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INNOVATIVE TRAINING CAMP FOR TALENTED YOUNG FOOD SCIENTISTS FROM UZBEKISTAN (PROJECT ECAMPUZ)

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Abstract. Article dedicated to project capacity-building in higher education Erasmus+ ECAMPUZ project, coordinated by Tashkent Institute of Chemical Technology. CAMP1 activities, process of selection of participants, educational program and materials described. In total 26 students and young researchers participated in innovative theoretical and practical lessons organized by professors of the University of Copenhagen and University of Extremadura.

Keywords: food security, sustainability, food safety, hunger, CAMP, research challenge, food science and technology, foodomics, biochemistry, biotechnology.

Introduction

ECAMPUZ is a three-year (January 2023 – December 2025) EU co-funded capacity-building in higher education Erasmus+ project between six partner institutions from Uzbekistan and two HEI partners from the EU. The main aim of the project is to build capacity, develop and implement sustainable tools to address the national priorities in Uzbekistan (UZB) related to the "Sustainable growth and jobs" (the subcategory of "Knowledge triangle, innovation") within the Food sector.

One of the most important global challenge is the limited natural resources for food production, the continuous increase in population and the consistent decrease in agricultural area. This scenario is becoming even more challenging due to the continuous climate change [2-3, 7]. The United Nations estimate a 70 % rise in food demand as the world's population reaches ten billion by 2050 [18-19]. Uzbekistan has the largest population in Central Asia and Caucasus. The current population of Uzbekistan is 35,380,296 as of December, 2023, based on Worldometer elaboration of the latest United Nations data [20]. It is the biggest food producer and exporter in the region.

Uzbekistan (UZB) has the potential to become one of the most attractive suppliers of foodstuffs such as fruit, vegetables, dairy and animal products for surrounding countries as well as for the EU. Therefore, the upgrade of the food sector toward sustainable food production is amongst the top priorities of the country [5-6].

The food sector plays a key role in fulfilling the country's internal food demand for the increasing population and significantly contributes to the Gross National Income. Despite the fact that UZB has one of the most favorable climate, soil and infrastructure for a large scale production of high quality plant and animal based foods, the country's food sector is currently facing critical problems that cannot be solved without the involvement of the international experts and adapting knowledge and proven technologies of the developed countries. The ECAMPUZ project aims to build the capacity in UZB and ensure sustainable solutions for the food sector. In this project, UZB experts have the opportunity to establish necessary collaboration with EU partners and acquire new knowledge and skills.

The project addresses the two most important problems of the UZB food sector that need urgent solutions though strengthening of relations between HEIs, research and the food industry triangle. The first problem addresses a lack of food science and technology professionals (teachers and researchers) that are trained according to international standards and able to address and cope with today's challenges of the food sector in UZB.

ECAMPUZ project addresses this problem within work packages that aims at capacity building in the field of food science and technology education and research at UZB partner institutions using the knowledge and expertise of world's leading food scientists from the EU HEIs [10-11].

The second problem which is addressed in ECAMPUZ concerns the weak synergy between education, research and businesses in food industries in UZB. This problem is addressed by development and implementation of new, innovative and sustainable strategy for reinforcing collaborations between HEIs, research institutes and the local food industries.

Methods

During 3 years of ECAMPUZ project three series of Food Science CAMPs are offered for bachelor, master and PhD students of Uzbekistan, each focusing on different aspects of this dynamic field.

ECAMPUZ project activities focus on capacity building among young food science professionals and include:

1) establishment of a committee to select candidate students from UZB HEIs,

2) based on the Food industry needs analysis outcomes, a series of focused and intensive training courses are designed within chemometrics and analytical technologies, food microbiology and food safety and food chemistry and gastronomy,

3) CAMP 1 with a scheme for "an academic food science upgrade" takes place in Tashkent,

4) CAMP 2 with a scheme to "meet the food industry" takes place in Spain,

5) CAMP 3 with a scheme for "food chemistry and health" takes place in Bukhara region,

6) post CAMP evaluation to support implementation of gained knowledge and to discuss and evaluate the students CAMP reports,

7) preparation of training materials. Milestones and indicators in this work package will be developed as teaching materials for increased knowledge and skills of UZB BSc and MSc students.

According to the program, ECAMPUZ team announced the start for registration to participate in CAMP 1 of the project in May 2023. The main criteria for the future participants were: B2-C1 level of English; Basic knowledge in chemistry: general, organic, analytical, biochemistry, food chemistry; Relation to food science.

Overall, BSc, MSc and PhD students from following partner organizations of ECAMPUZ project participated in this call: Tashkent Institute of Chemical Technology; National University of Uzbekistan; Bukhara Engineering-technological Institute; Andijan State University and Urgench State University.

The dissemination of registration form for the participation in ECAMPUZ project CAMP 1 started in May 2023. All the registered future candidates were initially required to pass their CV and motivation letter. The future candidates with no relation to food science or with the lack of language skills were eliminated. All chosen candidates were interviewed online by evaluation committee. The Second call of applications were announced and the second row of interviews was held on June 26-27, 2023.

Evaluation scoring criteria for skills of candidates was set as follows (max. 100 %):

1) Language skills – 50%;
2) Background (candidate's active involvement into scientific projects and events) – 25%
3) Candidate's relevance to food science and overall knowledge of food science – 25%.

Apart from the high academic profile of candidates, ECAMPUZ project team also considered "Ethics and values" matters. In addition to the scoring criteria mentioned above, the selection process took into account a gender balance, and candidates belonging to socio-economically disadvantaged populations and/or from rural areas. After further consideration and analysis of the interviews, the evaluation committee of the project presented their decision on future participants to the steering committee of the project.

Pre-CAMP preparation included the followings:

- Being in contact with the participants of CAMP 1 prior to the start of CAMP;
- Organizing couple of online meetings, when required;
- Introducing compulsory documents (safety regulations in the lab and etc.) to the participants on time;
- Sharing the pre-learning materials provided by EU partners with the participants;
- Controlling the pre-CAMP preparation of participants (studying the shared materials, improving the language skills).

Fig. 1. First online meeting with the participants of project's CAMP 1 on 13th July 2023 via Zoom

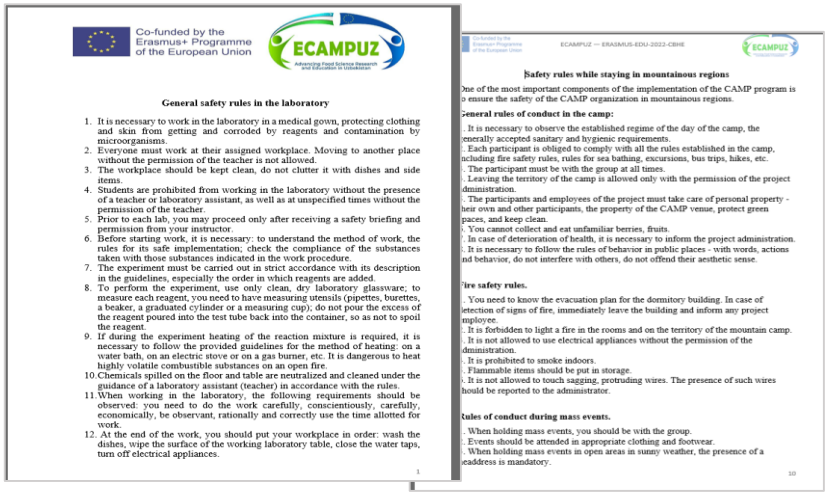
Project team had its first online meeting with the participants of project's first CAMP on 13th July 2023 via Zoom (Fig. 1). The main purpose of the online meeting was to familiarize students with upcoming activities before and during the CAMP 1. Further instructions were given regarding the activities for students before the CAMP 1 starts – from boosting language skills by joining the education centers or clubs to upgrading overall knowledge in food science by reading up books and articles in food science [14-17].

Participants were informed about "General safety rules in the laboratory" and "Safety rules while staying in mountainous regions", developed by project team. It was mentioned that all the participants are required to get acquainted with the rules carefully, fill the space where it is required and present the signed document to the project manager on the first day of CAMP 1.

Prior to the start of CAMP 1, the teaching staff of CAMP 1 shared the compulsory teaching materials for pre-CAMP 1 preparation, so the participants would have a general idea on the upcoming CAMP 1 program (Fig. 2) [1, 4, 8-9, 12-13, 15-16, 19].

Fig. 2. Compulsory teaching materials for pre-CAMP 1 preparation

Approximately 2 weeks prior to the start of CAMP 1, an online meeting was organized with the CAMP 1 participants to discuss the matters related to the organizational matters of CAMP 1, including the details of trip to the mountains, suggestions, required documents and other details (Fig. 3). Apart from the online meetings with the ECAMPUZ project team, the future participants from every UZB partner University were supervised by the manager of ECAMPUZ project from their HEI.



General safety rules in the laboratory

1. It is necessary to work in the laboratory in a medical gown, protecting clothing and skin from getting and corroded by reagents and contamination by microorganisms.
2. Everyone must work at their assigned workplace. Moving to another place without the permission of the teacher is not allowed.
3. The workplace should be kept clean, do not clutter it with dishes and side items.
4. Students are prohibited from working in the laboratory without the presence of a teacher or laboratory assistant, as well as at unspecified times without the permission of the teacher.
5. Prior to each lab, you may proceed only after receiving a safety briefing and permission from your instructor.
6. Before starting work, it is necessary: to understand the method of work, the rules for its safe implementation; check the compliance of the substances taken with those substances indicated in the work procedure.
7. The experiment must be carried out in strict accordance with its description in the guidelines, especially the order in which reagents are added.
8. To perform the experiment, use only clean, dry laboratory glassware; to measure each reagent, you need to have measuring utensils (pipettes, burettes, a beaker, a graduated cylinder or a measuring cup); do not pour the excess of the reagent poured into the test tube back into the container, so as not to spoil the reagent.
9. If during the experiment heating of the reaction mixture is required, it is necessary to follow the provided guidelines for the method of heating: on a water bath, on an electric stove or on a gas burner, etc. It is dangerous to heat highly volatile combustible substances on an open fire.
10. Chemicals spilled on the floor and table are neutralized and cleaned under the guidance of a laboratory assistant (teacher) in accordance with the rules.
11. When working in the laboratory, the following requirements should be observed: you need to do the work carefully, conscientiously, carefully, economically, be observant, rationally and correctly use the time allotted for work.
12. At the end of the work, you should put your workplace in order: wash the dishes, wipe the surface of the working laboratory table, close the water taps, turn off electrical appliances.

Safety rules while staying in mountainous regions

One of the most important components of the implementation of the CAMP program is o ensure the safety of the CAMP organization in mountainous regions.

General rules of conduct in the camp:

. It is necessary to observe the established regime of the day of the camp, the enerally accepted sanitary and hygienic requirements.
. Each participant is obliged to comply with all the rules established in the camp, ncluding fire safety rules, rules for sea bathing, excursions, bus trips, hikes, etc.
. The participant must be with the group at all times.
. Leaving the territory of the camp is allowed only with the permission of the project dministration.
. The participants and employees of the project must take care of personal property - heir own and other participants, the property of the CAMP venue, protect green paces, and keep clean.
. You cannot collect and eat unfamiliar berries, fruits.
. In case of deterioration of health, it is necessary to inform the project administration.
. It is necessary to follow the rules of behavior in public places - with words, actions nd behavior, do not interfere with others, do not offend their aesthetic sense.

ire safety rules.

. You need to know the evacuation plan for the dormitory building. In case of etection of signs of fire, immediately leave the building and inform any project mployee.
. It is forbidden to light a fire in the rooms and on the territory of the mountain camp.
. It is not allowed to use electrical appliances without the permission of the dministration.
. It is prohibited to smoke indoors.
. Flammable items should be put in storage.
. It is not allowed to touch sagging, protruding wires. The presence of such wires hould be reported to the administrator.

ules of conduct during mass events.

. When holding mass events, you should be with the group.
. Events should be attended in appropriate clothing and footwear.
. When holding mass events in open areas in sunny weather, the presence of a eaddress is mandatory.

Fig. 3. “General safety rules in the laboratory” and “Safety rules while staying in mountainous regions”

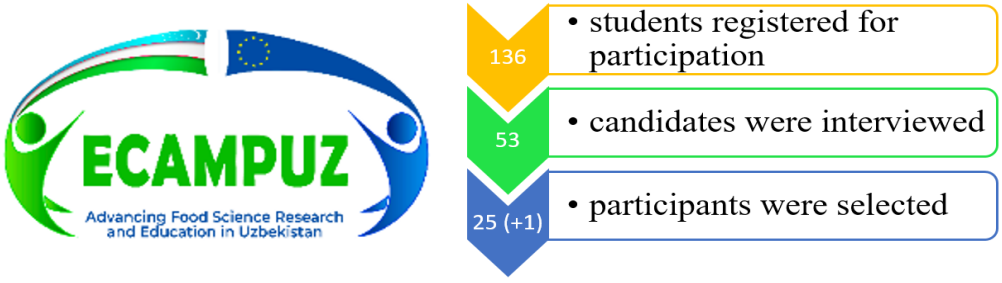
Coordinating TICT and CAT team members worked on the preparation of laboratories and auditorium for the organization of the second week of CAMP 1 in their organization.

The ECAMPUZ project team had significant support from the Ministry of Higher Edation, Science, and Innovation of the Republic of Uzbekistan in the organization of CAMP 1, which played an inevitable role in the CAMP 1 organization activities.

Results and Discussion

CAMP-1: “Academic food science upgrade and primary food production”. 25 (+1) candidates were selected to join CAMP 1 (Fig. 4). ECAMPUZ project team announced the final results of interviews on 7th July 2023. For the elimination of problems, in case some participants refuse or will not be able to join CAMP 1, the Evaluation team included at least 1 person as a reserve participant.

Results of evaluation and selection of participants to CAMP1 as follows:



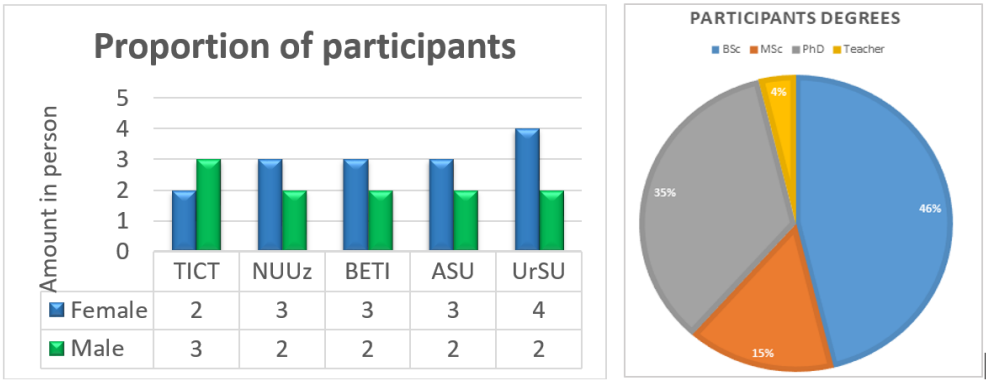


Fig. 4. Statistics about candidates and selected participants of CAMP1

"CAMP 1" was organized on September 18-30, 2023 on the topic "Academic food science upgrade and primary food production". It was dedicated to food chemistry, molecular gastronomy, and food analytics.

26 students' participants of CAMP 1 participated in a two-week immersive program in Tashkent, Uzbekistan. Through innovative teaching methodologies, practical exercises, and industry visits, they acquired knowledge and practical skills.

During the first week, on 18-24th September 2023 the CAMP 1 activities were organized at Chimgan mountains in Tashkent region in "Youth camp" ("Yoshlar oromgohi"). Participants were divided in groups and were assigned a specific contemporary problem present in the food industry. Then, each group worked on their problems under the supervision of the EU trainers to prepare a presentation which will be fully completed by December 2023 with their own solution to the problem based on the learned knowledge and obtained skills during the CAMP 1.

CAMP 1 academic program. CAMP 1training program of lectures and practical lessons were prepared by main working group from the University of Copenhagen and the University of Extremadura. Innovative teaching methods, lecture and practical lessons were provided by top researchers and professors of EU HEIs: assoc.prof. **Bekzod Khakimov and Tomasz Pawel Czaja** from University of Copenhagen (Denmark); **Professor Jorge Ruiz-Carrascal, assoc. prof. Mario Estevez Garcia and Dr. Ana Isabel Andrés Nieto** from University of Extremadura (Spain) (Fig. 6).

Fig. 5. CAMP 1 participants. 18.09.2023 y.

During the first week of CAMP the team responsible for teaching gave lectures on Food components and Molecular Gastronomy; as well as a kitchen lab practical lesson on Molecular gastronomy. Lectures were conducted on the topic of Food Components, Intro to Sensory Science, Food Analysis: Aroma, Texture and Taste. After the training time, participants and "ECAMPUZ" project got involved into sport activities and had a chance to get acquainted with each other. Participants were mostly attracted to lectures on the topic of Chemical Reactions in Food (browning and oxidation) and Basic Meat Science [1].

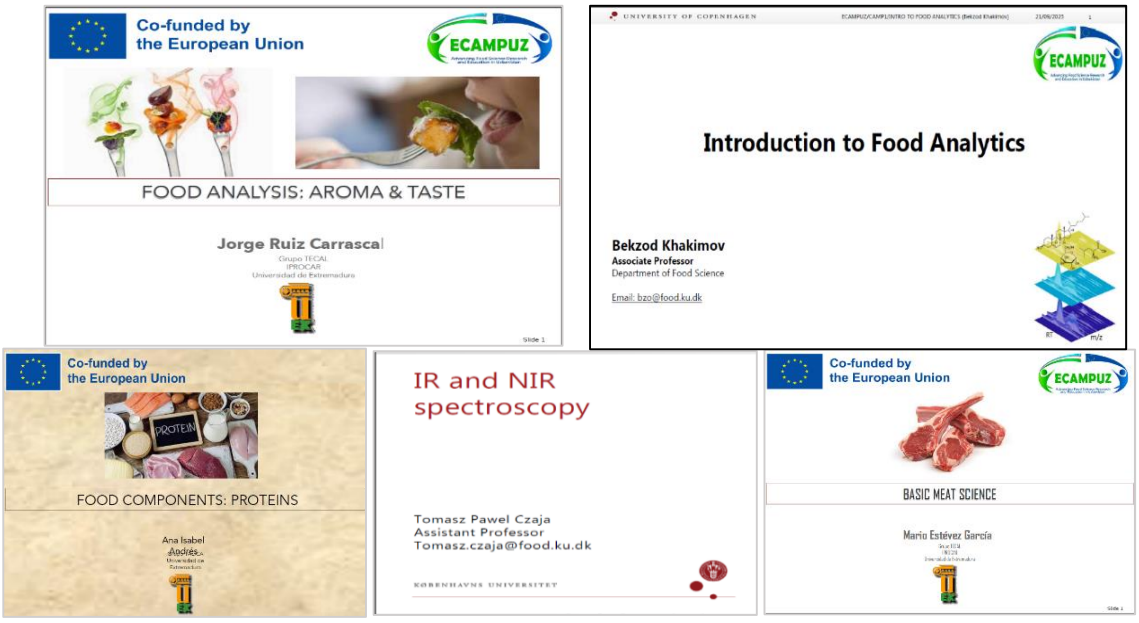


Fig. 6. CAMP 1 learning materials

The second part of training took place in the kitchen, where the participants had an opportunity to test their knowledge acquired during the lectures on Molecular Gastronomy and Chemical Reactions in Food. On Saturday, the ECAMPUZ project team and the CAMP 1 participants went hiking in the Chimgan Mountains, where

they explored the local food plants growing in the mountains and had outdoors lecture on Food Science and Technology.

During the second week of CAMP1 the lessons were organized in the laboratories of Tashkent Institute of Chemical Technology (Fig. 7) and Center of Advanced Technologies (Fig. 8) in Tashkent city. Not only were the participants of CAMP 1 involved in the lectures and practical lessons provided by the EU partners, but they also had the opportunity to interact with the representatives of the food industry in Uzbekistan.

Fig. 7. Practical lessons of CAMP 1at the department of "Food Safety and Technology of Production of Functional Products" of the Tashkent Institute of Chemical Technology. 25.09.2023 y.

The second week started at the department of "Food Safety and Technology of Production of Functional Products" of the Tashkent Institute of Chemical Technology. The participants had lectures on the topic of Food ingredients related to raw materials (not commonly considered ingredients), additives, spices and seasonings, flavors, other functional ingredients (salt, proteins, starch…) and bioactive added compounds. Some of the practical part on Molecular Gastronomy was accomplished in the kitchen-laboratory, where the participants witnessed how sodium alginate reacts with the calcium chloride and how is it used in the Molecular Gastronomy. Between and after the lectures, all 8 teams had a brainstorming with their team members on their challenge topic and discussed their plans with the CAMP 1 trainers.

During the practical lessons in the kitchen lab at TICT, the teams prepared two types of sausage under the guidance of Professor Jorge Ruiz-Carrascal of the University of Extremadura and with the support of **LLC "Promeat" company** employees. The ECAMPUZ project CAMP 1 team organized a visit to a leading brewery plant in Uzbekistan **"UzCarlsberg"**, where the CAMP 1 participants saw the brand new technological line of producing beer, from the raw material to the ready product. Both the project team and the CAMP 1 participants had a chance to discuss matters related to the technology of beer in Uzbekistan: challenges, innovation, implementation of new products for the local people, etc.

Fig.8. Participants of CAMP 1 at the Center of Advanced Technologies. 27.09.2023 y.

Three days of CAMP 1 training and lectures were held in the Center for Advanced Technologies. The trainers from UCPH shared with the CAMP 1 participants the software called Latenix to use for data analysis exercises. The CAMP 1 participants had lectures on Basic statistics and Data visualization and had a practical part of training related to modern laboratory measurements of food in **FOODOMICS [9]** and **BIOTECHNOLOGY** laboratories of the CAT.

CAMP 1 finished with a mini-conference in which the groups presented their innovative solutions to the problems in a plenary session for an audience in the CAT. During the final day, all eight teams presented their innovative approaches to solving the challenge given by EU trainers. Teams demonstrated their presentations and received general feedback from the EU trainers to work on their final report, which was presented by December 31st 2023.

Student participants experienced a competitive environment where they had to discuss the given challenges, brainstorm feasible technological methods, and make decisions as a team on the problem they were working on. Apart from being involved in training, the CAMP participants also had fun activities – sport activities, interactive games and hiking to the mountains.

Research Challenges on food science, requirements and evaluation. The research challenges were given by EU professors to teams of 3 or 4 students. Topics of challenges were related to development of a ready-to-eat meal based on traditional plov with healthier oils or plov without meat; application of sous-vide cooking to lamb meat; using lamb by-products for producing supplements; healthier replacers for margarine and developing functional bioactive ingredients based on Uzbek traditionally consumed herbs or spices and other food related topics.

Students devoted time during specific supervised sessions during the CAMP and in the spare time after classes to address the problems around the assigned food research challenge. The final outcome was a group presentation during the last day

of the CAMP and a final written report that was handed in to EU professors by student teams before December 31st, 2023**.** Projects were evaluated based on technical problem-solving skills and successful analytical implementations. Each project was scored on a basis of 100 points, with the points distributed as shown here:

- Oral presentation 30 points
- Answers and defense 20 points
- Written report 50 points

Follow-up meeting. In February 2024, there was a follow up of CAMP 1, where trainers from the program countries (Denmark and Spain) visited the stu-dents and checked how CAMP 1 had influenced the young professionals' work.

During this follow-up visit, EU trainers held additional scientific seminars with CAMP 1 students as well as with other UZB partners, including representatives from the food industry. This procedure ensured progress and helped to improve the next CAMP based on the feedback from both the CAMP committee and students. During the follow-up of CAMP 1 the EU trainers visited partner universities in Andijan, Bukhara, Urgench and Tashkent cities for two weeks.

During the follow-up meetings, comprehensive trainings on selected contemporary subjects in food manufacturing were organized for CAMP 1 trainees, members from food industries in UZB (associate partners) and other partners from UZB HEIs. Special seminars and discussions were dedicated to sustainable water use in the food industries in the regions, which suffer from shortage of water supplies due to the drying of the Aral Sea.

Conclusion

The three years of ECAMPUZ project of EU co-funded CBHE ERASMUS+ program's goal is providing highly intensive CAMPs to more than 75 talented young professionals and students from Uzbekistan Universities. The training covers the most important areas within the food science, and producing sustainable teaching materials. As a result, increased interest of food science among students and young professionals are helping them to choose appropriate work place in the food sector. Also, the willingness of Uzbekistan food companies to hire trained food scientists is being increased. Food science research in key areas such as "production of healthier food products"; "optimal use of water in the food production" and "production of value-added products from large amount of food waste produced in the country" is being developed.

References:

1. André Müller, Hans Steinhart. Recent developments in instrumental analysis for food quality, Food Chemistry, Volume 101, Issue 3, 2007, Pages 1136-1144, https://doi.org/10.1016/j.foodchem.2006.03.014.

2. Billen, G., Lassaletta, L., & Garnier, J. A vast range of opportunities for feeding the world in 2050: trade-off between diet, N contamination and international trade. Environ. Res. Lett. https://doi.org/10.1088/1748-9326/10/2/025001 (2015).

3. Dawson, T. P., Perryman, A. H. & Osborne, T. M. Modelling impacts of climate change on global food security. *Clim. Change* **134**, 429–440 (2016).

4. Edward B. Walker, Don R. Davies, Mike Campbell. Quantitative Measurement of Trans-Fats by Infrared Spectroscopy. J. Chem. Educ. 2007, 84, 7, 1162. https://doi.org/10.1021/ed084p1162.

5. Gouel, C. & Guimbard, H. *Nutrition Transition and the Structure of Global Food Demand* (CEPI, 2017).

6. Government of Uzbekistan. Presidential Decree №158 "About Strategy Uzbekistan-2030". 11.09.2023 y. https://lex.uz/ru/docs/6600404. Accessed on 04.12.2023.

7. Hertel, T. W. & Baldos, U. L. C. Attaining food and environmental security in an era of globalization. *Glob. Environ. Change* **41**, 195–205 (2016).

8. Ishikawa D, Shinzawa H, Genkawa T, Kazarian SG, Ozaki Y. Recent progress of near-infrared (NIR) imaging-development of novel instruments and their applicability for practical situations. Anal Sci. 2014;30(1):143-50. Doi: 10.2116/analsci.30.143. PMID: 24420256.

9. Josić D., Peršurić Ž., Rešetar D., Martinović T., Saftić L., Kraljević Pavelić S., Chapter Six - Use of Foodomics for Control of Food Processing and Assessing of Food Safety, Editor(s): Fidel Toldrá, Advances in Food and Nutrition Research, Academic Press, Volume 81, 2017, Pages 187-229, https://doi.org/10.1016/bs.afnr.2016.12.001.

10. Kearney, J. Food consumption trends and drivers. *Phil. Trans. R. Soc. B* **365**, 2793–2807 (2010).

11. Linehan, V. et al. Global food production and prices to 2050: scenario analysis under policy assumptions. In 43rd ABARES Outlook Conference (2013).

12. Michael K. Bellamy. Using FTIR-ATR Spectroscopy To Teach the Internal Standard Method. *Journal of Chemical Education* **2010**, *87* (12) , 1399-1401. https://doi.org/10.1021/ed100544m

13. Ozaki Y. Near-infrared spectroscopy-its versatility in analytical chemistry. Anal Sci. 2012;28(6):545-63. doi: 10.2116/analsci.28.545. PMID: 22729040.

14. Pardey, P. G., Beddow, J. M., Hurley, T. M., Beatty, T. K. M. & Eidman, V. R. A bounds analysis of world food futures: global agriculture through to 2050. *Aust. J. Agric. Res. Econ.* **58**, 571–589 (2014).

15. Sayo O. Fakayode, Angela G. King, Mamudu Yakubu, Abdul K. Mohammed, and David A. Pollard . Determination of Fe Content of Some Food Items by Flame Atomic Absorption Spectroscopy (FAAS): A Guided-Inquiry Learning Experience in Instrumental Analysis Laboratory. *Journal of Chemical Education* **2012**, *89* (1) , 109-113. https://doi.org/10.1021/ed1011585

16. Sarn Settachaimongkon, Hein J.F. van Valenberg, Eddy J. Smid, Chapter 25 - Metabolomics as an Emerging Strategy for the Investigation of Yogurt Components, Editor(s): Nagendra P. Shah, Yogurt in Health and Disease Prevention, Academic Press, 2017, Pages 427-449, https://doi.org/10.1016/B978-0-12-805134-4.00025-0.

17. The Future of Food and Agriculture—Alternative Pathways to 2050 (FAO, 2018).

18. Valin, H. et al. The future of food demand: understanding differences in global economic models. *Agric. Econ.* **45**, 51–67 (2014).

19. van Dijk, M., Morley, T., Rau, M.L. et al. A meta-analysis of projected global food demand and population at risk of hunger for the period 2010–2050. Nat Food 2, 494–501 (2021). https://doi.org/10.1038/s43016-021-00322-9

20. Worldometers.info (2023). Uzbekistan Population. Retrieved from: https://www.worldometers.info/world-population/uzbekistan-population/. Accessed on 04.12.2023