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RESEARCH ON THE PHYSICO-CHEMICAL AND MICROBIOLOGICAL QUALITY OF FAST FOOD PRODUCTS

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Abstract

This study aimed to monitor the quality of food products distributed in fast food restaurants. Physico-chemical and microbiological analyses were conducted on burger and sandwich products containing beef, chicken, turkey, fish, cheese, as well as on sweet desserts such as apple juice, ice cream, and milkshakes. Additionally, the equipment and utensils used in the preparation of these products were checked microbiologically. The ice and drinking water from the supply network, used in the preparation process of these products, were tested both microbiologically and physic-chemically.

Key words: *burger, dessert, meat, physico-chemical parameters.*

INTRODUCTION

Human nutrition represents one of the fundamental pillars of its construction. Health and individual balance are directly correlated with food. Adopting an adequate diet, along with other correct behavioral elements, leads to a healthy life. The human body remains healthier when the diet is more balanced. A diversified and individualized diet (based on lifestyle, gender, activity level, health status), correctly composed in terms of calories and respecting the optimal ratio of main substances (carbohydrates, proteins, lipids, dietary fibers), can be considered a balanced diet. In supplying the population with high biological value food products, products of animal origin play a particularly important role, with meat and meat derivatives being a priority. In the context of the observed increase in meat products production, special attention must be given to the quality of the end products. Quality control of the end products should be carried out as quickly as possible to avoid any possible non-conformities (Banu et al., 1980; 1985).

In this context, the present study aimed to monitor the quality of fast food products from a physico-chemical and microbiological perspective. It is well known that not all food is beneficial to the human body. Today, phrases like "unhealthy food" or "healthy food" have almost entered everyday speech. The quality of food depends on both its source and the way it is processed, whether it is done industrially or at home (Ciocârlie et al., 2002).

The foods available on the market today can be categorized as natural, semi-natural, or even semi-synthetic. Among all these, it is well known that the healthiest foods are those of natural origin, which do not contain synthetic additives, have not undergone industrial refining processes, and have not been excessively processed from a culinary perspective (Banu et al., 2009).

Unprocessed natural foods, typically of plant origin and known as raw foods, have particular importance for human health. Food is not just a source of matter and energy; it also carries information (Marcu et al., 2008).

Humans, like any other beings on Earth, are part of the food chains, which means that through their food, they exchange information, matter, and energy with the environment. The emerging field of nutrigenomics has provided evidence of how food influences the genetic information encoded in our DNA and RNA chains. Detached from nature and immersed in a synthetic civilization, modern humans risk severely distorting not only their immediate health but also the fundamental material of

their chromosomes through highly processed food products, with consequences that are still incalculable for both themselves and their descendants. Thus, the act of nourishment becomes a matter of great responsibility for the future of the entire human species, as we already live in a world where children are sicker than their parents and, in far too many cases, die before them. Foods, depending on their origin, industrial processing technology, and culinary preparation methods, have distinct compositions, both in terms of the quantities of bioactive compounds and their ratios. In addition to their chemical composition, culinary preparations are distinguished by the ingredients used.

The criteria for classifying foods are extremely varied. From the multitude of classifications, I have chosen a few more conclusive ones so that anyone can get an idea about food. Food is edible substances that contain a certain number of organic elements such as proteins, lipids, carbohydrates, as well as minerals and vitamins. They also consist of water and indigestible substances such as dietary fibers.

Based on their origin, foods can be broadly categorized into plant-based and animal-based. Furthermore, both plant-based and animal-based foods can be divided into multiple groups. Together or separately, these foods have been categorized over time in various forms, upon which numerous diets have been constructed (Mencinicopschi & Cironeanu, 2006; Ciocârlie et al., 2002).

There are also classifications that focus on the value of other nutrients such as carbohydrates and lipids, both in terms of quantity and assimilation power. Additionally, classifications have been developed based on the energy value (caloric content) of food. Although there are sophisticated categorizations in this regard, in general, we can divide food based on its consistency. Thus, we have light foods (snacks) and substantial foods (energy-rich meals).

MATERIALS AND METHODS

Approximately one-third of the ingredients used in Fast Food units in Romania come from local suppliers, such as buns and bread slices, pork ham, salads, jams, apple juices, eggs, and milk. The rest of the ingredients are imported, such as beef, potatoes, chicken and turkey meat, fish, and cheese.

The sampling should be carried out by qualified personnel in accordance with the applicable regulations, from slaughterhouses, meat processing units, distribution networks, and public and collective administration units. Sterile instruments should be used, and each sample should be placed in a sterile container, parchment paper, or new plastic bags. Quantitatively, the proportions specified in the relevant legislation should be respected.

Depending on the product being analyzed, the sampling of the samples was conducted as follows:

- for boneless meat products (e.g., smoked beef, beef and pork pastrami, catering products), thicker portions or slices were collected, including both the surface layers and the deeper layers;
- for not portioned minced meat, samples were collected from each container;
- for meat and meat products packaged as individual units with a certain weight or meat pieces not exceeding 2 kg, 300 g was collected;
- for packaged meat products in membranes and meat products in pieces, whole packaging or pieces were collected;
- for salted or smoked meat products, pieces from the vicinity of the bone were collected.

Packaging of the samples

Carcasses or pieces exceeding 2 kg are packaged in plastic bags, which are sealed and labeled.

Samples from pieces weighing less than 2 kg, if they are in properly sealed packaging, do not require additional packaging; otherwise, they must be packaged in a sterile and tightly closed manner to ensure the possibility of sealing and labelling.

The samples were appropriately labelled, specifying the name and address of the producing unit, the product name, the place and date of sampling, the lot number, and the number of the sampling protocol. The protocol was signed by the person who collected the sample and a representative of the interested party or parties.

Transportation was ensured in a timely manner and under optimal temperature conditions.

Frozen samples were stored in the refrigerator at a maximum temperature of 5°C for a maximum of 12 hours for thawing.

The microbiological analysis of fast-food products under study involved the determination of microorganisms such as *Listeria monocytogenes*, *Salmonella*, and *Enterobacteriaceae*. For water, ice, and the equipment used in the preparation of fast-food products, determinations were made for E. coli, Total Mesophilic Aerobic Bacteria (TMAB), Enterobacteriaceae, and Coliform Bacteria. (Diaconescu & Șuler, 2017; Ionescu & Diaconescu, 2010)

Chemical analysis for tap water samples from the network. The determination of total residual chlorine is based on the iodometric method, which involves the oxidation of potassium iodide by chlorine and the titration of the elemental iodine formed with sodium thiosulfate. Total hardness can be determined by several methods, with the most commonly used one being the complexometric method. The principle of the method lies in the ability of calcium and magnesium ions to form stable complexes with complexon III (disodium salt of ethylenediaminetetraacetic acid) at pH 10. The identification of nitrites and nitrates is based on the use of the GRIESS reagent (a solution of sulfanilic acid and naphthylamine in acetic acid) (Hodosan et al., 2007).

Colony count method or pour plate method

Prepare serial dilutions: 10 g of each product was cut it into small pieces and mixed well with 90 ml of peptone water, to ensure proper dilution. This process is repeated for multiple dilutions, ranging from 10-1 to 10-6, using a new pipette for each dilution and transferring the appropriate amounts to obtain the next dilution. 2 ml from each dilution were distributed into Petri dishes (2 plates per dilution), using the same pipettes used for homogenizing the dilutions. 14-15 ml of molten glucose and yeast extract agar cooled to 45-50ºC were poured over the inoculated plates and mixed the inoculum well with the medium by gently swirling the plates, then allow them to solidify on the benchtop.

The plates were inverted and incubated at a temperature of 30˚C for 48 hours.

Counting and expressing the results was done using a magnifying glass.

TMAB was calculate by multiplying the colony count by the dilution factor and expressing it as colony-forming units per milliliter (CFU/ml) or colony-forming units per gram (CFU/g) if the sample was initially diluted in a known volume of diluent.

The presence and number of coliform bacteria, including the *Escherichia coli* (*E. coli*) species, can be determined using a method called the Most Probable Number (MPN) test.

1 ml of the homogenized product is inoculated and each dilution in test tubes containing one of the enrichment media (Kessler);

Multiple tubes are prepared with different dilutions of the sample, ranging from 10-1 to 10-5. The inoculated tubes are incubated at 37°C for 24 hours. The selective medium encourages the growth of coliform bacteria and suppresses the growth of other bacteria. The appearance of gases in the Durham tube is monitored daily;

If gas is produced, indicating the presence of coliform bacteria, a confirmation test is performed to identify the presence of E. coli. This involve subculturing the positive tubes onto a differential medium such as Levine agar poured into Petri plates and incubation at 37ºC for 24 hours; Colonies grown on Levine agar are checked. E. coli shows dark colored colonies, with a surface with a metallic luster and a golden-green reflex. The other coliform bacteria show dark blue colonies without metallic luster or atypical, opaque, mucous, pink colonies (*Klebsiella*), with a gray-brown center. Colonies specific to coliform bacteria must be differentiated from Salmonella colonies, which are transparent;

For confirmation from two or more characteristic colonies of *E. coli*, a culture is sown in three test tubes with the following media:

- a test tube with BBLV (or lauryl sulfate) and fermentation tube;
- a test tube with tryptonized water heated to 45ºC;
- a test tube with inclined nutrient agar;

The test tubes with the seeded culture media will be incubated at 45ºC for 24 hours. The temperature of 45ºC acts selectively on *E. coli*, favoring the germ in competition with the associated microflora;

After incubation, the cultures are examined for the presence of gases appearing in the Durham tube in the test tube with BBLV medium (Brilliant Green Bile Lactose) and for the presence of indole in the test tube with tryptonized water seeded and incubated by adding a few drops of Kovacs reagent (red ring on the surface of the medium) . If cultures are positive, it is considered *E. coli* confirmation;
From the culture present in the slanted agar, this bacterium is further tested for enteropathogenicity by the rapid agglutination reaction on the slide with polyvalent anti-*E. coli* serum and the sero-group is established using monovalent anti-"O-B" serum.
The genus *Salmonella* belongs to the family Enterobacteriaceae and the isolation and identification of bacteria from the genus Salmonella is done in accordance with SR ISO 65-79/1997.
The pre-enrichment step involves inoculating the samples into a non-selective liquid medium (buffered peptone water). 25 g of the product is inoculated into 225 ml of pre-enrichment medium, and it is incubated at 35 or 37°C for 16-20 hours. This method is applied for frozen or dehydrated products.
The enrichment step is carried out by transferring the sample to two selective enrichment media: Rapaport-Vassiliadis medium, incubated at 42°C for 24 hours, and selenite cystine broth, incubated at 35-37°C for 24-48 hours.
The isolation step involves inoculating two selective media with the cultures obtained from the enrichment step. The following media were used: phenol red agar and brilliant green-Edel Kampelmacher agar.
Incubation is carried out at 35-37°C for 20-24-48 hours. Only the characteristic colonies developed on the selective isolation media are taken into consideration.
In the confirmation stage, presumptive positive colonies of *Salmonella* were tested for biochemical and serological characteristics. Incubation was carried out at 35-37°C on multipurpose media, including TSI (triple sugar iron agar), MIU (motility, indole, urea), and MILF (motility, indole, lysine decarboxylase, phenylalanine deaminize).
After incubation, the inoculated agar medium is examined.
After the biochemical tests, serological confirmations are performed.

RESULTS AND DISCUSSIONS

Microbiological analysis of the 5 types of Fast Food products examined involved the identification of bacteria from the genus *Listeria monocytogenes, Salmonella,* and *Enterobacteriaceae* (Table 1).

Table 1. The results of the microbiological analysis conducted on the analyzed fast food products

Microbiological parameter	Unit	Reference analytical method	Analised products					
			beef burger	chicken burger	cheese burger	fish burger	turkey burger	pork sandwich
Salmonella	CFU/ 25 g	SR ISO 6579-1:2017	Absent	Absent	Absent	Absent	Absent	Absent
Enterobacteriaceae	MPV/g, maxim	SR ISO 21528-1:2017	0	0	0	0	0	0
Listeria monocytogenes	CFU 5 g, maxim	SRN EN ISO 11290-1:2017	Absent	Absent	Absent	Absent	Absent	Absent

CFU - colony-forming unit
MPV - mean platelet volume

The results of the microbiological analyses conducted by the Laboratory of Physicochemical and Microbiological Analyses for the products under study indicate that all the analysed varieties met the sanitary and veterinary requirements for food safety. The results of the microbiological analyses conducted on some equipment and utensils used in the preparation of FAST FOOD products, specifically the Total Mesophilic Aerobic Bacteria (TMAB) count and Coliform Bacteria, are presented in Table 2.

Table 2. Results of microbiological analyses on equipment and utensils used in fast food preparation

Microbiological parameter	Unit	Reference analytical method	Analysed equipment and utensils			
			Kitchen dressing table 10/10 cm^2	Serving spoon	Tomato cutter blade 10/10 cm^2	Work apron 10/10 cm^2
Total Mesophilic Aerobic Bacteria	CFU/cm^2 CFU/ml	SR EN ISO 4833-1:2014	< 1/cm^2	< 1/ml	2/cm^2	2/cm^2
Coliform Bacteria	CFU/10 cm^2 CFU/ml	SR ISO 4831:2009	Abs/10 cm^2	Abs/ml	Abs/10 cm^2	Abs/10 cm^2

The analysis of these microbiological parameters indicates that the risk of contamination with pathogenic microorganisms in utensils and production equipment is manageable, both through the implementation of sanitation programs and the education of workers in the respective units. The results of the microbiological analyses conducted on water and ice used in the preparation of FAST FOOD products, specifically Escherichia coli, Coliform Bacteria, and Total Germ Count, are presented in the Table 3.

Table 3. The results of the microbiological analyses conducted on drinking water and ice used in the preparation of FAST FOOD products

Microbiological parameter	Unit	Reference analytical method	Prepared ice 1×500 l	Purchased ice 1×500 l	Tap water
Escherichia coli	CFU/100 ml	SR EN ISO 9308-1:2015	0	0	0
Coliform bacteria	CFU/100 ml	SR EN ISO 9308-1:2015	-	-	0
Total Germ Count	CFU/ml	SR EN ISO 4833-1:2014	190	7	-

Drinking water from the network and the ice used in the technological process of obtaining the studied FAST FOOD products meet the sanitary-veterinary requirements for food safety. Physico-chemical analyses were also performed on samples of drinking water from the network. The results of these analyses are presented in Table 4.

Table 4. Physico-chemical parameters determined on samples of tap water from the network

Specification	Reference analytical method	Obtained values	Maximum allowed concentrations
Nitrites (mg/l)	SR ISO 7800-3/2000	0.935	Max. 50
Nitrate (mg/l)	SR EN20777/2002	0.0246	Max. 0.5
Chlorides (mg/l)	SRISO9297/2001	20.10	Max. 2500
Total hardness (d)	SR ISO 6059/2008	6.75	Min. 6.
Turbidity (NTUs)	SR EN ISO 7027/2001	0.44	Max. 5
Conductivity (µS/cm, 20^{0}C)	SR EN 27888/1997	252.6	2500
ph units	SR EN ISO 10523/2012	7.7	6.5-9.5

NTUs - Nephelometric Turbidity Units

The analysis of the values presented in this table highlights that the water samples subjected to the study met all the analyzed parameters, thus the tap water meets all the drinking water requirements. Microbiological analysis was also conducted on some sweet dessert preparations such as apple juice, chocolate ice cream, and chocolate syrup shake. The results are presented in Table 5 and represent the average of five determinations.

Table 5. Results of microbiological analysis performed on sweet dessert preparations.

Microbiological parameter	Unit	Reference analytical method	Dessert type		
			Chocolate ice cream (5×250 g)	Shake with chocolate syrup (5×250 g)	Apple juice
Escherichia coli	CFU/ml	SR EN ISO 9308-1:2015	<10	<10	-
Coliform bacteria	MPV/g	SR ISO 21528-1:2017	<10	<10	0
Total Germ Count	CFU/ml	SR EN ISO 4833-1:2014	6×10	9.4×10^2	-

Also in this case, the results of the microbiological analysis performed on the three types of sweet dessert preparations studied indicate that all the analyzed varieties met the sanitary-veterinary requirements for food safety.

CONCLUSIONS

Physicochemical and microbiological analyses were conducted on both fast food products and sweet dessert products. Additionally, the microbiological analysis was performed on the equipment and utensils used in the preparation of these products, as well as on the ice and tap water (both microbiologically and physicochemically) used in the technological process of producing the studied fast food products.

For all analyzed fast food products, the manufacturing recipes align with those specified in the specialized literature for these types of meat preparations. From an ingredient perspective, all the studied products are manufactured according to the recipe and working instructions.

Beef, chicken, turkey, and fish used in the products come from a network of farms where animals are fed non-genetically modified cereals, grains, and grass. These undergo 31 quality control points from the farm to the distribution center, and 3 control points in restaurants to monitor the quality and safety of the raw materials.

The monitored and analyzed microbiological parameters for the studied products meet the required standards, allowing the examined products to be marketed and consumed without restrictions.

Both tap water and ice used in the technological process of producing the studied fast food products meet the sanitary-veterinary requirements for food safety.

From a physicochemical perspective, the tap water used in the respective establishments meets all the drinking water standards.

The analysis of these microbiological parameters indicates that the risk of contamination with pathogenic microorganisms is manageable through the implementation of sanitation programs and the education of workers in the respective units.

Proper preparation of products and adherence to food safety practices are daily concerns food units.

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