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Organization of Healthy Catering in Russian Universities Using Vending Technologies

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Abstract:

Relevance of the research: at present moment, healthy catering is a relevant issue for higher education institutions; this includes ensuring the quality of food and automating the sale of set lunches through vending machines, thereby providing students with a better access to healthy food and taking into account consumer preferences. The article presents a comparative analysis of the organization of healthy catering by using vending technologies not only in leading Russian universities, but also at the international level. Goal of the research: to develop diets for male and female students, as well as the mechanisms for their implementation, mainly using vending machines for selling set breakfasts and lunches that meet the regulatory requirements for developed diets. Research methods: the study involved using a range of questionnaires and analyzing preferences of students and university staff. Conducting marketing research, the authors applied methods of market analysis, as well as on-line questionnaires. The research sample included 230 students. Results of the study: the article considers in detail catering at the Plekhanov Russian University of Economics. To compare the results, the authors also studied other six leading universities of Moscow and the data from a number of large international universities. It was determined that most universities require the development of healthy catering, as well as improving the service. These problems are especially acute in the sphere of social catering, and namely in the university catering. Therefore, the authors explored the following aspects: the market situation with the demand for catering services in universities (Russian and international); conducting polls, interviewing the youth to assess the quality of food, service, range of meals, ways of selling dishes and others. The best way to improve catering at universities seems to be through using vending machines, pizza mats and other innovations. However, there are some problems associated with the maintenance of vending machines, which implies their rational location. In addition, it is necessary to develop the required product range, and solve the related tasks of batching, packaging, and logistics.

Keywords: surveys; vending machines; healthy catering; diets; set lunches.

JEL Classification: L66; I12; C83.

Introduction

The issue of healthy catering and its organization is an extremely relevant scientific and practical field both in Russia and in the world, especially for higher education institutions, which includes quality control and price issues. The study aims to develop healthy meals for students, namely set breakfasts and lunches, and to automate their sales.

The development of the concept of healthy catering is significant in Russia. In this regard, the student union participates in the development of social food standards (a range of dishes, their composition, and energy value).

Healthy catering can be organized using vending machines as they are in demand in the university environment; can serve the consumer at any convenient time during the learning process. For this purpose, we developed the project of a vending machine adapted for servicing set lunches and breakfasts for students.

Russia has a long history of vending. In our country, vending began in 1898 with vending machines for selling chocolate in St. Petersburg (Nazarov 2017). In the 1950s, the USSR produced vending machines selling sandwiches, notebooks, pencils, matches, cigarettes, bread, sunflower oil, milk, kerosene, coffee, tea, beer and, of course, sparkling water, so well-remembered by everybody. The demand for such services is currently growing, both in Russia and in the world (Vending machines of the USSR 2012).

The next section contains a review of scientific publications and explores the international experience of catering in universities. Next, research methods and findings are presented in detail. In addition to that, we formulated some practical recommendations. The last section of the article contains conclusions and recommendations.

1. Organization of Healthy Catering in Universities through Vending Technologies

For many years, Plekhanov Russian University of Economics has been studying issues related to the development of high quality catering by modification of the properties of food raw materials, finding the optimal ratio of ingredients of animal and vegetable origin, dietary fiber, spices, and flavor additives, vitamins and others. This will ensure the variability of the range of products.

A number of monographs and publications (Belyaeva 2015, 2016, 2017) are devoted to the issues of food and its biological value considering the example of manufactured meat products and developing daily meals for students (mainly set breakfasts and lunches).

In their articles, Sokolov (2015) and Bezryadnova (2015) present the findings of studies on the main properties, histological structure and other characteristics of meat raw materials with high nutritional and biological value, in particular, pork and poultry meat, estimating their chemical and amino acid composition. Histological identification of the latter enabled the author to reveal the features of the raw materials of animal origin, the specifics of its primary processing, cooling, freezing, and their significant influence on product quality.

The findings enabled us to determine the optimal ways of processing raw materials into cooked dishes, to develop daily meals, not only for students, but also for different social groups, to ensure quality and safety control, including the microbial characteristics of products sold through vending (Jiang *et al.* 2017, Al-Nabusli *et al.* 2017).

To introduce vending machines and to serve set lunches through them as one of the innovative types of food, it is necessary to analyze the application of vending technologies and the level of catering provided by vending machines, both at the international and Russian levels, especially regarding catering at university.

Vending business implies using automated devices for retail trade, through which a wide range of the FMCG products (Fast Moving Consumer Goods) is sold (Vending Business in Russia 2017).

Currently, vending in Russia includes 60,000 machines with a turnover of 4 billion rubles a year. The payback is 2 years on average with initial investments from 100,000 rubles to 1 million. Evaluation of the potential market shows an estimated tenfold growth within 5 years; this estimation is based on the fact that the share of vending is about 1% of retail in Russia at the moment, and, for instance, in the European Union it makes up an average of 5%. More than 60% of the market in Russia is occupied by coffee machines, another 25% – snacks, the rest of the market accounts for machines selling beverages, juices, sparkling water, hot meals, personal hygiene items, newspapers, lenses, etc. (New Vending technologies 2017).

2. Catering in International Universities

In the developed countries, the number of students varies from 500 (Russia) to 230 (Japan) per 10,000 people, which is a huge amount (up to 5% of the population) (Main trends in the development of education in the modern world 2017, Gajour 2017). Students demand proper and inexpensive meals, so different eating-places available in

universities and other educational institutions meet this requirement. Public catering should satisfy these physiological needs (GOST 31985-2013, 2017).

The issue of using vending machines in the university environment to organize healthier diet is being solved only now, and vending is supposed to be profitable (Viana 2018).

Italy sees it as a relevant task to provide a wide range of food through vending machines, to ensure that the food is healthy, as well as to increase consumers' awareness. Consumers should be provided with all necessary information (a special label), which reduces food risks, in particular, the obesity factor (Rosi 2017).

In Finland, researchers have explored the influence of consumers' sex and age, the type of food and segment of food industry targeted at young consumers (Kumpulainen 2018). The results showed that even when the product is not attractive by itself; its origin (a local one) can increase the perceived quality.

Many students eat irregularly, often "on the go", 1-2 times a day, and many of them do not attend canteens. Fast food is becoming more popular among students, while this type of food contains a large amount of fats, salt, modified ingredients, flavorings, colorants, etc. At the same time, American scientists formulated the principles: fast food is not good, and good food is not fast. Malnutrition becomes a serious risk factor for a number of diseases. Statistics show a sharp increase in the number of young people suffering from obesity, sugar diabetes, cardiovascular disease, stroke, etc. These diseases may be prevented if one has a healthy lifestyle and, first, eats properly. That is why rational nutrition is an important part of healthy lifestyle of students (Bidlack 1996, Horacek *et al.* 2013).

Currently, younger people have certain diseases, for instance, one should mention the risks of gastrointestinal disease, cancer, etc. (Cohen *et al.* 2016). To prevent them, one should consume specialized and functional purpose foods, containing physiologically active ingredients, namely, food fibers, peptides, amino acids, vitamins, and minerals.

This negative situation largely may be compensated through properly organized, rational nutrition, optimized for various parameters, including the development of a more informative menu, computer, and online applications for creating a diet (Kim *et al.* 2018, Agapito *et al.* 2018).

3. Data and Methods

Taking into account the data reviewed and to consider this issue from scientific and theoretical perspective, the authors studied the public opinion on the quality and safety of food and cooked products, their range offered by the catering system in the leading Russian economic university and various international universities. For this purpose, the authors carried out marketing research, which included surveying students.

The questionnaire was developed in such a way that it should be easy to understand, not long (including about 15 questions) and distributed automatically among the probable target audience of students at various university departments. Therefore, the results are useful for segmenting the market sector.

The average sample size for testing the product and for trial marketing is 200. In order to minimize the errors in the field study, the sample size is increased. Thus, in the field of food research, as well as that on cooked dishes, the survey usually includes a sample of $n=300-400$ respondents (Dubrovin 2008, Korotkov 2014). However, statistics says that the results of the study under the condition of random implementation are reliable with $n > 30$.

We studied the needs of students with the following majors: technology of production and organization of public catering, commodity science and goods expertise, economics and management at an enterprise, marketing, and management of the various departments of Plekhanov Russian University of Economics, using online technologies and Google Forms (questionnaires).

Students should be regarded as a professional and production group of a certain age, united by specific features of employment and living conditions. Therefore, it is appropriate to classify students into a special segment. Student years are busy and diverse, they are characterized by a great overstrain of the nervous system. The load, especially during examination periods, increases significantly, reaching 15-16 hours per day. Permanent lack of sleep, intense mental work, and violation of routine and eating habits can lead to neuropsychiatric breakdowns.

Vending machines can play a significant role in ensuring effective and healthy catering for students and employees. Some of these machines are already available in higher education institutions, while others can be located there quickly and in optimal quantities, considering the compactness and ease of installation of vending machines. We believe it is also important to introduce a new vending machine, which would serve set lunches.

Developing set breakfasts and lunches, we proceeded from the following approximate distribution of calories of the daily ration (%) with four meals: breakfast – 25%, lunch – 35%, lunner – 15%, dinner – 25%. For five meals a day, the figures are the following: breakfast – 20%, luncheon – 10-15%, lunch – 30-35%, lunner – 10-15%, dinner – 20% (Belyaeva 2015, 2016).

Constructive solutions for the development of a new vending machine should be based on the principle of combining temperature fields from different heat sources, so we have designed a combined oven for heating up set lunches on offer.

4. Findings and discussion

Next, using the method of survey we determined the attitude to catering of students and employees of some Moscow leading universities:

- 1) MSU (Lomonosov Moscow State University, Departments of Journalism and Economics);
- 2) Sechenov University (Sechenov First Moscow State Medical University);
- 3) RSUH (Russian State University for the Humanities);
- 4) FU (Financial University under the Government of the Russian Federation);
- 5) HSE (Research University of the Higher School of Economics);
- 6) Gubkin University (Gubkin Russian State University of Oil and Gas);
- 7) Plekhanov University (Plekhanov Russian University of Economics).

All these universities are either in the top 20 Russian universities, or in the top 20 Moscow universities according to different ratings. The authors of the article considered it reasonable and representative enough to restrict the sample to seven universities.

The total number of respondents estimated 229 people.

At this stage of the research, it was revealed that 15.4% of the respondents (or 35 people) did not use vending machines at all, and only 3.9% (or 9 people) very often (several times a day).

Next, we would like to present a comparative analysis of the organization of catering at well-known universities of the EU and the USA.

Humboldt-Universität zu Berlin (HU Berlin) widely uses a Mensa system which is an electronic environment uniting various dining rooms and cafeterias. The student gets a card and can have discounts for university catering. The site has information on the prices, composition and availability of dishes on the eating-places of the university, and one can leave a comment on the quality of food.

The menu is adjusted according to students' opinions, so that it better meets their eating needs. For instance, the menu includes vegetarian dishes or dishes that do not contain a certain type of food, for example, pork. This card allows a student to have meals in different universities because the system operates all over Berlin. It is convenient and inexpensive. In addition to various dining rooms in which the Mensa system is used, the university also has various cafeterias and cafes, in which a student can dine. The university has vending machines, which sell various drinks and foods, from Coca Cola to sandwiches.

EU Business School mostly has cafes and cafeterias, and there is a discount card, but only for students of this university. Most dishes served can be considered healthy as the university promotes a healthy lifestyle. Students can get full information about the menu on the site and leave their comments there.

The University of Calabria (Official website of the Università de la Calabria 2017) has about 6-8 vending machines. The food range does not include salads and sandwiches, which are more balanced food than sweets. Classes are held from 9:00am to 06:00pm, and all this time vending machines are actively used. In addition to snack machines, this university has coffee machines popular with employees and students due to the high consumption of this drink in Italy (Official website of the University of Calabria 2017).

Catering at the University of Applied Sciences Würzburg-Schweinfurt, FHWS is represented by two vending machines that are placed according to the cascade principle, which ensures the centralization of a wide range of products (Official website of the University of Applied Sciences Würzburg 2016).

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

At Aristotle University of Thessaloniki, the dining room is for students only. People who attend the language course only are not considered students, and therefore, they eat on their own during the first month of training; after this, they can use the dining room. Meals in the dining room are served three times a day, with breakfast from 8:00 to 8:30am, lunch from 12:30 to 04:00pm, dinner from 06:30 to 09:00pm, every day from Monday to Sunday. Breakfast does not vary from day to day and includes the same menu:

- coffee (or milk, tea, juice);
- bread (or toast) with butter and marmalade;
- corn flakes (or cake, boiled egg, scrambled eggs, cheese).

The lunch and dinner menus are developed for one week, but there are three options of set lunches every day, and two options of a set dinner. Thus, for three weeks one can have meals without repeating dishes. Meals are balanced, at lunchtime there is always soup, mostly legume, lentils, despite the fact that people do not very often eat soup in Greece.

In addition to that, the menu includes fish dishes two or three times a week. On Thursday, there are several meat dishes. A variety of salads is always served for both lunch and dinner, for example, including cabbage and carrots (or tzatziki). At lunchtime, there are always fruits, mostly pears, apples, oranges, tangerines, or kiwi. At dinner, they frequently offer sweet dishes like jelly, donuts, or pudding. Most of the students using the dining room in the morning and evening live on their own. Lunchtime is the busiest time for the dining room.

In general, it can be noted that universities all over the world have different systems of catering. There are both traditional types such as dining rooms, cafeterias, board and lodging, or vending machines. A specific feature of catering at universities is providing this or that form of discounts (Gajour 2017).

Considering Plekhanov University in more detail, we may say that it is one of the leading universities in Russia. More than 70,000 students study at university departments, enrolled at various programs of higher education. Of these, over 20,000 students are studying in the main university (Moscow). The number of the teaching staff in the head university exceeds 1,800 people.

Catering system in Plekhanov University includes a number of dining rooms, cafes, lunch counters, a restaurant and various vending machines located in the university's academic buildings.

To assess the efficiency of catering in Plekhanov University, we conducted surveys with the sample size of $n \approx 170$.

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

The results obtained demonstrate that the majority of students, namely 43%, use catering services offered by Plekhanov University, 21% of the respondents attend eating places several times a month, and 29% of the students – several times a week, 7% of the respondents do not buy food at the university, but attend other eating places, or bring food with them.

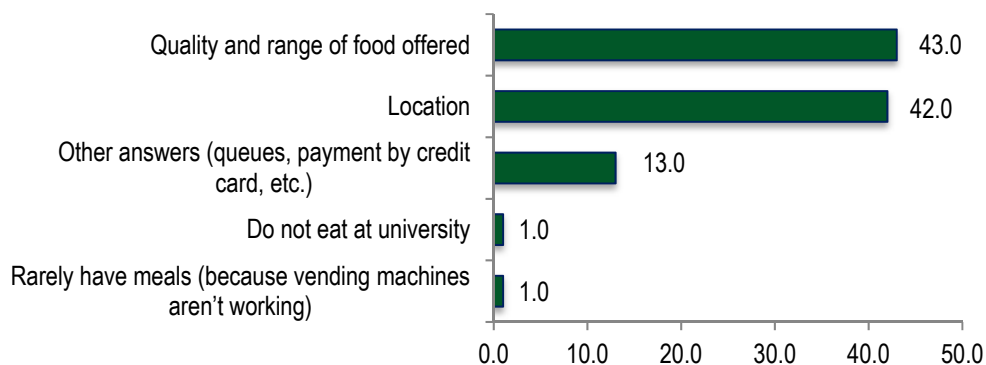
The analysis showed that the possible reasons for this are inconvenient location of eating places; high prices; a narrow range; insufficiently high food quality; limited break time between classes.

Answering the question “What other eating places would you like to see at the university?” the students mentioned the following: automatic machines with frozen yogurt, a cafe with healthy food, a cafe with desserts, and a mini-pizzeria.

Having analyzed the target audience, mostly 18-30 year-olds and studying at Plekhanov University, we can establish the following.

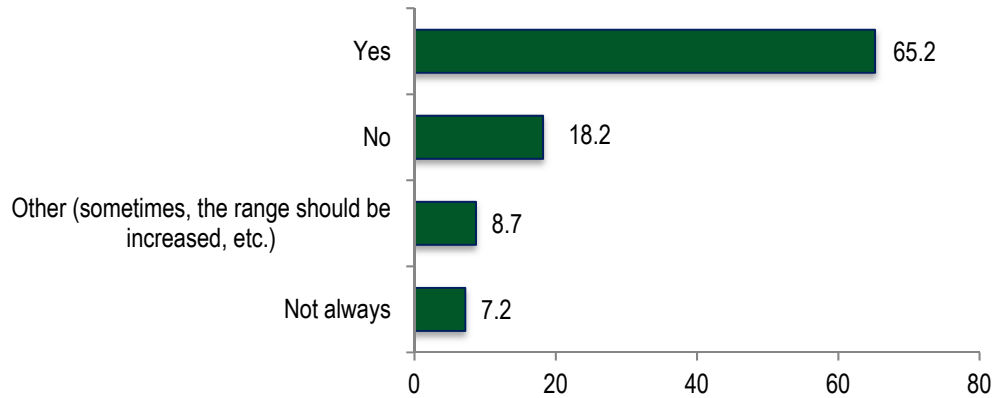
The majority of the respondents choose dishes according to their quality and range (43% of the respondents), location of an eating place (42%); some answers stated regardless of the location of the eating place at the University and others (these answers made up for about 1.0%), see Figure 1.

Figure 1. Distribution of answers to the question “Which factor influences your choice of an eating place in Plekhanov University?”



In most cases (65%) the respondents were satisfied with the quality of meals offered at the eating places of Plekhanov University. The negative answer was given by 18.9% of the students. There were other answer options, but their shares were by far less significant (Figure 2).

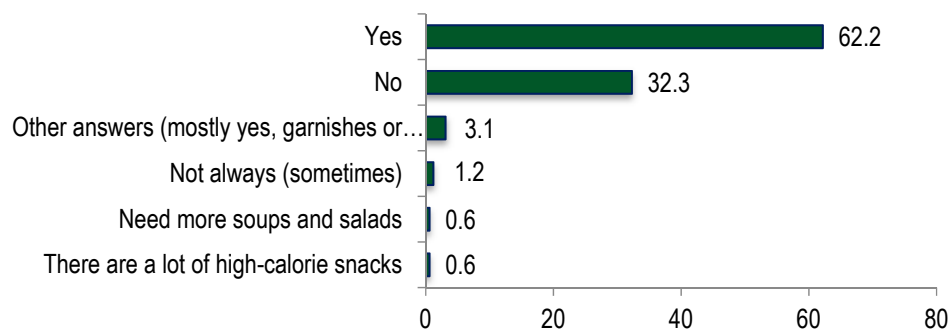
Figure 2. Distribution of answers to the question "Are you satisfied with the quality of meals offered at the eating places in Plekhanov University?"



The respondents noted that the range of food met their expectations: 62.2% of the total number of those surveyed gave a positive answer, in 32.3% of cases the answer was negative, it was noted that snacks with high calorie value and other food like this should not be included in the menu, see Figure 3.

Answering the question about the most frequently consumed foods, the respondents said that they prefer hot dishes, salads, and drinks. Soups were chosen by 18% of the respondents, pastries – 24%, other types of food: about 0.6% of respondents would like to be offered sandwiches, rice snacks, sushi, while the lowest number of 17% of the respondents prefer confectionery.

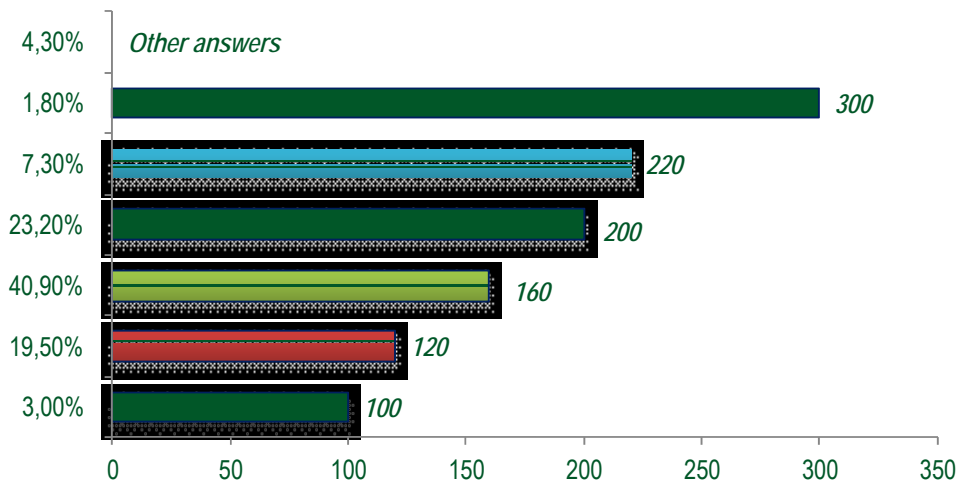
Figure 3. Distribution of the answers to the question "Are you satisfied with the range of meals offered at the eating places in Plekhanov University?"



The majority of the respondents would like to have a free choice of dishes; some would take a set lunch or breakfast, and drinks. Some students mentioned the free choice of dishes, as well as an opportunity to choose meals like in a buffet, and some options for set lunches and breakfasts, preferably including some national dishes, for example soups, second courses, confectionery, and sour-milk drinks.

One of the important factors – a social one – is the price of set meals. As we discovered, the optimal price range is the following: 160 rubles ($\approx 41\%$ of the answers), 200 rubles ($\approx 23\%$), 220 rubles (7%), etc., while the average price estimated 183 rubles (Figure 4).

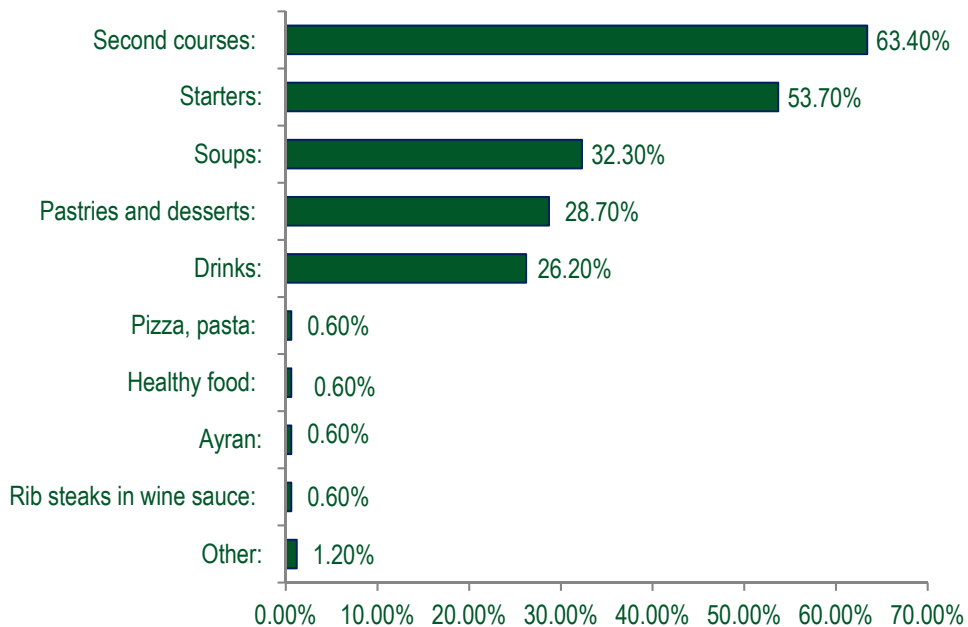
Figure 4. Distribution of answers to the question “What is the optimal price of a set lunch?” (rubles)



There were some opinions that a set meal should include various combinations of soups, second courses, starters, snacks, salads, drinks, and sweets. The preference of certain dishes such as pizza, pasta, sushi, healthy food without spices was mentioned by less than 1% of the respondents (Figure 5).

Some students named national dishes as preferable: okroshka, gazpacho, beef wellington, American pie, shepherd’s pie, hot carrot salad with tofu skin, Turkish delight, churchhela, drinks: mulled wine, kvass, and cider. The results showed a certain demand for Japanese cuisine: onigiri, rolls, and sushi.

Figure 5. Distribution of answers to the question “What dishes, national foods would you like to be offered?”



The survey also revealed the demand for accompanying items: wet towel wipes, chewing gum, toothpicks with mint flavor, etc.

The analysis of data on automation of catering showed that about 30.5% of the respondents do not use vending machines for various reasons.

A significant part of consumers ($\approx 15\%$) used these machines rarely (several times a week) or very rarely (several times a month – about 42%). About 8% of the respondents used these machines often (once a day). The shares of other answers are insignificant (0.6%).

We conducted a survey among the consumers of the eating places at Plekhanov University and established the following. According to the questionnaire, when answering the question “What vending machines would you like to see in Plekhanov University?”, 77% of the students mentioned vending machines selling pizza or set lunches.

Having analyzed the demand and suggestions, we developed set lunches and breakfasts that reflect national traditions and comply with the norms for nutrition and biological value, as well as a daily calorie intake of students. These meals are to be packaged in plastic trays and to be sold through a vending machine with a built-in microwave oven developed by us. The dishes of set breakfasts and dinners are heated using electrophysical methods of heating: infrared, microwave ones and combined types: microwave + infrared heating; infrared + microwave heating.

A patent application on the developed design of the vending machine No. 2017137620 of the Russian Federation of 27.10.2017 was submitted by Belyaeva *et al.* (2017).

Examples of the developed set lunches. The set is designed for students aging 18-30 years old; dishes are chosen in accordance with the preferences of students, taking into account national traditions, with a focus on second courses as they have a higher calorie value, also we calculated the prime cost and price of these meals (Table 1).

Table 1. A set lunch for male and female students

Dish	Serving size, g	Proteins, g	Fats, g	Carbohydrates, g	Energy value, kcal/100 g	Selling price, rub.
Set 1 (male students)						
Chicken Olivier salad	150	8.1	26.7	42	518	50.0
Potato and mushroom cream soup	350	23.52	50.64	2.62	298	84.0
Classic Ajapsandal	250	14.7	30.3	17.4	232	100.0
Strawberry drink	200	0	0	22.2	86	25.0
Achma	100	42	27	31	340	95.5
Borodinsky bread	50	20.45	30.45	0.65	104	7.5
		88.32+20.45	134.64+30.45	115.22+0.65	1474+ 104 (bread)	
Set 2 (female students)						
Beetroot salad with cheese and garlic	100	7.1	17.1	7.8	211.6	50
Cauliflower cream soup	210	3.78	2.73	9.87	74.9	45
Turkey in boiled sauce with mushrooms and rice	200	28.8	30.8	67	644	135
Black tea	200	0	0	0.6	1.6	20
Wheat bread	20	1.84	0.64	9.82	53	2
Total		41.52	51.27	95.09	985.1	252
Set 3 (female students)						
“Crab” salad	150	9.3	13.5	33.75	294.95	
Mushroom noodles soup	250	3.2	3	14.43	98.5	
Porcini risotto	150	18.8	1.5	120.8	444	
Cowberry drink	200	0.1	0.1	21.84	82.8	
Total		31.4	18.1	190.8	920.25	

Thus, considering all the requirements for food safety, its quality, convenient location of eating places, the service and user-friendly equipment, including vending machines, it can be stated that there is a great potential for the development of healthy catering in a university.

Conclusion

Research findings let us conclude that Russian and international universities have different approaches to the organization of catering. The range of food and accompanying items varies significantly.

Given the huge number of students in the population structure of developed countries, as well as stressful working conditions, including examination periods, end-of-course assessment, and organization of healthy nutrition is an extremely relevant problem, which is currently being discussed at the level of the Russian Student Union, in particular, the standard of social lunches for students.

Most universities adopt technology that is close to fast food. The organization of catering does not satisfy students and all consumers in general in terms of environmental friendliness, quality, and range of dishes.

The problem can be solved through vending technologies, providing standardized and healthy food, the quality indicators of which can be automatically controlled. A significant advantage of vending machines is the ease of installation, operation, which makes it possible to locate them in the places of highest student traffic and gives the opportunity to use optimally short periods between classes, as well as to sell set breakfasts and lunches through them.

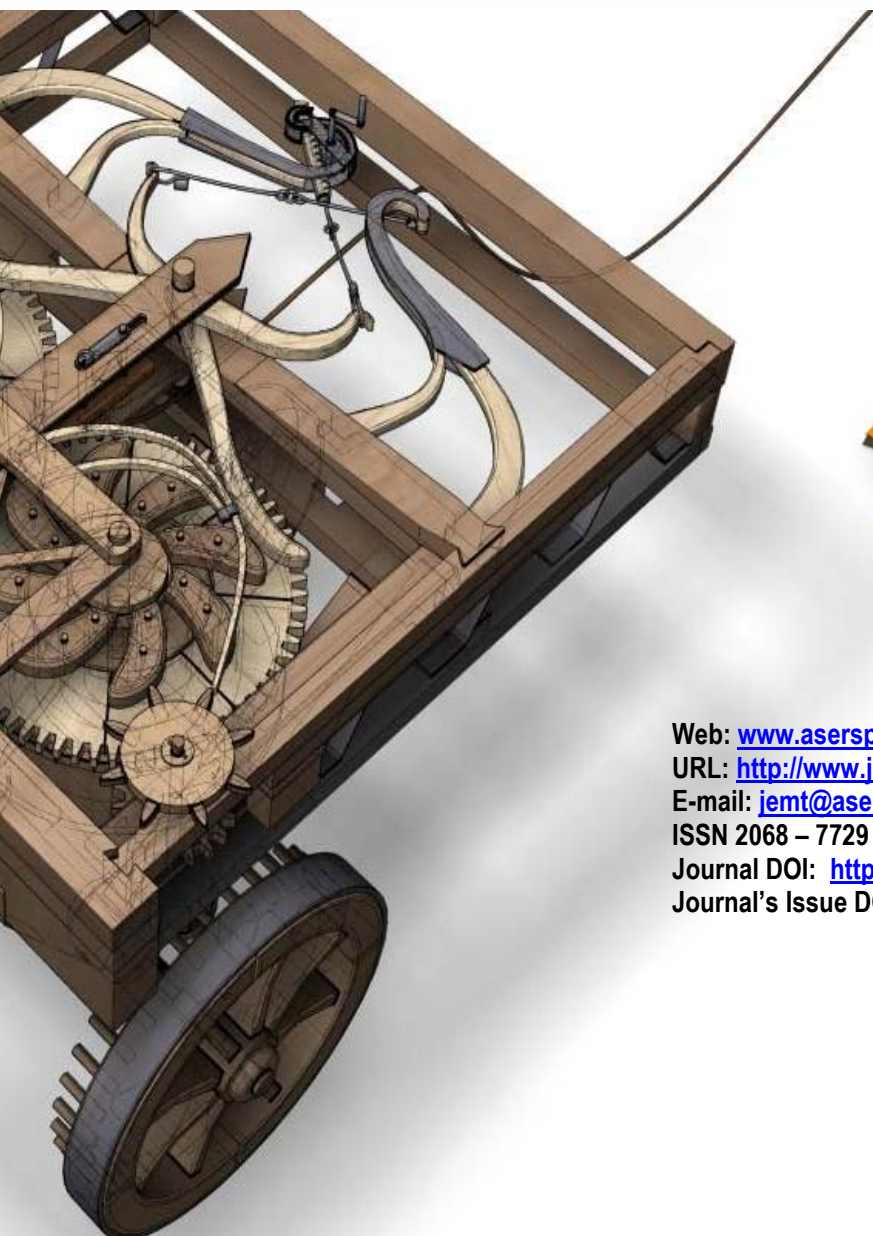
Therefore, the research conducted makes it possible to optimize the catering system in universities.

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