Heavy Metal Content in Subtropical Fruit Trees Cultivated in Varied Ecological Conditions

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Abstract. *The study titled "Heavy Metal Content in Subtropical Fruit Trees Cultivated in Varied Ecological Conditions" examines the presence of cadmium, arsenic, lead, mercury, copper, and zinc in feijoa and actinidia (kiwi) fruits cultivated across diverse orographic terrains within the subtropical zone of Adjara. Utilizing a plasma atomic emission spectrometer, the investigation reveals that the examined fruits are free from toxic heavy metals such as arsenic, lead, and mercury. However, cadmium content shows variation, notably with higher concentrations observed in feijoa fruits. Furthermore, the levels of copper and zinc fall within the established regulatory limits.*
Keywords: *Fruit crops, kiwi, feijoa, heavy metals.*

Introduction. In today's world, one of the foremost challenges is the escalating impact of climate change, including global warming, and its repercussions on the ecological equilibrium. This interconnectedness directly influences the qualitative attributes of food products. Ensuring the populace's access to high-quality fruits, vegetables, and animal products stands as a pivotal mandate for public farms. These food items serve as vital sources of macro and micro nutrients, vitamins, organic acids, proteins, fats, carbohydrates, among others, crucial for sustaining health, bolstering productivity, and enhancing overall well-being. However, the contemporary environmental landscape exposes food to various pollutants. Consequently, the presence of heavy metals in food assumes paramount importance due to their profound implications for human health. Georgia hosts a diverse array of introduced and indigenous crops, including subtropical varieties such as feijoa and kiwi, esteemed for their chemical composition and nutritional significance. These fruits boast rich reservoirs of organic acids, sugars, vitamins, essential oils, biologically active compounds, as well as macro and micro elements, rendering them indispensable from dietary, medicinal, and aesthetic perspectives. Fruits abound with organic acids, sugars, vitamins, essential oils, biologically active compounds, as well as macro and micro elements[1,2,3,4,5,6,7].

Research objectives: In this study, we examined the fruits of Choiseana Feijoa and Actinidia Hayward varieties, sourced from the Batumi Urekhi settlement (1,2) and Upper Makhinjauri (3,4), respectively. These specimens were studied under varying ecological conditions within the subtropical zone of Adjara.

Photos. 1, 2 fruits of Urekhi Photos. 3,4 Makhinjauri fruits

The research plants from both Urekhi and Upper Makhinjauri were gathered from the homestead plots of the same farmer. Urekhi settlement, situated 5 km east of Batumi city at an

elevation of 5 meters above sea level, experiences warm winters with minimal snowfall, and quickly melting snow. Summers are also warm, with an average annual temperature of 15.3°C. In January, temperatures average +7.4°C, while summers reach around 24°C. The settlement receives an average annual rainfall of 2560 mm, with approximately 1950 hours of sunshine per year. Upper Makhinjauri settlement, located 11 km northeast of Batumi, sits at an elevation of 200 meters above sea level. Winters are warm, and summers are hot, with January temperatures averaging +5.7°C and July reaching +22.2°C. The settlement experiences an average annual temperature of 13.8°C, with an average precipitation of 2750 mm annually. Sunshine duration is approximately 1890 hours per year.

Research Method: The mineral content analysis of feijoa and actinidia fruits was conducted using a plasma atomic emission spectrometer at the Laboratory of Plasma Atomic Emission Spectrometry, located within the Research Institute of Agrarian and Membrane Technologies at BSU. The primary objective of this study was to assess the presence of heavy metals - arsenic, cadmium, mercury, lead, copper, and zinc - in the samples. The findings are presented in Table 1.

Table 1

Content of particularly toxic heavy metals in mg/kg of feijoa and kiwi fruit grown under different environmental conditions

№	Study heavy metals mg/kg	Study objects				
		2	3	1	4	MPC
1	Cd	0,41	0,51	-	-	0,03
2	As	L	-	L	L	0,2
3	Hg	-	-	L	L	0,02
4	Pb	-	-	L	L	0,5
5	Cu	3,85	0,15	0,064	0,86	5
6	Zn	0,17	2,65	0,48	0,84	10

Note: - does not include; The content of element L is lower than the sensitivity of the device

It was determined that the researched fruits do not contain arsenic, mercury, lead. Cadmium content was recorded in feijoa fruits and their content was 2000. It is higher than the maximum permissible concentration. The copper content is the highest in the feijoa fruits of Urekhi settlement, and the lowest content is in the actinidia fruits grown in the same area. The copper content in upper Makhinjauri kiwi fruits is higher than in the feijoa fruits. The content of zinc in the studied fruits does not exceed maximum permissible concentration. But there are more fruits grown in Makhinjauri conditions, especially feijoa fruits. The smallest amount was observed in kiwi fruits grown under drought conditions.

Conclusions

The results of the research show that the fruits of feijoa and kiwi grown in different environmental conditions do not contain important toxicants such as arsenic, lead and mercury, but they contain cadmium in excess of the permissible concentration, the fruits grown in upper Makhinjauri (94%), Urekhi (93%) conditions.

The content of copper and zinc in the studied fruits does not exceed the permissible concentration, but in this respect the feijoa fruits stand out.

Recommendations

In order to protect fruits and other food products from contamination with heavy metals, it is important:

1. to protect the surrounding area, agricultural beds as much as possible from various pollutants,

chemical means, chemical means of plant protection;

2. to use organic and natural mineral fertilizers to increase the fertility of the beds. If necessary, mineral fertilizers can be used in compliance with agro-rules;
3. to pay attention to the placement of waste in the environment;

The obtained results will provide significant assistance to those interested in feijoa and kiwi fruits in terms of their intended use.

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სხვადასხვა ეკოლოგიურ პირობებში მოყვანილ სუბტროპიკულ ხეხილოვნებში მძიმე ლითონების შემცველობა

რეზიუმე

ნაშრომში „სხვადასხვა ეკოლოგიური პირობებში მოყვანილ სუბტროპიკულ ხეხილოვნებში მძიმე ლითონების შემცველობა“ განხილულია აჭარის სუბტროპიკული ზონის სხვადასხვა ოროგრაფიულ პირობებში მოყვანილ ფეიჰოას და აქტინიდიის(კივის) ნაყოფებში მძიმე ლითონების - კადმიუმის, დარიშხანის, ტყვიის, ვერცხლისწყლის, სპილენძისა და თუთიის შემცველობა. კვლევა ტარდებოდა პლაზმურ ატომურ ემისიურ სპექტრომეტრზე. დადგენილ იქნა, რომ საკვლევი ნაყოფები არ შეიცავენ ისეთ ტოქსიკურ მძიმე ლითონებს, როგორიცაა დარიშხანი, ტყვია და ვერცხლისწყალი. კადმიუმის შემცველობა ზ. დ. კონცენტრაციაზე მაღალია ფეიჰოას ნაყოფებში. სპილენძისა და თუთიის შემცველობა ზ.დ.კ.-იის ფარგლებშია.