UV-SPECTROPHOTOMETRIC DETERMINATION OF CAFFEINE IN GREEN TEA LEAF

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Introduction. Nowadays tea is one of the most popular plant in the world because of its stimulant properties, relatively cheap prices, and potential health benefits. Tea (also known as Thea sinensis L. seu Camellia sinensis L. Kuntze) belongs to the family Teaceae (Camelliaceae) and has more than 45 varieties. Black tea (70%), green tea (25%) and other kinds of tea (5%) are produced. Green tea leaf as a raw material consists of young shoots, tea leaves and buds. It has a simplest producing process – by withering and drying. Tea is very diverse plant in terms of chemical composition. About 2 000 chemical components are in tea leaf (the chemical composition of freshly picked green tea leaf and dry tea is not the same). The tea leaf contains three main phytochemical groups of compounds such as purine alkaloids, flavonoids and tannins. Purine alkaloids are presented by caffeine, theobromine and theophylline. Tea contains more caffeine than coffee or cocoa, but its effect is softer; it is the most important component of tea.

Aim. To develop and validate UV-spectrophotometric procedure of caffeine quantitative determination for standardization of plant raw material.

Materials and methods. Six batches of green tea leaf were used in the experiment.

The procedure of analysis: Place 0.2 g of powdered green tea leaf in a round-bottom flask and infuse twice for 30 minutes with 10 mL of distilled water (80 – 90°C) when constant shaking and maintaining the temperature of the mixture at the level of 80 – 90°C. Separate the obtained aqueous extracts through the paper filter in the measuring flask with the capacity of 50.0 mL, cool and dilute to the volume with distilled water (aqueous extract). Transfer 20.00 mL of the aqueous extract with a pipette into a separating funnel and extract twice with 20.00 mL of methylene chloride for 10 minutes. Separate the obtained organic extracts through the paper filter with 1 g of sodium sulphate anhydrous in the measuring flask with the capacity of 50.0 mL and dilute to the volume with methylene chloride (organic extract). Evaporate 5.00 mL of the obtained organic extract using water-bath at the temperature of 80°C to complete removal of organic layer. Dissolve the dry residue in 10.00 of 0.1 M hydrochloric acid solution, filter through the paper filter (the solution to be analysed).

Measure the absorbance of the solution to be analysed 3 times with randomization of cell position at the wavelength of 273 nm using a single beam UV/VIS spectrophotometer SPEKOL®1500 (Analytik Jena AG, Germany) in the cell with the layer thickness of 10 mm. 0.1 M hydrochloric acid solution is used as a compensation solution. The solution of caffeine with the concentration of 20 μg/mL is used as a reference solution.

Results and discussion. To develop UV-spectrophotometric procedure for quantitative determination of caffeine in green tea leaf we use the well-known abilities of caffeine to absorb the light at 273 nm and to be extracted from raw material with hot water and from aqueous solutions with chloroform. The procedure consists in double extraction of caffeine from raw material with water at 80 – 90°C for 30 minutes followed by double extraction of caffeine from aqueous extract with methylene chloride; the obtained organic extract is evaporated and dissolved in 0.1 M hydrochloric acid solution. Such procedure allows to ensure the selectivity of the method in relation to the co-extracted biologically active substances of green tea leaf, which absorb the light in the same wavelength range.

Quantitative determination of caffeine in six series of green tea leaf has been carried out using the proposed procedure in the variant of the method of standard; the caffeine content is from 2.35% to 3.62%, which meets the requirements of European Pharmacopoeia.

Conclusions. A new procedure of caffeine quantitative determination in green tea leaf by the method of UV-spectrophotometry has been developed; its acceptability for application in the variant of the method of standard has been shown.

MODERN ANALYTICAL CHEMYSTRY – RESEARCH FRONTS (2016-2019)

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Introduction. The Institute for Scientific Information (1960-1992) was founded by the famous American scientist Eugene Garfield. In 1992-2016, it had IP and Science branches of Thomson Reuters. Currently, it is Clarivate Analytics company created in 2016; it operates in more than 100 countries around the world. The company's goal is to select, analyze and provide high-quality information for scientists, teachers, publishers, librarians, physicians, employees of patent offices, pharmaceutical market, managers, etc.

At the end of each year, Clarivate Analytics together with the Institute of Science and Development of the Chinese Academy of Sciences (CASISD) and the National Science Library, Chinese Academy of Sciences (NSLC) publishes Research Fronts reports. In particular eleven research groups were represented in Research Fronts 2019; among them we were interested in a direction close to analytical chemistry – "Chemistry and materials science".

Aim. The aim of our work is to study the Research Fronts reports (2016-2019) relating to chemical disciplines, in particular analytical chemistry, which allows scientists to make modern maps of research in chemical and biomedical disciplines and find the leading hottest research areas.

Materials and methods. We studied the annual Research Fronts 2016-2019 reports of Clarivate Analytics together with CASISD and NSLC, as well as a series of periodicals and electronic publications available to us. Next we tried to conduct a comparative analysis of Research Fronts analytical chemistry in 2016-2017 and 2018-2019.

Results and discussion. Among the leading scientific fronts of analytical chemistry in 2016-2017, according to scientometric estimates of scientists, different types of sensors were ahead – biosensors based on nanomaterials, gas (including graphene-based), microfluidic devices (laboratory on a chip) allowing to obtain controlled flows of small volumes of liquid samples and the corresponding reagents. Paper chips formed a separate research front. In general, microfluidics was a leader in high citations of publications. Works on proteomics, microextraction, hydrophilic extraction, studies of ionic liquids and graphene-based sorbents were of great interest.

The research in the field of creating solar cells and batteries that are necessary for solar energy, electronics, and computer devices is interesting. The direction of fluorescent carbon quantum dots already appeared in the maps of scientific research in 2016.

The general trends should be noted, including the miniaturization of analytical devices that allow determination outside the laboratory. The main trend remains the dominance of the biological analysis over other types of the analytical research.

To evaluate the leading Research Fronts of 2018-2019 in analytical chemistry the researchers compiled lists of about 100 most cited scientific articles in the discipline. These articles have been published over the past 4-5 years in such recognized scientific publications as "Analytical Chemistry", "Trends in Analytical Chemistry", "Analytica Chimica Acta", etc.

Thus, fluorescent carbon quantum dots (fluorescent carbon nanomaterials), paper microfluidic devices, cell microfluidics, 3 D printing in microfluidics, models of human organs (organs on a chip) lead on the map of scientific research in analytical chemistry from 2018. Miniature microfluidic analytical