XXIV INTERNATIONAL
ECO-CONFERENCE® 2020
23–25th SEPTEMBER

XI SAFE FOOD

PROCEEDINGS

NOVI SAD, SERBIA

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SAFE FOOD

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2020.

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– Russian State Agrarian University–MTAA, Moscow, Russian Federation
– International Independent Ecological–Politicology University in Moscow, Russian Federation
– Institute for Field and Vegetable Crops Novi Sad, Novi Sad, Serbia
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Official host of the XX International Eco-Conference® 2018
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THE ECOLOGICAL MOVEMENT OF THE CITY OF NOVI SAD: AN IMPORTANT DECISION OF ITS PROGRAMME COUNCIL

Since 1995, the Ecological Movement of the City of Novi Sad organizes "Eco-Conference® on Environmental Protection of Urban and Suburban Areas", with international participation. Seven biennial conferences have been held so far (in 1995, 1997, 1999, 2001, 2003, 2005, 2007, 2009, 2011, 2013 and 2015.). Their programs included the following environmental topics:

Session 1: Environmental spheres: a) air, b) water, c) soil, d) biosphere
Session 2: Technical and technological aspects of environmental protection
Session 3: Sociological, health, cultural, educational and recreational aspects of environmental protection
Session 4: Economic aspects of environmental protection
Session 5: Legal aspects of environmental protection
Session 6: Ecological system projecting (informatics and computer applications in the field of integrated protection)
Session 7: Sustainable development of urban and suburban settlements-ecological aspects.

Conference participants have commended the scientific and organizational levels of the conferences. Conference evaluations have indicated that some aspects are missing in the conference program. In addition, since a team of conference organizers was completed, each even year between the conferences started to be viewed as an unnecessary lag in activity.

Eco-Conference® on Safe Food

With the above deliberations in mind, a decision was made that the Ecological Movement of the City of Novi Sad should embark on another project – the organization of Eco-Conferences® on Safe Food. These Conferences were planned to take place in each even year. Preparations for the first Eco-Conferences® on safe food started after the successful completion of the Eco-Conference® '99.

So far four Eco-Conferences® have been held (in 2000, 2002, 2004, 2006, 2008, 2010, 2012 and 2014.) focusing this general theme.

Theme of the Eco-Conference®

By organizing the Eco-Conference® on Safe Food, the organizer wishes to cover all factors that affect the quality of human living. Exchange of opinions and practical experiences should help in identifying and resolving the various problems associated with the production of safe food.

Since 2007 Eco-Conference gained patronship from UNESCO and became purely scientific Conference.

Objectives of the Eco-Conference®

– To acquaint participants with current problems in the production of safe food.

– To make realistic assessments of the causes of ecological imbalance in the conventional agricultural production and the impact of various pollution sources on the current agricultural production.

– Based on an exchange of opinions and available research data, to make long-term strategic programs of developing an industrialized, controlled, integral, alternative and sustainable agriculture capable of supplying sufficient quantities of quality food, free of negative side effects on human health and the environment.

Basic Topics of the Eco-Conference®

Basic topics should cover all relevant aspects of the production of safe food.

When defining the basic topics, the intention was itemize the segments of the production of safe food as well as the related factors that may affect or that already have already been identified as detrimental for food safety and quality. The topics include ecological factors of safe food production, correct choice of seed (genetic) material, status and preparation of soil as the basic substrate for the production of food and feed, use of fertilizers and pesticides in integrated plant protection, use of biologicals, food processing technology, economic aspects, marketing and packaging of safe food.

To paraphrase, the envisaged topics cover the production of safe food on the whole, individual aspects of the production and their mutual relations, and impact on food quality and safety.

Sessions of the Eco-Conference®

1. Climate and production of safe food.
2. Soil and water as the basis of agricultural production.
3. Genetics, genetic resources, breeding and genetic engineering in the function of producing safe food.
4. Fertilizers and fertilization practice in the function of producing safe food.
5. Integrated pest management and use of biologicals.

6. Agricultural production in view of sustainable development
7. Production of field and vegetable crops.
8. Production of fruits and grapes.
9. Lifestock husbandry form the aspect of safe food production.
10. Processing of agricultural products in the framework of safe food production.
11. Economic aspects and marketing as segments of the production of safe food.
12. Food storage, transportation and packaging.
13. Nutritional food value and quality nutrition.
14. Legal aspects of protecting brand names of safe food.
15. Ecological models and software in production of safe food.

Attempts will be made to make the above conference program permanent. In this way will the conference become recognizable in form, topics and quality, which should help it find its place among similar conferences on organized elsewhere in the world.

By alternately organizing conferences on environmental protection of urban and suburban areas in odd years and conferences on safe food in even years, the Ecological Movement of the City of Novi Sad is completing its contribution to a higher quality of living of the population. Already in the 19th century, Novi Sad was a regional center of social progress and broad-mindedness. Today, owing first of all to its being a university center, Novi Sad is in the vanguard of ecological thought in this part of Europe.

It is our duty to work on the furtherance of the ecological programs of action and, by doing so, to make our contribution to the protection of the natural environment and spiritual heritage with the ultimate goal of helping the population attain e higher level of consciousness and a higher quality of living.

Director of the Ecological
Movement of Novi Sad
Nikola Aleksic

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PRODUCTION OF FIELD AND VEGETABLE CROPS

FRUITS AND GRAPES PRODUCTIONS

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PROCESSING OF AGRICULTURAL PRODUCTS IN THE FRAMEWORK OF SAFE FOOD PRODUCTION

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NUTRITIONAL FOOD VALUE AND QUALITY NUTRITION

LEGAL ASPECTSOF PROTECTING BRAND NAMES OF SAFE FOOD

ECOLOGICAL MODELS AND SOFTWARE IN SAFE FOOD PRODUCTION

ECO-CONFERENCE® 2020
ECOLOGICAL MOVEMENT OF NOVI SAD

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HEALTH SAFE FOOD – RISK OF CARCINOGENIC SUBSTANCES

Abstract

Food is a substance must be taken into the human organism in order to preserve homeostasis. Foods can be of plant, animal and mineral origin, and by chemical composition belong to carbohydrates, proteins, fats, vitamins and minerals. However, various toxic and carcinogenic substances can be found in food, which originate from natural sources, the environment, or are formed during the food processing process. In the production of health safe food, it is extremely important to reduce their amount in food or eliminate them completely. In this paper, carcinogenic substances, which can be found in food and pose a risk to food safety are considered.

Key words: *food safety, carcinogenic substances, carcinogenic effect, pollutants*

INTRODUCTION

Food is a substance that must be taken into the human organism in order to preserve homeostasis. Food health monitoring is the responsibility of the World Food Programme and the Food and Agriculture Organization (FAO) within the United Nations. The main goal of these organizations is to improve food production and the elimination of hunger in the world, and one of the basic human rights is the right to food. Foods can be of plant, animal and mineral origin, and according to their chemical composition, they belong to carbohydrates, proteins, fats, vitamins and minerals. Plant-based food products form the basis of food chains in almost all ecosystems on the planet and have exceptional nutritional value and positive impact on human health, thanks to their

high content of proteins, vitamins, flavonoids, phytosterols, dietary fibers and antioxidants (antimutagenic, anticancer and anti-inflammatory effects). Among foods of plant origin, cereals are a very important source of starch and other carbohydrates, which is why they are used in human and animal nutrition. Cereals (family Poaceae) are a source of minerals such as manganese, magnesium, copper, phosphorus, potassium and zinc, which are important for the proper functioning and development of body tissues, glands and enzymes. Regular intake of cereals helps prevent digestive tract diseases, hypertension, cardiovascular disease and cancer (Popović, 2001; Popović et al., 2015; Šarčević-Todosijević et al., 2019; Kolarić et al., 2019; Živanović et al., 2017). However, on the other hand, it has been proven that certain substances from food can play a significant role in certain pathological processes in the human body, and even in carcinogenesis. Carcinogenic chemicals that can be found in food, come from natural sources, the environment, or are formed during the food processing process. Also, a significant number of chemical compounds are added to food in order to improve the smell, taste, color or extend the shelf life. These substances can have mutagenic and carcinogenic effects in the human organism.

In this paper, carcinogenic substances, which can be found in food and pose a risk to food safety are considered.

CARCINOGENIC FOOD CONTAMINANTS

Cancer is one of the leading causes of death in the world. During malignant transformation, cells undergo morphological and functional changes, which enable them to acquire new properties. The most significant new trait acquired by a malignant cell is immortality. Thanks to the new properties, malignant cells make maximum use of nutritional and energy resources, adapting the surrounding tissues to their needs, overcoming them in number and finally occupying new organs and tissues for their growth. Experiments performed on cells transformation *in vitro*, using DNA isolated from a cancer cell, unequivocally indicated the genetic mechanisms of carcinogenesis. However, the complex changes that occur during cell transformation cannot be the result of just one gene mutation or altered activity of just one gene. Based on empirical data confirmed in a number of experimental models, it has been concluded that mutation or activation of one gene is not sufficient, but may be a trigger for a cascade process, i.e. mutation or activation of a number of other genes. It is assumed that at least two or more mutations are necessary for physiologically normal cells to become malignant. There are three types of evidence for this claim: evidence based on DNA analysis from different stages of carcinogenesis; evidence based on increased expression in cell cultures and experimental animals of oncogenes, i.e. genes encoding proteins, capable of inducing carcinogenesis in a living organism; as well as evidence from epidemiology. Namely, all cancer cells have a clonal origin, and the incidence of cancer increases with age (Zimonjić et al., 1990; Marinković and Marinković, 2012).

It has been proven that certain substances from food can play a significant role in the described genesis of malignant processes in the organism. A large number of chemical compounds are added to food in order to improve the smell, taste, color or

prolong the shelf life. Various additives have a mutagenic effect, such as synthetic dyes and artificial sweeteners, while nitrites are used in the meat industry. And in the process of heat treatment of food, some natural ingredients of foods give reactive derivatives of genotoxic nature (Sofradžija et al., 2003). Carcinogenic substances can enter the food uncontrollably from the environment or they can be residues of treatments that man have carried out at different stages of food production. Carcinogenic chemicals that can be found in food, depending on their source, can be divided into: natural, such as mycotoxins derived from fungi; environmental substances such as dioxins, polycyclic biphenyls, polycyclic aromatic hydrocarbons; substances derived from food processing, such as acrylamide; cleaning agent residues (Šarkanj, 2010). Of all the known mycotoxins, aflatoxin is considered to be the greatest potential threat to human health. It is a product of the fungal species *Aspergillus flavus* and *Aspergillus parasiticus*, which are widespread in nature due to spores. These species of fungi often contaminate cereals, almonds, walnuts, peanuts, cottonseeds, and sugar cane. Their development can occur as a result of damage to food by insects, slow drying and storage in humid conditions (Đukić and Đorđević, 2004; Šumić, 2009; Živanović et al., 2017).

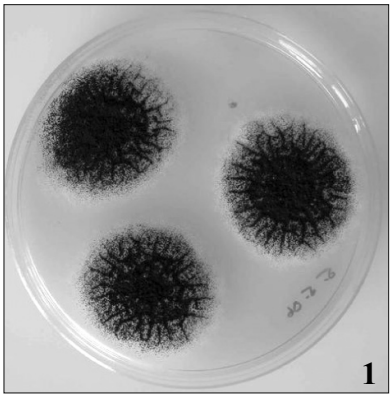

Figure 1. Aspergillus sp. (source: http://fungi.myspecies.info/file-colorboxed/945)

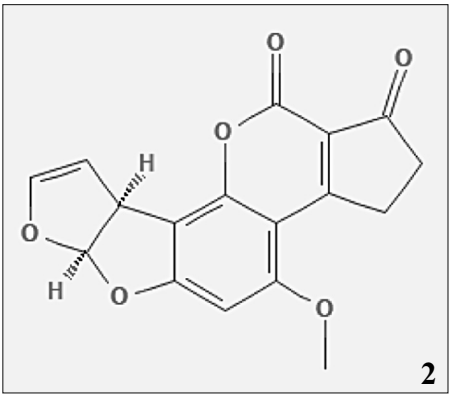

Figure 2. Aflatoxin B1 (source: https://pubchem.ncbi.nlm.nih.gov/compound/Aflatoxin-B1)

Aflatoxins are a mixture of related chemical compounds. The series of aflatoxins designated as B has a cyclopentane ring in the structure of molecules, which has been replaced by lactone in the G series. Three structural variations of aflatoxin molecules provide a family of eight aflatoxins, and of the eighteen toxins known to date, aflatoxin B1 is the most important in terms of presence and toxicity (Šumić, 2009). Aflatoxin B1 (AFB1) is the most carcinogenic substance of biological origin. It is found in agricultural products, cereals, coffee, rice, peanuts, pistachios, and in the organism of mammals it transforms into an active form. Based on numerous epidemiological studies conducted on experimental animals, the carcinogenic effect of AFB1 has been proven, especially on the liver. Long-term intake of AFB1 is a risk factor for the development

of primary hepatocellular carcinoma. Reduction of carcinogenicity is impossible to ensure by heat treatment of food, because it tolerates very high temperatures. Only by applying physical, chemical and biological procedures, drying cereals, primarily proper storage, chemical antifungal agents, strong acids and oxidizing agents, the amount of aflatoxins in food can be reduced. In large doses, aflatoxins are acutely toxic; cause significant liver damage, intestinal and peritoneal bleeding, which eventually leads to death. Clinical signs of acute aflatoxicosis include loss of appetite, lethargy, weight loss, neurological disorders, jaundice of mucous membranes, and convulsions (Šumić, 2009, Živanović et al., 2017). However, on the other hand, the discovery made by Conde et al. (1989) is very important. They found that metabolites of certain species of the genus *Aspergillus* can serve as cytotoxic agents, directed against the cells of some types of human carcinoma. They observed that the protein toxin restrictocin, isolated from the species *Aspergillus restrictus*, inactivates protein synthesis in eukaryotic cells by blocking the ribosome elongation cycle. This protein acts as a specific nuclease that cuts off a small fragment from the 28S rRNA in eukaryotic cells. Biochemical and biological characterization of this toxin, indicated that it is a non-glycosylated polypeptide of *M*r 16836, which shows property of inhibition protein synthesis (Conde et al., 1989).

Ochratoxins are a group of close derivatives of dihydroisocoumarin, whose most toxic representative is ochratoxin A (OA). It is a colorless, crystalline compound, moderately stable, and to some extent tolerates most food processing operations. Ochratoxin A produce two genera of fungi: *Aspergillus* in tropical areas and *Penicillium* in cooler climates. Factors influencing OA production include: temperature, humidity, pH of the substrate, type of substrate, presence of competitive microflora, as well as strain of fungi (Đukić and Đorđević, 2004; Clark and Snedeker, 2007).

Ochratoxin A (OA) is a natural mycotoxin known to contaminate a variety of foods and beverages. It is found in corn, wheat, rye, barley, rice, soybean, nuts, dried fruit, wine, beer, grape juices, pork and poultry, dairy products, spices and chocolate.

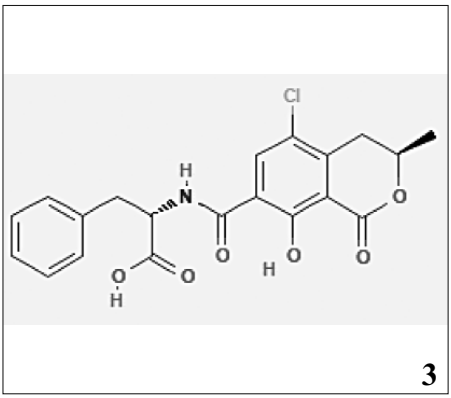

Fig. 3. Ochratoxin A (source:https://pubchem.ncbi.nlm.nih.gov/compound/Ochratoxin-A)

Fig. 4. Penicillium sp., isolated from natural ecosystems (Lalević, 2009)

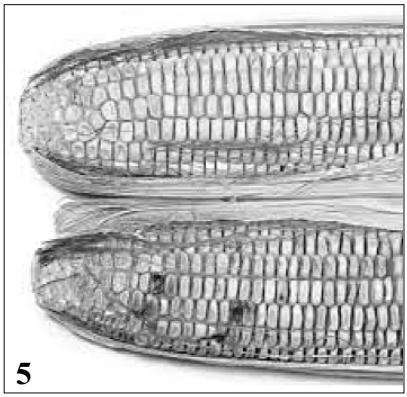

Fig. 5. Fumonisin contaminated maize
(source:https://www.who.int/foodsafety/FSDigest_Fumonisins_EN.pdf)

Ochratoxin A moves through the food chain and has been found in the tissues and organs of animals, including human blood and breast milk. OA is associated with various health risks in the organisms to which they are exposed. OA acts as a potent nephrotoxin and is associated with the development of kidney disease in livestock and the human population (Clark and Snedeker, 2007).

The results of biological tests on rodents, which were conducted within the National Toxicology Program in the USA, indicate a statistically significantly increased incidence of mammary gland tumors in female rats and kidney tumors in male and female rats given ochratoxin A orally. Liver tumors in female mice fed OA in the diet have also been observed. Although Clark and Snedeker (2007) state that no epidemiological study has yet adequately assessed the risk of developing cancer in the human population due to ochratoxins exposure, data on tumor development, derived from long-term rodents bioassays, give a good reason to study ochratoxin A and its potential impact on human health. Studies have certainly shown that OA is genotoxic and immunotoxic, although its mode of action is not fully understood. In humans, exposure to ochratoxins is most commonly associated with the kidney disease Balkan endemic nephropathy (BEN), symptoms of which include tumors of the kidney and urinary tract (Clark and Snedeker, 2007).

Fumonisins are natural toxins, produced by several species of the genus *Fusarium*. Several different types of fumonisins are known, but B1, B2 and B2 are the most toxic and major forms found in food. According to the World Health Organization (WHO) report (2018), fumonisins can have significant negative health effects on livestock and other animals. In the studied animal models, fumonisins disrupt fat metabolism, exhibit potential immunotoxicity, reducing specific and nonspecific immune response, as well as indirect mutagenicity (DNA damage). There are serious indications that fumonisins have a carcinogenic and teratogenic effect on humans, as well as that they can affect the appearance of birth defects. The fungal species *Fusarium verticillioides*, *F. proliferatum* and *F. fujikuroi*, as well as some less widespread species of the genus *Fusarium*, are common contaminants of maize, and to a lesser extent of wheat and other

cereals, included nutritious products based on said cereals. Species of the genus *Fusarium* occur worldwide, but are most common in warm climate and warm tropical areas where maize is grown. Accordingly, during 2016, high concentrations of fumonisin B1 were reported in food products, which originated from Africa, Central and South America and some countries in the Western Pacific Region (WHO, 2018). Westhuizen et al. (2008) indicate high incidences of oesophageal cancer, associated with the consumption of subsistence-grown maize by rural populations in the Eastern Cape Province of South Africa. In a joint expert assessment by the FAO and the WHO, it was found that maize and its products have the highest concentration of fumonisin B1 compared to any other cereal or products based on it (WHO, 2018).

Contaminants from the environment reach the food from the soil in which the plants grow, or from the environment in which the animals are raised or live. Dioxins are the most widespread toxic substances in the environment. They reach the environment as a consequence of human technological activities. They are carcinogenic, destroy the immune system and can cause problems in reproduction and development. They slowly decompose in the human organism and accumulate, which is especially dangerous for people who are chronically exposed to dioxins. Since dioxins accumulate in adipose tissue, the skin should be removed when consuming fish and poultry, in order to reduce the risk of poisoning. Polycyclic aromatic hydrocarbons (PAHs) are compounds that consist of two or more condensed aromatic (benzene) rings and have carbon and hydrogen atoms in their composition. They reach the food from the environment during the industrial production of food and during the preparation of food in the household. The highest concentration of PAHs was found in cereals and seafood (fishes, shellfish). Certain food processing procedures, such as smoking, drying, heat treatment (cooking/baking/grilling) of food, are usually the main sources of contamination with these substances. Studies on animals have shown that polycyclic aromatic hydrocarbons cause mutagenic and carcinogenic changes, so it is assumed that they have such an effect on humans (Cvijan, 2000; Šarkanj, 2010).

By heat treatment of food at high temperatures, certain types of toxic substances are created. Scientists have discovered high concentrations of acrylamide in food rich in starch, such as chips, french fries and bread. Numerous scientific studies have confirmed that acrylamide has neurotoxic, genotoxic and carcinogenic properties (Semla et al., 2017). Kumar et al. (2018) emphasize the detrimental effects of acrylamide on the nervous system, reproductive system, immune system, and liver.

CONCLUSION

Foods can be of plant, animal and mineral origin. Products of plant origin form the basis of food chains in almost all ecosystems on the planet and have an exceptional nutritional value and a positive impact on human health. However, it has been proven that certain substances from food, including food of plant origin, can play a significant role in certain pathological processes in the human body, and even in carcinogenesis. Carcinogenic chemicals in food can come from a variety of sources, so in the production of safe food, it is extremely important to reduce their amount in food or eliminate them completely.

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LITERATURE

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ZDRAVSTVENO BEZBEDNA HRANA – RIZIK OD KANCEROGENIH MATERIJA

Apstrakt

Hrana je materija koju je neophodno unositi u ljudski organizam da bi se očuvala homeostaza. Životne namirnice mogu biti biljnog, životinjskog i mineralnog porekla. Međutim, u hrani se mogu naći i razne toksične i kancerogene materije, koje potiču iz prirodnih izvora, okoline, ili nastaju u toku procesa obrade hrane. U proizvodnji zdravstveno bezbedne hrane, izuzetno je važno smanjiti njihovu količinu u hrani ili ih potpuno eliminisati. U ovom radu, razmatraju se kancerogene materije, koje se mogu naći u hrani i predstavljati rizik za zdravstvenu bezbednost hrane.

Ključne reči: *zdravstveno bezbedna hrana, kancerogene materije, kancerogeni efekat, zagađivači*

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