tea extract were tested in the tasting commission of the National culinary center of Azerbaijan, approved samples and technological parameters were recommended for use in production.

The name of the organization in which the dissertation work was performed. The dissertation work was carried out at the department of "Technology and technical disciplines" Lankaran State University.

The total volume of the dissertation, indicating the volume of the structural sections of the dissertation separately. The dissertation work consists of an introduction, three chapters, a conclusion, a list of references in the number of 227 and appendices. There are 27 figures, 22 tables. The content of the dissertation contains an introduction of 8 pages and 16421 characters, the first chapter of 48 pages and 99323 characters, the second chapter of 18 pages and 3511 characters, the third chapter of 63 pages and 109354 characters,

conclusions of 2 pages and 2942 characters, recommendations for production of 1 page and 1364 characters, the list of references includes 26 pages and 50680 characters. The volume of the dissertation is 168 pages of com-puterized text, the total volume is 319614 characters (excluding the list of references and appendices-268687 characters).

CONTENT OF THE WORK

In the introduction, the relevance of the topic, the problem statement and the general characteristics of the dissertation are given.

First chapter. This chapter is entitled "Analytical analysis of the current state of the main directions of tea production processes" provides general information about the types of tea, its chemical composition, the effect of tea components on the human body, the history of the development of tea farming in the Republic, the current state of the basic principles and biochemistry of tea production. It is noted that the tea plant is *Camellia sinensis*[*Camellia sinensis*(L.) O. Kuntze] or *Camellia* assamica [*Caellia sinensis*. *Assamica* (Mast.) Kitamura] - its stems, shoots, leaves and stems are used as raw materials for the production of various tea products. Tea is classified into black, green, white, yellow, oolong and dark tea depending on the production processes in which it is processed. Fresh tea leaves contain a large amount of water and a lot of astringents and tannins, weakly flavored compounds. But after processing, various flavor combinations are formed. Therefore, processing processes play an important role in shaping the basic properties of each type of tea.

Although the chemical composition of tea is currently not fully understood, it is believed that it contains more than 300 chemical compounds. The ratio of these compounds is so unique that no plant can replace them. Tea contains up to 52% of water-soluble substances (cel-lulose, proteins, fats, chlorophyll pigments, pectins, starch, etc., as well as water-soluble substances (simple phenols, oxidizing and non-oxidizing polyphenols, sugars, amino acids, vitamins, minerals, etc.), and also contains caffeine. It is rich in trace elements, including zinc. The higher the tannin content in the tea, the more its taste becomes so crisp and appetizing. The reason for the

phenomenal beneficial properties of tea is that at least a quarter of the most useful and valuable substances are concentrated in 2-3 leaves (flush) located in the uppermost part of the tea bush.

Current research shows that until recently, the vast majority of the numerous studies of theanine in the world were devoted to the effects of theanine on human health and the study of the amount of theanine in various types of tea. At the same time, it became known that no studies on the study of theanine were conducted in our republic and the content of amino acids, including theanine, in green tea leaves and the finished product grown in Azerbaijan was not studied.

As a result of the research, it was considered appropriate to study such issues as the mechanical composition, biological and chemical characteristics of green tea leaves grown on the territory of Azerbaijan, in particular in the Lankaran-Astara economic region, the amino acid and theanine composition of tea, the influence of technological parameters and processing methods on their change, physical and chemical properties and the possibility of using tea extract.

Second chapter is entitled It is called “"Tea as an object of research. Methods and techniques of research". Here, as an object of research, the tea varieties "Colchis", "Farmanchay", "Azerbaijan - 1", "Azerbaijan-2", "Azerbaijan-4" grown in the farms of the Lenkoran-Astara region, zoned and introduced, as well as the fresh green leaves of the local population (YAP) formed as a result of long-term natural pollination of various varieties and varietal mixtures, and the products of their processing were presented.

When analyzing tea leaves, a number of classical and modern multilayer methods (physical, physico-chemical, chemical, biochemical, chromatographic, etc.) were used.

The main components of the chemical composition of the tea leaf-moisture, the density of the cell juice, the content of extractives, phenolic compounds, catechins, caffeine and amino acids, pectin and cellulose, the mass fraction of dry matter in the solution, the relative density, as well as the organoleptic analysis of the finished tea product, the extract of the tea extract were carried out using the methods of current standards.

The amino acid content in fresh green tea leaves, as well as at the stages of its processing and in the finished product, was determined by high-performance liquid chromatography. The high-performance liquid chromatography kit HPLC-Shimadzu and HPLC System LHLC-A10 were used in the study.

Currently, the most common method for determining the content of polyphenols in tea is the extraction of 70% from crushed tea leaves in a methanol solution at a temperature of 70°C, centrifugation and precipitation of the solution, as well as repeated extraction from the insoluble tea residue. Observations made from the point of view of the characteristics studied in the conducted research work, repeated changes in size were evaluated by the method of dispersion analysis. Mathematical and statistical processing of the results of the study was also carried out in accordance with the interpreted methods. A multiple comparison test was used to identify individual groups. The difference in the amount of substances studied for each stage of the process was also estimated. The results were displayed on average with a standard error (±) compiled in the Microsoft Word text editor (2013).

Third chapter under the title « Experimental studies", where such issues as the mechanical composition, biological and chemical characteristics of tea leaves, the amino acid and theanine composition of tea, the influence of technological parameters and processing methods on their change, physical and chemical properties and the possibility of using tea extract, economic efficiency were considered.

In the course of studying the mechanical, physico-chemical, biological, chemical, technological and other characteristics of the tea leaf, it was found that in 2010 - 2019, the content of the refined fraction prevails in the raw materials supplied to the tea processing enterprise (53.2±2.62%). 3-4-leaf shoots account for the main part of the total raw material-36.8±2.58%, 5-6-leaf shoots- a much smaller part-14.9±0.93%, and rough green and pink stems-only a small amount-3.4±0.18%.

The dynamics of individual fractions of raw materials received by the company in those years, by month, is shown in table 1. The dynamics of individual raw fractions entering the enterprise by

month shows that the maximum amount of refined fraction (62.6 ± 2.27 %) falls on the month of May, in June it significantly decreases - to 50.3±2.35%, in July-August it partially increases and reaches 55.2 ± 2.18%, and in September it reaches a minimum value, that is, 48.3 ±1.72%. The amount of partially roughened and coarse fraction increases slightly in May-June (37.4 - 49.7%), in the following months it increases slightly and makes up 44-51% of the total mass.

Table 1. Dynamics of changes in individual fractions of tea leaves by month

Raw material fractions	Dynamics of change by month, %				
	May	June	July	August	September
Gentle fraction	62,6±2,27	50,3±2,35	52,5±1,93	55,2±2,18	48,3±1,72
Partially rough	31,3±1,34	38,1±1,09	32,7±1,68	31,5±0,85	34,1±1,54
Rude	6,1±0,56	11,6±0,78	14,8±1,23	13,3±0,74	17,6±1,14

During the season, the moisture content of the tea raw materials entering the production and the density of the cell juice (CJD) change. The dynamics of humidity changes are identical for almost all fractions.

Analysis of the dynamics of changes in the humidity of individual fractions of tea leaves by month shows that the maximum amount of moisture in the tea leaf of the refined fraction-80.4±2.85% falls on the last decade of April and May, in June-July this indicator falls to 74.3 ± 1.68%, in August, slightly increasing, reaches 76.2±2.43%, and in September, the minimum limit of this indicator for all fractions (68,8 ±2,24 -72,5±1,84%). The dynamics of changes in the density of cell juice (CJD) of individual fractions of tea leaves by month is shown in table 2.

The study of the dynamics of changes in the viscosity of cell juice (CJD) by month shows that the lowest viscosity limit - 7.6±0.29% - is observed in May in the refined fraction, and the highest-18.3±0.47% - in the coarse fraction in September (table 2). The hardness for all fractions gradually increases in May-July and reaches-12.8±0.68-17.4 ± 0.58%, depending on the fraction, partially decreases in August and is 11.4±0.49 - 15.4±1.12%, and in September again gradually increases. increases and reaches 15.3±0.84 - 18.3±0.47%.

Table 2. Dynamics of changes in the cell juice density of individual tea leaf fractions by month

Raw material fractions	dynamics of changes CJD by month, %				
	May	June	July	August	September
Gentle Fraction	7,6±0,29	9,3±0,52	12,8±0,68	11,4±0,49	15,3±0,84
Partially rough	11,7±0,36	12,6±0,61	15,7±0,28	13,5±0,72	17,2±1,06
Rude	14,0±0,83	15,6±1,22	17,4±0,58	15,4±1,12	18,3±0,47

A comparative analysis of the dynamics of changes in the humidity and density of cell juice (CJD) in individual fractions of tea leaves by month shows that there is a direct relationship between these two indicators. Thus, in the refined fraction of tea leaves, the lowest limit of cell juice density (CJD) is observed - 7.6±0.29%, while the moisture content in the upper limit is 80.4±2.85%. A similar situation is observed when the humidity changes by month. A similar situation is observed in partial coarse and coarse fractions.

In addition to the mechanical composition and biological properties, the technological advantages of raw materials are determined by the content of the main chemicals in it. Because the transformations that occur in them during processing determine the quality indicators of the finished product. This led to the need for a chemical analysis of the composition of the tea leaf entering the processing, the results of which are shown in table 3. Table 3 shows that the composition of the rough (coarse) and rough fractions of important chemicals is less than in the refined fraction. The content of the rough (coarse) and rough fraction is relatively refined, respectively: the content of extractive substances is 5.06 and 12.86%, phenolic compounds-4.55 and 11.14%, catechins 39.41 mg/g and 69.03 mg/g, caffeine 1.15% and 1.78%, free amino acids-804.7 mg/l and 1143.5 mg/l, pectin-1.23% and 1.61% less. At the same time, the content of other substances in them, respectively, is higher than in the refined fraction, for example: chlorophyll-1.93% and 3.19%, protopectin-1.06% and 1.81%, cellulose-6.26% and 9.43%.

One of the main chemical compounds that determine the taste and aroma of tea are proteins and amino acids. Green teas are the most rich in proteins, while the high protein content does not harm the quality of this tea, but reduces the quality of black tea, worsens its

taste. In the composition of the tea leaf, along with many other valuable chemical compounds, there is an amino acid that belongs only to the tea plant - theanine (*γ-ethylamine - L-glutamic acid*). While most amino acids are found in green tea leaves in small amounts, theanine makes up about 50% of all amino acids.

Table 3. Individual fractions of tea raw materials chemical composition

№	Chemical indicators	Fresh leaf	Fraction		
			Elegant	A little rough	Rough
1	Extractive substances, %	36,28±0,83	40,12±1,38	35,06±0,92	27,26±1,95
2	Sum of phenolic	18,11±**1,**06	22,07±0,98	17,52±1,36	10,93±0,79
3	Catechins, mg / g	94,32±2,83	119,27±3,02	79,86±2,92	50,24±1,58
4	dry matter (g m).	2,12±0,27	2,86±0,33	1,71±0,21	1,08±0,13
5	Caffeine, %	2465,5±18,0	2684,3±21,2	1879,6±14,7	1540,8±6,84
6	Chlorophyll, mg /gg / l	5,17±0,23	4,35±0,13	6,28±0,31	7,54±0,26
7	Pectin,%	3,61±0,11	4,27±0,19	3,04±0,13	2,66±0,09
8	Protopectin,%	7,16±0,25	6,28±0,22	7,34±0,28	8,09±0,23
9	Cellulose,%	16,14±0,53	12,31±0,35	18,57±0,42	21,74±0,58

The main lines of the synthesis of theanine are shown in figure 1.

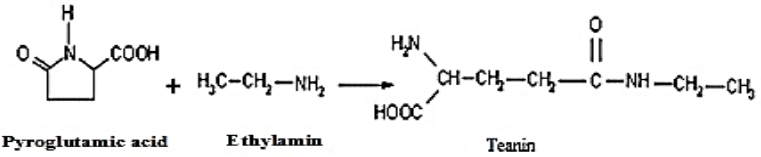

Figure 1. Formation of theanine from pyroglutamic acid and ethylamine.

The amino acid composition of freshly harvested and introduced into the production of green tea leaves of the Azerbaijan-1 and Kolkhida varieties is shown in table 4. The tea extract contains 16 amino acids, including 8 essential amino acids. Of the essential amino acids in the tea leaf extract, tryptophan and methionine were not found. As can be seen from Table 4, the main part of the total number of amino acids is theanine. The content of theanine in the

Azerbaijan-1 variety is 41.3% of the total amount of amino acids, and in the Kolkhida variety-38.8%.

Experiments conducted in 2014-2018 in production and laboratory conditions show that when inhaling green tea leaves of both varieties, the content of all amino acids, except Serine, threonine and glutamine, increases by an average of 25.0 + 1.40%. This increase is due to the hydrolysis of protein substances and partial evaporation of moisture, including chemically bound water.

Table 4. Average amino acid (AA) composition of a tea leaf, mg/l

Amino Acids	Preliminary–before processing		after processing	
	Azerbaijan-1	Kolkhida	Azerbaijan-1	Kolkhida
Theanine	1018.4±1.32	887.1±0.96	804.3±1.26	706.2±1.14
Glutamic Acid	279.6±0.88	288.5±1.37	283.2±1.18	295.8±2.05
Aspartic Acid	347.3±2.26	310.9±1.84	309.3±2.35	279.4±0.96
Arginine	190.5±1.98	173.6±0.85	176.3±0.68	162.3±2.40
Glutamine	167.8±3.12	169.7±1.11	183.8±2.02	179.5±3.26
Serina	97.6±0.87	108.3±1.67	81.4±2.43	84.5±0.98
Threonine	52.5±2.28	50.2±1.44	43.1±0.67	44.7±2.19
Alanine	44.9±0.66	41.8±2.18	59.3±1.49	60.7±0.83
Asparagine	56.2±2.45	59.3±1.87	94.5±1.88	98.7±3.10
Lysine+histidine	42.9±1.67	39.8±2.23	46.9±0.93	45.2±2.42
Phenylalanine	28.6±0.62	30.3±3.06	64.7±1.41	61.8±1.92
Tyrosine	39.3±1.87	41.2±2.35	69.1±2.08	72.0±2.41
Leucine+isoleucin	31.4±2.06	29.7±1.78	62.5±2.32	60.9±1.98
Valine	68.5±3.08	56.8±1.68	123.7±2.48	126.2±3.16
Total AA	2465.5±1.80	2287.2±1.74	2402.1±1.56	2277.9±2.03

Figure 2. Theanine chromatogram of a fresh green leaf of the Azerbaijan-1 variety, the main part of the total amount of amino acids in a tea leaf is theanine, the chromatogram of which is shown in figure 2. As can be seen from the chromatogram, the peak limit of theanine is better observed at excitation (excitation) and irradiation (radiation), respectively, at the wavelengths of 340 and 450 Nm.

Of the local teas, the highest content of L-theanine is found in such teas as Farmanchai, Azerbaijan-1, Azerbaijan-2, Azerbaijan-4, Lankaran bouquet, and of the imported ones-Ceylon Pekoe (Sri Lanka), Yunnan (China) and Sencha (Japan). At the same time, in

the production of egg tea from Azerbaijan - 1 and Kolkhida varieties, the content of L-theanine was 1.46-1.88 mg/100 ml less than in black velvet tea. Studies show that a decrease in the amount of theanine and an increase in the amount of glutamic acid occurs at all stages of the pro-cessing of tea leaves, with a significant loss of theanine occurring at the stages of inhalation (up to 50% of the total loss) and drying (up to 34% of the total loss). Apparently, as a result of the breakdown of theanine, its component is formed – glutamic acid.

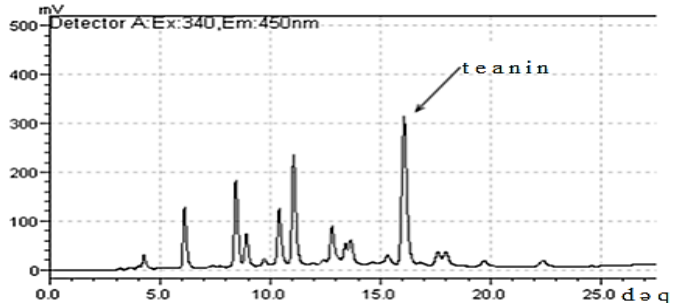

Figure 2. Theanine chromatogram of a fresh green leaf of the Azerbaijan-1 variety.

The total loss of L-theanine, depending on the variety of the treated tea leaf, is 19.72± 0.26, up to 22.07± 0.37 mg/100 ml. The highest losses are observed in the Azerbaijan-4 variety (22.07 ± 0.37 mg/100 ml), the lowest – in the Azerbaijan-1 variety (19.72± 0.26 mg/100 ml). Experiments show that the loss of L-theanine during the twisting of the tea leaf is on average 6-8%, as well as 18-21% both during grinding (grinding) and during twisting, that is, the loss before grinding increases by about 3 times.

It was found that the extraction process of theanine is affected by the size of the tea leaf particles, the temperature and the duration of extraction. Optimal at this time are: the size of the tea leaf particles-200-450 microns, the extraction temperature-80-85°C. With and extraction time-20-25 min. One of the directions of enriching food products with physiologically active substances are various drinks from the tea plant, extracts, liquid and dry extracts, tea powder, etc. The use of tea extract, various tea drinks, tea extract and tea powder as a vitamin and mineral supplement allows you to regulate the chemical composition of many

food products, enrich them with biologically active components that meet the modern requirements of food science, and thus replace chemical synthesis products, artificial flavors and colors with natural components.

To obtain objective information about the quality of the obtained extracts, the influence of temperature, extraction time and the ratio of the system components on the physico-chemical parameters of the green and black tea extract was studied. The graph of the dependence of the extra activity in the tea extract on the temperature is shown in Figure 3.

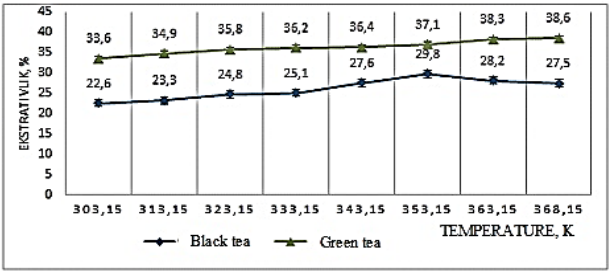

Figure 3. Graph of the dependence of the extra activity of black and green tea extract on the temperature.

From this graph, it can be seen that the extra activity increases as a result of an increase in temperature during tea extraction. So, at a temperature of 303.15 K, the extra activity is 33.6%, and at a temperature of 365.15 K-38.6%. The extra activity of black tea extract is 22.6% at a temperature of 303.15 K and a maximum of 29.8% at a temperature of 355.15 K. The results of experimental experiments showed that the optimal conditions for the transition of the maximum amount of dry matter to the solvent during the extraction of black and green tea with water are the temperature of 363.15 K,the extraction time of 3-3. 5 hours and the ratio of the extractant (hydromodule) with the raw material 1:20.

In order to effectively use the production waste generated during the processing of tea leaves, non-standard and low-grade teas, as well as leaves and shoots obtained during the pruning of tea bushes, it is possible to produce tea extract rich in biologically active substances.

At the same time, the economic effect arising from the processing of these wastes is 207 manats per ton of products, according to the savings obtained by reducing the cost of the main products as a result of replacing the main raw materials with secondary (secondary) raw materials.

Results

1. The new improved method for the determination of polyphenols in tea leaves and tea products reduces the analysis time, the number of operations and the consumption of reagents;

2. Experimental data on the structural (fractional) composition of the tea leaf coming into processing from the farms of the Lenkoran-Astara region, the dynamics of its changes over the months allow us to obtain better products by optimizing the processing processes and their individual technological parameters;

3. Experimental data on the humidity and density of the cell juice of tea leaves grown in the Lenkoran-Astara region, the dynamics of their changes and the relationship between them indicate that HSHG and the dynamics of its changes are a universal indicator of water supply of tea leaf cells, are of great importance for the development of cell metabolism, its changes affect the growth, enzymatic and other physiological processes in the cell of young leaves, the state of the plant as a whole;

4. The results obtained as a result of the study of the effect of tea leaves and its products on the content of amino acids, including theanine, give a high sensitivity (taste, aroma, etc.), which have properties that allow optimizing the processing processes and its individual para-meters to obtain high-quality tea products;

5. An experimental technology has been developed for the production of tea extract (extract), which has natural and functional properties, from production waste generated during the processing of tea leaves, non-standard and low-grade teas, leaves and shoots obtained during the pruning of tea bushes;

6. It is established that the technological parameters of the processing processes have a significant impact on the physical and che-

mical parameters, chemical composition and quality of the tea extract, and these parameters are optimized;

7. Tea extract contains a large amount of physiologically and biologically active substances, which allows them to be used as natural flavors and colors and, thus, replace chemical synthesis products, artificial flavors and colors with natural components;

8. The social effect of the study is based on an increase in organoleptic parameters and the biological value of the finished product due to the use of tea extracts in the amount of 5-15% of raw materials in the production of a number of food products, the enrichment of BAM chemical composition, partial cheapness and accessibility for most segments of the population, their use for therapeutic, preventive and dietary purposes;

9. The economic effect of the study is based on the use of production waste generated during the processing of tea leaves instead of the main raw materials (tea leaves) in the production of tea extract(extract), non-standard and low-grade teas, leaves and shoots,

Recommendatıons for producers

-when laying new tea plantations, restoring existing tea plantations, laying tea plantations and growing tea planting material, higher-yielding varieties are obtained, the chemical composition and biological properties of which make it possible to obtain a high-quality crop that is resistant to environmental stress (drought, frost, etc.);

- the use of a new improved method for the determination of polyphenols in tea leaves and tea products, which reduces the analysis time, the number of operations and the consumption of reagents, i.e. during extraction, instead of an ethanol solution, use 50-65 cm^3 of distilled water at a temperature of 95-100°C, and instead of a standard solution of tannin-standard soluble acid;

- the use of experimental data on the structural composition of the tea leaf coming into processing from their farms, the dynamics of its changes over the months to create conditions for obtaining better products by optimizing the processing processes and their individual technological parameters;

- organization of production of tea extract (extract), which has natural and functional properties, from production waste generated during the processing of tea leaves, non-standard and low-grade teas, leaves and shoots obtained during pruning of tea bushes.

The main provisions of the dissertation are reflected in the following published articles:

1. Jahangirov, M.M The study of the chemical composition and quality of tea/ M. Materials of the Republican scientific conference "Problems of the development of nature and the Humanities", dedicated to the 94th anniversary of the birth of National Leader Heydar Aliyev.- Lankaran: LSU, - May 5-6, 2017, - pp. 84-85.

2. Jahangirov, M.M. Research of the chemical composition and quality of tea //-Ganja: Collection of scientific news of the Azerbaijan Technological University, - 2017. No. 1/23. - pp. 26-29.

3. Jahangirov, M. M. The meaning and possibilities of using tea extract / / Materials of the Republican Scientific conference" Integration and actual problems of science in the modern world".- Lankaran: LSU, - December 22-23, 2017, - pp. 229-231.

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