

## PRODUCTION OF TONUSGENERATING NON-ALCOHOLIC BEVERAGE (TAI) FROM TEA LEAF

Sevinj Maharramova<sup>1</sup>, Mikail Maharramov<sup>2\*</sup>

<sup>1</sup>Azerbaijan State University of Economics, Baku, Azerbaijan

<sup>2</sup>Lankaran State University, Lankaran, Azerbaijan

**Abstract.** It is known that in the composition of tea there are some physiological active substances, including the group of alkaloids which have caffeine with high functional activity. Therefore, tea can be used in the treatment and prevention of many diseases. Different varieties of tea contain one 1-4%, and dark varieties of tea up to 5% of caffeine. Despite the fact that the amount of caffeine in tea is much higher than in coffee, the softness of its effect is particularly interesting. This is because the caffeine in the tea is related to tannin, it generates tein or tannin. Analysis of the chemical composition of teas shows that tonusgenerating component is caffeine-tannin which helps to improve mental-spiritual and cognitive functions of human body. The optimal amount of caffeine in these drinks is 25-35 mg / 100 ml cannot provide their tonusgenerating effect. Research shows that tea grown in Azerbaijan conditions contains an average of 1-3% of caffeine. Therefore, during tea and tea production from fresh tea leaves, the infusion generated from low-quality products and wastes it is considered expedient to use it as coffee substitute.

**Keywords:** tea leaf, caffeine, tonusgenerating drink, tea ore, health.

**Corresponding Author:** Mikail Maharramov, Lankaran State University, Hazi Aslanov, 50, Lankaran, Azerbaijan, Tel.: +994502165057, e-mail: [mikailbyst@mail.ru](mailto:mikailbyst@mail.ru)

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### 1. Introduction

Tea is one of the most popular everyday drinks in the world (Guliyev & Guliyev, 2014). There are *Camellia sinensis* (*Camellia sinensis* (L.) O. Kuntze) or *Camellia assamica* (*Caellia sinensis*) for the production of various tea products. The stalks, flesh, leaves and stalks of the tea plant called *Assamica* (*Mast.*) *Kitamura* are used as raw material. *Camellia sinensis* is the most widespread type of tea in the world and has abundant reserves for tea production (Zhang *et al.*, 2019).

At present, many varieties of black tea drinks packaged in glass containers are sold in the world markets: aromatic tea, pure tea, milk tea and instant tea (Yin *et al.*, 2010). Most black tea drinks sold in glass containers are made from black velvet tea. Therefore, the aroma and taste of such tea depends on the quality of black velvet tea. Recently, a new technology for the production of black tea, which dissolves quickly by fermenting fresh tea juice, has been developed (Sinija *et al.*, 2007).

Although the chemical composition of tea has not been fully studied in modern times, it is estimated that it contains about 300 chemical compounds. The ratio of these compounds is very unique and cannot be replaced by any plant. Tea contains up to 52% water-insoluble (cellulose, fats, water-insoluble vitamins, etc.), as well as water-soluble substances (simple phenols, oxidizing and non-oxidizing polyphenols, sugar, amino acids, vitamins, minerals, etc.), also contains (Zhang *et al.*, 2019).

Today, the market for tonic soft drinks is developing rapidly, as evidenced by the results of research by well-known international and local companies. The largest sale markets are the American and European contingent countries. At present, energy drinks are produced not only by specialized enterprises such as *Red Bull, GmbH*, but also by leaders in the production of soft drinks - *Pepsi Cola, Coca-Cola* and other companies (Lorenzo & Munekata, 2016).

## 2. Possibilities of using tonic soft drinks and physiologically active substances in tea

### 2.1. Non-alcoholic tonusgenerating drinks and their effect on the body

The history of energy (tonusgenerating) drinks goes back to the ancient times. Warriors were looking for ways to increase their physical activity, give strength to the body, travelers - focus on the crucial moments, nomads - maintain immunity, relieve fatigue and quench thirst. From this point of view, the first "ancestors" of energy drinks appeared. Made from the dried husk of coffee beans, infusion-coffee was a surprisingly strong drink that could disrupt sleep. Healing rivers and invigorating kvass are among the secrets that keep the strength and endurance of ancient warriors. The source of endurance was considered for the Aztecs (Indian peoples living in Central Mexico), infusion made from Spanish sage (*Salvia hispanica*) and amaranth quinoa (*Triplex hortēnsis*), buckwheat and tofu cocktails for Japanese scouts - ninjas, and mare (horse) milk for the Mongols. Beverages such as buttermilk and sand are among the products that can retain their beneficial nutritional properties for a long time. The Indians of the Andes used the leaves of the coca plant for medicinal and ritual purposes, as well as for the preparation of tonusgenerating drinks (Lorenzo & Munekata, 2016).

Modern energy drinks are often called "third millennium" drinks. This is far from the truth. The idea of creating drinks to stimulate the psycho-emotional and physical activity of the human body, to give them strength and to ensure concentration in responsible moments was realized many years ago. Natural substances used in ancient times are used even in the production of modern beverages.

Today, energy drinks such as Red Bull, Jaguar, Oronamin C, Real Gold, SoBe and Pocari Sueat occupy the highest places in the world ranking (Lorenzo & Munekata, 2016). At the same time, we would like to note that in Denmark, France, Norway and other energy drinks are sold only in drugstores. Because these drinks are considered medicine in those countries.

It should be noted with regret that this or that beverage has gained a stable position in the consumer market of Azerbaijan and is becoming increasingly popular among young people and adolescents (sometimes minors) (Lorenzo & Munekata, 2016).

As noted, the range of tonic soft drinks (TAI) is becoming increasingly popular in the consumer market of Azerbaijan, although it is partially new. Statistical data and marketing research conducted in the supermarket chain of Baku in 2018-2021 showed that TAI is mainly represented by the following varieties: Red Bull, Bullit, Burn, Flash, Adrenaline Rush, Adrenaline Nature, MD Guarana, XXI power Guarana, Tornado, Tornado ice, Spring Energy, Super max, etc. The summary analysis of the composition indicated on the labels of the mentioned TAIs shows that the tonusgenerating component, which helps to improve mood and cognitive functions is caffeine-feral (Lorenzo & Munakata, 2016). At the same time, it can be concluded from the data that the majority of manufacturers comply with the requirements of the current normative and technical

documents - the optimal amount of tonic-containing substance in the drink - 25-35 mg / 100 cm<sup>3</sup>. The amount of caffeine in TAI brands such as Tornado, Tornado ice is 14-15 mg / 100 cm<sup>3</sup>, and in the XXI power Guarana brand is 20 mg / 100 cm<sup>3</sup>. It can be concluded that the amount of caffeine indicated by the manufacturers does not provide the optimal toning effect of beverages.

One of the substrates that stimulates energy metabolism is taurine, the recommended level of which is 300-400 mg / 100 cm<sup>3</sup> per drink. The amount of taurine in the labels of drinks such as Red Bull and Adrenaline Rush is in the range of 340-390 mg / 100 cm<sup>3</sup>, and the amount of taurine in the labels of brands such as XXI power Guarana, Tornado, Tornado ice, Flash, Super max is in the range of 17-120 mg / 100 cm<sup>3</sup>. It seems that the consumer is unlikely to experience any effect.

B vitamins are used as the main source of vitamins in the production of TAI. Some TAIs, such as Tornado ice, Adrenaline Nature, etc. vitamins were generally not observed. MD Guarana contains 0.16 mg / 100 cm<sup>3</sup> of vitamin B1 (thiamine), a small amount of vitamin PP (niacin), biotin (vitamin B7), folic acid (vitamin B9), cyanocobalamin (vitamin B12), vitamins C and E. No information on the amount of vitamins was found on the label of the drink.

These TAIs can be considered as a source of carbohydrates, the amount of which is 12.0-14.0 g / 100 cm<sup>3</sup> (Kotova & Cheremichkina, 2012).

Shark drinks, which have been available in TAIs for almost 50 years, are sold in more than 60 countries around the world and are trying to maintain their place in the global market. The main difference between the drink produced by Ostopa Corporation of Thailand and other TAIs is the use of natural caffeine from cocoa beans instead of synthetic caffeine. Dextrose and grape sugar are also used in the production of this drink, which improves the quality of other carbohydrates and amino acids such as lysine. Each jar with a volume of 250 cm<sup>3</sup> contains 1000 mg of taurine, 80 mg of natural caffeine, 4.25 mg of guarana extract (Kotova, 2017).

## ***2.2. Chemical composition of tea and its effect on the human body***

The compliance or proximity of a wide range of biologically active compounds in the tea to the physiological needs of the body activates the digestive process, protects the health of pregnant women, has a positive effect on the cardiovascular system, minimizes low cholesterol, prevents the accumulation of fatty substances in blood vessel walls. breaks down, normalizes blood pressure and blood circulation in the brain, improves the physical, psychological and health status of people (Maharramov *et al.*, 2020).

Taking into account the demand for tea products and its impact on the human body, a number of purposeful measures have been taken in recent years to stimulate tea production, ensure the restoration and development of tea in the country, create an economic and legal basis for the production of competitive tea products (State Program on the development of tea growing in the Republic of Azerbaijan for 2018-2027).

As a result of this work, tea production increased from 6,209 tons in 2015 to 10,522 tons in 2020, and the level of tea self-sufficiency increased from 40.2% in 2015 to 45.5% (Food balance of Azerbaijan. Reports of the Statistical Committee of the Republic of Azerbaijan).

Tea contains many physiologically active substances. Therefore, tea can be used in the treatment and prevention of many diseases. Phytochemical substances of tea leaves are divided into 3 main groups: alkaloids belonging to the purine group, flavanoids, vaccines (Jain *et al.*, 2013).

Alkaloids are nitrogen-containing heterocyclic compounds with high functional activity. These include three main groups of compounds - caffeine, theobromine and theophylline. Although the amount of caffeine in tea is higher than in coffee, the mildness of its effect is of particular interest.

This is because the caffeine in tea binds to tannins and forms thein or tannins. Thein tea gives bitterness, has a tonic effect on the body, improves mental performance, stimulates the cardiovascular and central nervous systems and increases its activity (Bohn *et al.*, 2012). Different types of tea contain different amounts of caffeine, on average, 1-4%, and dark varieties of tea up to 5% (Sharma & Rao, 2009). Due to its tannin binding, caffeine is eliminated from the body faster than alkaloids, thus eliminating the risk of poisoning in people who drink a lot of tea. High-grade tea contain more caffeine than green tea. At the same time, there is information that thein is formed during the growth and development of the plant and accumulates in large quantities in the young shoots of high-grade green tea (Melkadze & Khvedelidze, 2008). However, there is information that caffeine does not determine the darkness of tea (Tariq & Reyaz, 2012). For example, Ceylon tea contain less caffeine than weak Chinese tea. In addition to it, tea contains a small amount of other alkaloids with diuretic and diuretic properties: theobromine and theophylline, about 0.5% by weight of dry tea leaves. In addition to useful alkaloids, tea contains quanine, which is converted into toxic quanine as a result of prolonged exposure to heat or prolonged exposure to brewed tea (Hiroshi *et al.*, 2008).

Research, conducted in our republic (Jahangirov, 2019) shows that the extract from tea leaves and wastes generated during tea production, low-grade tea products contain enough physiologically active substances, including caffeine.

All this allows us to conclude that in order to increase the biological and nutritional value of tonusgenerating soft drinks, it is advisable to use an extract from plant raw materials, including tea leaves.

**The research methodology** is based on theoretical and practical aspects of modern nutrition dedicated to the assessment of the functional properties of raw and ready products, including TAI. Within the framework of this methodology, it is proposed to use an assessment that determines the intensity and duration of the toning effect, which allows to increase the competitiveness of the new product, assess its consumption characteristics and make a complete choice. During the research, generally accepted, standard and modified methods were used to check the quality, safety and functional characteristics, and statistical process of the results.

### **2.3. Research object and research methods**

As the object of research Kolkhida, Azerbaijan-1 and Farmanchay tea varieties grown, regionalized, introduced and tea leaves were used in the farms of Lankaran-Astara region. Characteristics of these varieties have been given in Guliyev (2014).

The leaves collected by individual varieties were collected in special containers, cooled to 4-5°C in the refrigerator and delivered to the laboratory.

**Research methods.** The samples brought to the laboratory were dried in a sublimation device. Prior to analysis, the sublimation-dried samples were ground in a hammer-type laboratory mill, then passed through steel sieves with a hole diameter of 200-300 µm, and samples of this size were used in the analysis.

Extraction conditions were optimized for caffeine extraction using different parameters (extraction temperature, extraction time, particle size, etc.). The most suitable extraction method determined as a result of this work is to pour 0.25 g of tea sample into

hermetically sealed test tubes, add 50 ml of distilled water at 80°C and keep at 80°C in a water bath for 25 minutes. The samples are then cooled under running water for 5 minutes and mixed in a vortex (shaker) for 1 minute.

The cooled and mixed samples were first passed through a coarse filter paper and then through a 0.22 µm membrane filter and transferred to the test tubes. No dilution was performed on the samples prior to transfer to HPLC with a disposable syringe. The method of analysis used in the quantitative and qualitative analysis of caffeine, the calibration curve and its equation (Sarı, 2010) and has been modified and improved by us. For the analysis of caffeine, a standard of 10 mg of caffeine is drawn, transferred to a 1000 ml flask and a 1000 ml reserve solution is prepared with distilled water. 25, 50, 100 and 200 ml of working solutions are prepared from this reserve solution. The calibration curve obtained with these different concentrations of caffeine is a straight line, the equation of the curve is  $Y = 268.8 X + 947.3$  and the correlation coefficient is  $R^2 = 1$ .

The experiments were carried out in the laboratories of the Department of Engineering and Applied Sciences of the Azerbaijan State University of Economics, Food Technology, Food Safety and Ecology of the Department of Technology and Technical Sciences of Lankaran State University and Lankaran Tea Production and Processing LLC.

#### 2.4. The results of the experiment and its discussion

Based on the experiments, the percentage of caffeine in the individual fractions of tea raw materials by sorts is given in the Table 1.

**Table 1.** The amount of caffeine in the individual fractions of tea raw materials by sort's %

№	Tea sorts	Fresh leaf, on average	Fractions		
			Gentle	Coarsen	Coarse
1	Kolkhida	1,90±0,16	2,54±0,19	1,48±0,20	0,93±0,12
2	Azerbaijan-1	2,15±0,28	2,88±0,32	1,81±0,21	1,21±0,25
3	Azerbaijan-4	2,48±0,31	3,26±0,31	2,17±0,27	1,52±0,18
4	Farmanchay	2,27±0,25	3,04±0,28	1,93±0,19	1,39±0,23

As can be seen from the table, the highest amount of caffeine ( $2.48 \pm 0.31\%$ ) was found in the "Azerbaijan-4" sort, and the lowest amount ( $1.90 \pm 0.16\%$ ) was found in the Kolkhida sort. At the same time, the amount of caffeine in different fractions of tea leaves also differs. Thus, the highest amount of caffeine ( $3.26 \pm 0.31\%$ ) was found in the fine fraction of the "Azerbaijan-4" sort, and the relatively lowest amount ( $0.93 \pm 0.12\%$ ) was found in the coarse fraction of the "Kolkhida" sort.

As you see, our research has found significant differences in the amount of caffeine in different sorts of tea leaves.

Similar results were obtained during the study of theanine and caffeine content of tea leaves grown in Turkey (Sarı, 2010). In another study on the caffeine content of various tea leaves, the caffeine content was between 2.54-2.78% (Caffin *et al.*, 2004), in another study Yagi *et al.* (2009) showed that the amount of caffeine in different tea leaves varies in a wider range - from 2.32 to 3.39%.

As we mentioned, most TAIs contain caffeine, which clearly stimulates the central nervous system. Therefore, caffeinated beverages are intended for episodic use (not more

than 350 cm<sup>3</sup> per day), suitable for people with cardiovascular disease and the elderly, as well as for mild central nervous system agitation, insomnia, pregnancy and people under 18 years of age is not considered. Systematic use of caffeinated beverages such as coffee can lead to addiction and related adverse changes in the body (Kalinin, 2014). Analysis of all these cases suggests the production of soft drinks using herbal supplements, including tea leaf extract, instead of caffeine.

Patent information and marketing research shows that TAIs should contain an average of 25-35 mg / 100 cm<sup>3</sup> of caffeine, 300-400 mg / 100 cm<sup>3</sup> of taurine and other components (Maharramov *et al.*, 2019).

Preliminary experimental studies conducted in the laboratory confirmed the expediency of using tea tincture containing  $30.0 \pm 0.1$  mg / 100 cm<sup>3</sup> of caffeine instead of caffeine in the formulation of soft drinks. Organoleptic, biochemical and microbiological analyzes showed that the samples of non-alcoholic beverages complied with the requirements of existing normative and technical documents.

Thus, the replacement of caffeine in the recipe with the appropriate amount of caffeine-containing tea during the production of TAI provides for the expansion of the range of non-alcoholic beverages using local plant raw materials and increase the biological and nutritional value of these beverages.

### 3. Conclusion

Patent information and marketing research, as well as preliminary experimental studies conducted in the laboratory, show that TAIs should contain an average of 25-35 mg / 100 cm<sup>3</sup> of caffeine, 300-400 mg / 100 cm<sup>3</sup> of taurine and other components. However, the amount of caffeine indicated by the manufacturers does not provide the optimal tonusgenerating effect of beverages.

At the same time, it was found that the caffeine in tea is related to tannins and forms tein or tannins. Tein tea is bitter, it has a tonusgenerating effect on the body, improves mental performance, stimulates the cardiovascular and central nervous system and increases its activity.

Researches show that depending on the sort and fraction of the tea grown in the Lankaran economic region, the leaves contain  $0.93 \pm 0.12\%$  to  $3.26 \pm 0.31\%$  caffeine. Therefore, the replacement of caffeine in the recipe with the appropriate amount of caffeine in the production of TAI provides an expansion of the range of non-alcoholic beverages using local plant raw materials and increase the biological and nutritional value of these beverages.

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