Promising innovative technologies and equipment in the university food system

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Abstract. The food systems of the Plekhanov Russian Economic University studied in detail. For comparison, studies on the other six leading universities in Moscow and data on many large foreign universities are presented. The demand for healthy nutrition in most universities and the development of a customer services network in them has been established. These problems are especially acute in the field of human nutrition, namely in the university nutrition system. Therefore, the authors studied the market situation with the demand for food services in universities (Russian and foreign). Surveys, questioning of a youth audience were carried out in order to ascertain the quality of culinary dishes and products, the level of service, assortment, methods of selling food and culinary products. In terms of improving the nutritional system of universities, it seems the best option for using vending sales, pizza and other innovations. However, problems were identified in the service of vending machines. Therefore, their most rational placement is necessary. Besides, it is necessary to form the required range of products and the related tasks of portioning, packaging, and logistics.

1. Introduction

Today, food quality is regarded as a factor of national security. Therefore, the growing food industry every year, the increase in shelf life, nutritional and biological value require further effective development of the industry, the introduction of new innovative equipment and advanced technologies [1]. The problem of healthy nutrition and its organization is a topical area in science and practice both in Russia and abroad, especially for universities, including the tasks of ensuring quality and price.

In Russia, the introduction of the concept of a healthy diet is significant. So, the student union is involved in creating standards of social nutrition (assortment of dishes, their composition, and energy value). A solution to the problem of organizing a healthy diet is proposed through the use of vending machines since they are in demand in the university environment because they can serve the consumer at any convenient time in the learning process. In this regard, a project has been developed for a vending machine, adapted for the implementation of complex lunches and breakfasts for students.

In Russia, the history of vending is quite long. In our country, vending begins in 1898 with vending machines for the sale of chocolate in St. Petersburg [2]. In the USSR, in the 50s, vending machines were sold for selling sandwiches, notebooks, pencils, matches, cigarettes, bread, sunflower oil, milk, kerosene, coffee, tea, beer, and, of course, all soda water. Demand for such services is currently growing, both in Russia and in the world.
The following section introduces a review of the scientific literature and presents international experience in catering at universities. The following are specific research methods and results. Practical recommendations are formulated. The last section of the article contains conclusions and recommendations.

In the Plekhanov Russian University of Economics for many years studying the problems of forming the quality of catering products, using a modification of the properties of food raw materials, optimal ratios of ingredients of animal and vegetable origin, food fibres, aromatic additives, vitamin preparations. The pursuit of quality of catering products ensures the variability of product formulations.

Many publications are devoted to the problems of the nutritional and biological value of food products on the example of semi-finished meat products, the development of diets for students [3]. The results allowed choosing the best ways of processing raw materials into culinary products, as well as inclusion in diets, not only for students but also for different population groups; ensuring quality and safety control, including the microbial state of products sold through vending [4]. For implement vending machines and implement complex lunches through them, as one of the innovative types of food, it is necessary to analyze the use of vending and the level of catering through vending machines both at the international and domestic levels, especially in the university food system.

A vending business is a type of business built on the use of automated retail equipment through which a wide range of products from the FMCG (Fast Moving Consumer Goods) group is sold. Vending in Russia now includes sixty thousand machines with 4 billion rubles in annual turnover. Payback is an average of 2 years with initial investments from 100 thousand rubles to 1 million. An assessment of the potential market shows an expected ten-fold increase over five years; it is based on the fact that now in Russia the share of vending is about 1% of retail, and, say, in the European Union – an average of 5%. Over 60% of the market in Russia is coffee machines. Another 25% are snack machines; the rest of the market is devices for the sale of drinks, juices, soda, hot food, hygiene items, newspapers, lenses.

Analysis of the review of the scientific literature of international experience in catering at universities showed that in the leading countries of the world, from 500 (Russia) to 230 (Japan) students per 10 thousand inhabitants, which is a tremendous amount (up to 5% of the population). Students need to eat right and inexpensively, and the presence of different food outlets at universities and other educational institutions provides them with this opportunity. Catering is designed to meet rational physiological needs [5].

Recently, the issue of using vending machines in the university environment to organize a healthier diet has only been resolved; the use of vending is assumed to be financially effective [6]. In Italy, the urgent task of ensuring the choice of food products using vending machines, including the importance of having healthy food, as well as consumer awareness. Be sure to correctly inform consumers (a special label), which reduces nutritional risks, in particular, obesity factors [7]. In Finland, the influence of gender and age of consumers, the type of food product on the structure of food production for the segment of young consumers is studied [8]. The results showed that even when a product is not attractive in itself, its origin (local) can increase perceived quality.

Today, diseases are "younger," respectively, it should be noted the risks of diseases of the gastrointestinal tract, oncological and others. Their prevention should be directed to specialized, functional products containing physiologically active ingredients, namely dietary fibre, peptides, amino acids, vitamins, trace elements [9]. Compensation for such a negative situation to a large extent is a properly organized, balanced diet optimized for various parameters, including the development of a more informative menu, computer, Web-based applications for choosing a diet.

2. The purpose of the study
The article aimed to the development of diets for male and female students, as well as mechanisms for their implementation, mainly using vending machines to ensure sales of complicated breakfasts and dinners that meet the regulatory requirements for the design of diets.
3. The object of the study
The object of research is the technology and equipment for the organization of healthy eating using vending technologies not only in leading universities of Russia but also at the international level.

4. Materials and methods
The study is based on existing foreign and domestic data of scientific and theoretical research and development. The authors carried out studies aimed at studying public opinion about the quality and safety of food and culinary products, their assortment presented in the food system, a leading Russian economic university and various foreign universities. Marketing research is carried out using the student survey method.

The questionnaire is developed according to the principles of the simplicity of its perception, compactness (included about 15 questions) and automation of the distribution of the probable target audience of students of various training profiles. Therefore, the results are useful for segmenting the market sector. The average sample size during product testing and trial marketing is 200. In order to minimize field research errors, the sample size is increased. In the food and culinary products study, as a rule, a sample of $n = 300-400$ respondents is used in the course of a survey. However, it is known from statistics that the results of the study, subject to randomized execution, are reliable for $n > 30$.

Studied the needs of students in the areas of product technology and the organization of catering, commodity science and examination of goods, economics and enterprise management, marketing, management of various faculties of using online technologies, including Google Forms (profiles). Students should be considered as a professional-production group of the population of a certain age category, united by specific labour characteristics and living conditions. Therefore, it is advisable to highlight students in a special segment. The student years are saturated and varied, characterized by a great overstrain of the nervous system. The load, especially during periods of sessions, is growing significantly, reaching 15-16 hours a day. Chronic lack of sleep, intense mental work, violation of the regime and nature of nutrition can lead to neuropsychic breakdowns.

A serious role in ensuring an effective and healthy nutrition for students and staff can be played, including the use of vending machines, both existing at universities and those that could be located there quickly and in the optimal number, given the compactness and ease of installation of vendors. It also seems important to introduce a new vending machine for the implementation of complex lunches.

The design solutions for the development of a new vending machine are based on the principle of combining temperature fields from different sources of heat - a combined furnace is designed to heat the complex lunches sold [10].

5. Discussion of the results
Further, we clarified the attitude to the catering of students and employees of leading universities in Moscow by the survey method: Lomonosov Moscow State University (Faculty of Journalism, Faculty of Economics); The First Moscow State Medical University named after I.M. Sechenov; Russian State University for the Humanities; Financial University under the Government of the Russian Federation; Research University Higher School of Economics; Russian State University of Oil and Gas named after I.M.Gubkin; Plekhanov Russian University of Economics.

According to various ratings, all these universities are included in the top 20 universities in the Russian Federation, or the top 20 universities in Moscow. The sampling restriction for seven universities was recognized by the authors of the article for this study to be quite representative.

The total number of respondents is 229 people.

As a result of this stage, it is revealed that 15.4% of respondents (or 35 people) do not use the services of vending machines at all, and very often (several times a day) only 3.9% (or nine people).
The following is a comparative analysis of the catering of well-known universities in the EU and the USA.

At the University of Humboldt-Universität Zu Berlin (HU Berlin), the Menza system is widely used, which is an electronic environment covering various dining rooms and cafeterias. The student draws up a card and can use the university catering services at a discount. The site has information on prices, composition and availability of goods at the university food points, and also a comment on the quality of the dish.

According to the students, people can adjust the menu to satisfy their nutritional needs more fully. In this regard, the menu includes vegetarian dishes or dishes that do not contain any product, such as pork. The presence of the card allows the student eating at different universities, as this system operates throughout Berlin. It is convenient and economical. In addition to the various canteens that use the Menza system, the university also has various cafeterias and cafes in which the student can dine. The university has vending machines for the sale of various drinks and products, from Coca-Cola to sandwiches.

Cafes and cafeterias dominate the EU Business School, and there is also a discount card, but only for students of this university. Healthy food predominates at the university, as it supports a healthy lifestyle. Students can get full information about the menu on the site and also leave their comments.

At the University of Calabria, Universita Della Calabria uses about 6-8 vending machines. The assortment does not include salads and sandwiches, which are more balanced foods than sweets. The learning process goes from 9:00 to 18:00 – all this time, vending machines are actively used. In addition to snack machines, coffee makers are installed at this university in Calabria, which is popular among employees and students due to the high consumption culture of this drink in Italy.

Catering at the University of Applied Sciences Würzburg-Schweinfurt, FHWS is represented by two vending machines, which are placed on the principle of a cascade, which ensures centralization of the implementation of a wide range of products.

The FLS St. Peter's University, New York campus is located in the city of Jersey City, which is part of the New York metropolitan area. For students living in the hostel, meals are organized in the hostel's dining room on a full board basis on weekdays and a half board on weekends. Drinks at lunch and dinner are usually not included.

At the Aristotle University of Thessaloniki, the dining room is only for students. Moreover, groups of people who study only the language are not students, and so they eat on their own for the first month of training, then they are allowed visiting the dining room. Three meals a day in the dining room, breakfast from 8:00 to 8:30, lunch from 12:30 to 16:00, dinner from 18:30 to 21:00, every day from Monday to Sunday. Breakfast is repeated daily and consists of the same menu: coffee (or milk, tea, juice); bread (or toasts) with butter and marmalade; corn flakes (or cupcake, boiled egg, omelette, cheese).

The lunch and dinner menu is composed for one week but has three options for a meal every day at lunch and two options for a meal for dinner. Thus, students can eat for three weeks so that the food does not repeat. The food is balanced, at lunch they always offer soup, mainly from legumes, lentils, even though the diet in Greece minimizes the presence of soups.

Two to three times a week, the menu includes fish dishes. On Thursday, several meat dishes are presented. Both lunch and dinner always serve a variety of salads, such as cabbage and carrots (or tzatziki). At lunch, fruits are always presented, mainly pears, apples, oranges, tangerines or kiwi. For dinner, they often offer a sweet dish – jelly, doughnuts, or pudding. Most of the students visiting the cafeteria in the morning and evening live on their own. Lunchtime in the dining room is the busiest. In general, it can be noted that university nutrition systems in the world are very diverse. There are both traditional types – dining rooms, cafeterias, and the hostel system in the hostel, as well as using vending machines. A distinctive feature of food in universities is a system of discounts in one form or another.

If we talk in more detail about the Plekhanov Russian University of Economics is one of the leading universities in the country. More than 70 thousand students study at higher education
programs at all university sites. In particular, over 20 thousand students study at head university (Moscow). The number of faculty of the head university is over 1800 teachers. Catering system of the Plekhanov Russian University of Economic includes many canteens, cafes, buffets, a restaurant and various vending machines located in the educational buildings of the university. For assessing the effectiveness of the power system in the Plekhanov Russian University of Economic, polls are conducted with a sample size of $n \approx 170$.

Segmentation of the sample showed that the majority of respondents are women (84%). The age groups are as follows: up to 18 years old – 23%, 18 years old – 4% 19-25 years old – 71%, 26-30 years old, 0.6%. The social status of 63% of respondents was average, 26% – above average, high – about 7%, below average – 3.7%.

From the results obtained, it can be seen that most of the students, namely: 43% use food services in the walls of the Plekhanov Russian University of Economics. 21% of these respondents visit food facilities several times a month, and 29% of these students – several times a week. 7% of respondents do not buy food at the university, but use the services of other enterprises, or bring food with them. The analysis showed that the reasons for this might be: inconvenient location of catering facilities; high prices; narrow range; not high consumer properties of products; limited time and breaks between classes.

To the question “What another catering facility would you like to see at the university?” The following answers were received: machines with frozen yoghurts; healthy food cafe; cafe with desserts; mini pizzeria. As a result of a study of the target audience, aged mainly from 18 to 30 years old, in the Plekhanov Russian University of Economics established the following. Most respondents choose culinary products by quality and assortment (43% of respondents), by location of food points (42%). Culinary products sold at power points of the Plekhanov Russian University of Economics in most cases (65%) responded to her quality.

The range of respondents' products corresponded to their expectations. In essence, 62.2% of the positive responses from the total number, in 32.3% of cases the opinion was negative, an undesirable inclusion of high-calorie snacks in the menu and many similar products were noted. One of the crucial factors – social – is the price of complexes. As it turned out, the preferred cost range: 160 rubles. (≈41% of answers), 200 rubles (23%), 220 rubles (7%), while the average price is 183 rubles.

Analysis of the data showed the use of vending technologies of the power system showed that most students use vending machines, as it is convenient. Taking into account the analysis of the questionnaire conducted by students, diets were developed, taking into account calories. A vending machine with a built-in microwave was developed at the department of the restaurant business for optimizing the food system. A patent was obtained for the developed design of the vending machine. For optimize the operation of the hot shop and implement a broader range of culinary products, a multifunctional three-tier furnace is developed, and a patent is obtained for the furnace design.

There are some examples of developed set meals.

The complex is designed for students aged 18-30 years. Culinary dishes are selected under the preferences of students, taking into account national traditions, the emphasis is on the other hot dishes, as they are more high-calorie and calculated cost and selling price (Table 1).

According to reference data, the calorie content of the daily diet, necessary for the healthy life of girls aged 18-40 years, is 2400 kcal. When preparing a complicated lunch, it is necessary to take into account that the calories obtained per day with three meals a day should be distributed in the following ratio: breakfast 25% (600 kcal); lunch 45% (1080 kcal); dinner 35% (840 kcal). Also, the proposed comprehensive lunch takes into account the wishes of students the Plekhanov Russian University of Economics, that is, it included national dairy products.
Table 1. Comprehensive lunch for female and male students

| Name of dish                              | Exit Content | Squirrels | Fats   | Carbohydrates | Cost price |
|-------------------------------------------|--------------|-----------|--------|---------------|------------|
| Cottage cheese casserole with sour cream  | 150/25       | 249       | 18.64  | 11.48         | 16.1       | 42         |
| Sandwich with butter and kurt             | 30/10/25     | 218       | 8.66   | 13.34         | 15.78      | 33         |
| Boiled egg                               | 60           | 93        | 7.52   | 6.34          | 0.67       | 11         |
| Green tea with sugar                      | 200          | 600       | 34.8   | 31.16         | 33.11      | 91         |
| **Total**                                 | **600**      | **34.8**  | **31.16** | **33.11**   | **91**     |

| Name of dish                              | Exit Content | Squirrels | Fats   | Carbohydrates | Cost price |
|-------------------------------------------|--------------|-----------|--------|---------------|------------|
| Soup khachho                              | 250          | 190       | 8.56   | 11.31         | 13.79      | 18         |
| Caesar salad with chicken                 | 150          | 283       | 15.5   | 21.15         | 8.2        | 30         |
| Baked chicken with cheese and mayonnaise  | 120          | 223       | 22.6   | 12.5          | 4          | 40         |
| Buckwheat with champignons                | 150          | 193       | 5      | 10            | 17         | 9          |
| Katyk                                     | 250          | 158       | 6.5    | 10            | 10.5       | 15         |
| **Total**                                 | **1047**     | **58.7**  | **65** | **54**        | **112**    |

6. Conclusion
According to the results of studies, we can conclude: in universities in Russia and the world, nutrition is organized differently. An extremely differentiated assortment of food and related accessories is used. Catering system is an extremely urgent problem that is being discussed today at the level of the Russian Student Union, which is developing a standard of social lunch for students. For solving this problem, it is necessary to consider the enormous number of students in the population structure of developed countries, as well as stressful working conditions, including stressful periods, namely, sessions, final certification, and the introduction of a healthy diet. Most universities use technology close to fast food. Catering does not satisfy students and consumers in general in terms of environmental friendliness, quality and assortment. The problem is solved with the use of vending technologies, which allow receiving standardized and healthy food, the quality indicators of which can be automatically controlled. A significant advantage of the vendors is the ease of installation and operation, which allows them being located in places of maximum student traffic and makes it possible to optimally use the short periods between classes, as well as to realize complicated breakfasts and lunches through them. Therefore, the studies performed allow optimizing the nutrition system in universities.

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