

5th Food Safety and Security Symposium: food and health

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Abstract

The 5^o Simpósio de Segurança Alimentar (5th Food Safety and Security Symposium) was held in May, 2015, in Bento Gonçalves, RS, Brazil with the objective of discussing the interrelation between food and health, in various perspectives. This paper reviews the state of the art regarding all the issues discussed during the Symposium, connecting them with the lectures presented at the conference. As final remarks, it was perceived that the interrelation between food and health is growing stronger and cannot be discussed without involving the different areas involved.

Keywords: food safety; food security; food and health.

Practical Application: This review presents an overview of the state of the art regarding the interrelation of food and health in different aspects of our everyday life, discussing them in an interdisciplinary approach. It connects this knowledge with the lectures presented at the 5^o *Simpósio de Segurança Alimentar* (5th Food Safety and Security Symposium).

The fifth edition of the *Simpósio de Segurança Alimentar* – Food Safety and Security Symposium was held in Bento Gonçalves in May 2015. The theme or subtitle of this edition was “Food and Health” which was chosen because we believed the discussion of the relationship between food and health reflects the world consciousness that food no longer plays only a nutritional role, but exerts a much deeper interrelationship with almost every aspect of our daily life.

Once the main theme was picked, choosing the five sub-themes or thematic axes was quite a straightforward decision as they represented practically all the issues in which food interferes in our daily routine.

As a standard procedure for the *Simpósio de Segurança Alimentar*, after those decisions were made, the Organizing Commission had the task to search for the best topics and speakers to fit in this vision. The results of this multidisciplinary team research is the backbone of this article, which were also presented as a multimedia presentation at the Symposium opening ceremony, and shows the importance of pursuing a correct and healthy nourishment on every aspect (nutritional, sensorial, social, cultural, ecological, anthropological, etc) on our lives.

The idea of the first axis “Food health” was to discuss those issues normally included under the tag “food safety”. On that matter, two questions immediately arouse: Which are the main problems that we will have to face in short and long terms when we think about the challenges related to food safety in the world? Are they different in Brazil than in other countries?

If we take a global perspective, we can look on what was brought about at the Global Food Safety Initiative (GFSI) annual meeting, which was held in Kuala Lumpur, Malaysia, in March 2015. The GFSI is an industry initiative, which mission is “provide

continuous improvement in food safety management systems to ensure confidence in the delivery of safe food to consumers worldwide” (Global Food Safety Initiative, 2015a).

The general concept established at this meeting was the idea that food safety is a shared responsibility, which means it belongs to all of us. Among the biggest challenges facing food safety, some points were highlighted: transparency throughout the whole food production chain, international norms and standards harmonization, ability to grow and deal with emerging risks. Among those risks, allergenic products, aluminum in additives, water footprint in the food production, food frauds, food supply chain management and validation were considered the most relevant ones (Global Food Safety Initiative, 2015b).

When we look to what is happening in Brazil we realize the concerns are not very different. The Food Safety Brazil blog has asked a number of quality managers and research and development managers of the Brazilian food chain suppliers, which were their main apprehensions concerning food safety for 2015. The answers were very similar to those listed by the GFSI: food frauds, allergenics, scarce resources management, food defense, sanitary project and foreign raw materials (Dias, 2014).

Among these, the term “food defense” is probably the most unusual one. Although it is already part of daily problems in many developed countries, in Brazil it seems still far from reality. According to the USDA, “Food defense” is the protection of food products from intentional adulteration by biological, chemical, physical, or radiological agents. It addresses additional concerns including physical, personnel and operational security (United States Department of Agriculture, 2015).

Even though no news about terrorist attacks to Brazilian food products have been heard, headlines like “school cook adds

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rat poison in food served at a public school in Porto Alegre” (Oliveira, 2011) indicate that Brazilian food industries also need to prepare a Food Defense Plan, as recommended by the American Food and Drug Administration (2015).

Meanwhile, news like “adulterated milk in Rio Grande do Sul” (G1-RS, 2014a), “wine with antifungal agent Natamycin” (G1-RS, 2014b), “dog meat pastry sold in Rio de Janeiro” (Macial, 2015), “fish processing fraud in Santa Catarina, species misinformation on labelling” (Brasil, 2014c) are quite common in the media.

In some cases, there are only economic issues involved threatening consumer rights or product authenticity, but very often, serious health problems, and even death may result. Anyway, in most cases, the reason to cheat and even endanger another human’s life is one of the big current problems: greed.

We certainly have a big portion of this around here, but this kind of problem exists everywhere in the world. Just as a reminder, we can quote the addition of horsemeat in beef burgers in Europe (Ketelaar, 2013), or one of the biggest food frauds in the last years: melamine contamination in milk and other infant products, taking ill more than 300,000 children and killing at least six of them (Wentzel, 2009).

Frauds have been and probably will continue to be a great challenge when we think about “Food Health” and because of that Leonardo Werlang Isolan, head of Animal Inspection of the MAPA - *Ministério da Agricultura, Pecuária e Abastecimento* (Agriculture, Livestock and Supply Ministry), was invited to talk about “Contamination and fraud” in the Symposium.

In all these cases, a human being was responsible for endangering consumers’ health and food safety, but it is not always the case; there are other beings, billions times smaller but just as powerful that never stop surprising us: pathogenic bacteria. These very small beings are food producers’ main headache.

Outbreaks and deaths associated to food pathogenic bacteria in the last years have shown science that, although it is a very ancient problem, is far from being solved. Countries change, cultures change, food change, but bacteria seem to be the same ones that travel all over the world: *Salmonella*, *Escherichia coli*, *Staphylococcus aureus*, among others. Because of that, “Traditional and forthcoming pathogenic bacteria in Brazil” was the subject of the talk given by Dr. Eduardo Tondo, professor at the *Instituto de Ciência e Tecnologia de Alimentos* (Food Science and Technology Institute) at UFRGS and member of the Food Hygiene-Brazil at the Codex Alimentarius, when important data related to these pathogens was presented.

Fortunately, when we speak about “Food Health”, besides negative aspects like frauds, contamination or pathogens, we must also consider the importance of new technologies being used to increase food “functionality” and other health associated benefits as well as to improve staple foods, particularly those consumed by under developed or developing countries.

BioFort Project is an EMBRAPA initiative with the support of international programs like Harvest Plus and AgroSalud, with the objective of decreasing malnutrition and assuring a better food quality by enhancing iron, zinc and vitamin A content in the diet of the needy. Some of the results already achieved in

Brazil include corn, sweet potato, pumpkin, wheat, caupi beans, cassava, black beans and rice (BIOFORT, 2015).

Marilia Nutti, EMBRAPA – *Agroindústria de Alimentos* (Food Agroindustry) researcher and head of the project enlightened the audience with recent information about this great national nutritional advance.

There are no doubts that foods related to health benefits are here to stay; consumer are increasingly demanding healthier and health promoting food products. Talking about consumers’ health, we come to the second panel of the Symposium: “Men’s health”.

Just as it happens with food’s health, men’s health is also a two-way road. On one side, the increase of NCD (Non Communicable Diseases), particularly those related to circulatory system, diabetes and neoplasms, that has been observed over the last decades, indicates a global change on illness patterns (Polônio & Peres, 2009).

NCD present a multifactor etiology and are associated to behavioral and environmental risk factors, such as inadequate eating, obesity, dyslipidemia, tobacco and physical inactivity (Morland & Evenson, 2009). NCD are responsible for 72% of all deaths in Brazil and risk factors for cardiovascular diseases, hypertension and obesity was the main concern on Sandra Fuchs talk; she is a Titular Professor of the Faculty of Medicine at UFRGS.

Due to the strong urbanization and the increasing level of women in the work market, convenience and ready to eat foods have become a strong tendency in Brazil and in the world (Federação das Indústrias do Estado de São Paulo, 2010). This tendency associated with the growth of eating out has led to a substitution of traditional natural foods, rich in fiber, vitamins, minerals and complex carbohydrates, for more industrialized foods, frequently nutritionally poorer. According to the Red Cross International, this substitution was the main cause for a larger number of obese persons, as compared to the famine, as reported in 2011 by the The International Federation of Red Cross and Red Crescent Societies (2011).

In Brazil, according to Vigitel 2012 (Risk and Protection Factors for Chronic Diseases Surveillance by Phone), the percentage of overweight persons has gone over half of the Brazilian population. This sad reality does not exclude children, as one in every three children is above WHO (World’s Health Organization) recommended weight (Brasil, 2012b).

Obesity substantially increases the risk of heart diseases, type 2 diabetes and certain types of cancer (National Institutes of Health, 1998), besides creating a poorer quality life and functional limitations for obese individuals (Fontaine & Barofsky, 2001).

An interesting research in the United States has proven that obesity is directly related to population access to different shopping premises (Morland & Evenson, 2009). Higher obesity rates were found when convenience stores were preferentially used as opposed to big supermarkets, as there is a larger concentration of industrialized goods in those ones.

In Brazil this issue was confirmed in a documentary called “Muito além do peso”(Much beyond weight), produced by

the Institute Alana, which discusses society's awareness and mobilization about the problems derived from childhood consumerism (Instituto Alana, 2012).

The habit of eating five or more portions of fruits and vegetables (as recommended by WHO) is a powerful allied against obesity and is being neglected, mainly for persons between ages 18-24 years and less educated. Besides that, high consumption of soft drinks (at least five times a week) and high saturated fat content foods also contribute for obesity rise (Brasil, 2012b).

On the other hand, there are also many studies indicating many foods as beneficial for human health and wellbeing; among those, foods directly related to chronicle diseases reduction are the most researched ones. Omega 3 polyunsaturated fatty acids from fish oil and seed action on the reduction of inflammatory diseases and colon and prostate cancer have been the object of various clinical essays with very promising results. Red berries, rich in ascorbic acid and flavonoids, especially anthocyanins, are very much related to decreasing free radicals formation (Ho, 2015).

On that issue, the region where the Symposium was held is very significant, as the main producers of antioxidants and resveratrol found in red wine, which has also been related to good heart diseases indexes.

On that line, although presenting significant differences among consumers of different continents, the trans-cultural research, conducted by Rosires Deliza, EMBRAPA researcher, about consumers' perception of the relationship between wellbeing and food, showed that sensorial characteristics, nutritional composition and food consumption environment are the main factors related with food and wellbeing. As she presented at the event, fruits and vegetables, fish and seafood, meat products, grains, cereals and dairy products were the ones mostly related to wellbeing. On the other side, high sugar and salt content, meat products, fast food and fried food were perceived as harmful for the health, indicating that there is a light at the end of the tunnel, at least on the consumers' side.

Maria Lucia Teixeira Polônio (UNIRIO/RJ) presented another view, relating the consumption of food additives and adverse reaction to some groups of people. The use of additives by the food industry is a topic of much debate when men's health is in concern. Regulation of the use of these additives is based on the ADI (Acceptable Daily Intake), which is established by the WHO/ JECFA (Joint Expert Committee on Food Additives) (Organización Mundial de la Salud, 1995).

Adverse effects appear when ADI is exceeded, mostly with artificial colorants. According to Polônio & Peres (2009), as

children are potential consumers of food additives, particularly of artificial colorants, they become a very vulnerable group.

Nowadays is no longer possible to assure men's and society's health without dealing with environmental issues. Hydric crisis, natural resources degradation and climate changes are severe indications about the planet's health, which indicate the need for caring.

It is estimated that world population can exceed 9.5 billion persons in 2050 (United Nations, 2014), with an increase of 32% of the present numbers. Food production must increase by 60% to keep up with this population growth, predominantly more urban (Nações Unidas no Brasil, 2015). Sustainable growth is, therefore, one of the millennium goals that has to be achieved for the survival of the planet. This issue has been discussed during the Symposium in three axes: water footprint, organic food and nanotechnology.

In a context in which a more sustainable and equitable use of water is imposed to governments, enterprises and citizens, emerges the concept of "water footprint". Water footprint is the total amount of water used during production and consumption of any goods or services, including what is directly consumed by people. It is a water resources consumption index that takes into account not only the amount directly consumed, but also that potentially polluted in the process, according to a specific methodology (Hoekstra et al., 2013).

Water footprint measures are classified as green, blue and gray, according to the different types of appropriation (Mekonnen & Hoekstra, 2011). Green relates to rain, for instance, as the quantity needed for plant growth; blue measures the volume of superficial and underground waters consumed for irrigation, cleaning, processing and cooling, among others; gray represents the amount of water needed to dilute specific pollutants, to return the original source to acceptable conditions again.

As presented at the Symposium by Albano Henrique de Araújo, coordinator of freshwater conservation strategy of The Nature Conservancy Brasil (The Nature Conservancy Brasil, 2015), UNO global numbers and other international organizations indicate that water footprint for Brazilians is 2,027 m³/year, almost 1.5 times bigger the global average of 1,385m³/year. This is mainly due to the Brazil's agricultural vocation and high consumption of animal products.

As can be seen in Table 1, indirect water footprint of a consumer is much higher than the direct one, meaning that the amount of "virtual water" embedded in products is much higher than the domestic use.

Table 1. Water footprint (WFP) by sector – Brazil and Global Average (1996-2005).

Sector	(WFP) - Brazil		(WFP) - Global Average	
	m ³ /year pp	%	m ³ /year pp	%
Agricultural products	1926.20	95.02	1267.48	91.50
Industrialized products	45.45	2.24	65.04	4.70
Home consumption	55.49	2.74	52.65	3.80
Total	2027.14	100	1385.16	100

Source: Beux (2014) and Hoekstra et al. (2013).

The Dutch researcher, Arjen Hoekstra from UNESCO-IHE (Institute for Water Education), states that the country does not have to change its economical profile, but can make a more efficient use of water resources (Freitas, 2015). As an example, he suggested better irrigation practices and technologies propagation, including organic agriculture incentives, which reduces gray water footprint.

About organic food, Brazilian consumers, as general, know that they are produced without the use of agrochemicals, are more natural and more expensive, which influences their buying decisions; most consumers lack a broader understanding of these products. Besides that, organic food must be produced in a social and environmental sustainable system in which human labor and cultural integrity must be prioritized, just as natural resources and biological diversity preservation. Therefore, they must be both socially and environmentally healthy, and this is compulsory and certified.

Organic production legislation in Brazil started in 2003 (Brasil, 2003) and today, every product sold in stores, markets or internet must bear a Brazilian stamp in the label, including imported goods (Brasil, 2014a). When directly sold in fairs, organics products can be commercialized without the stamp, but the producer must be affiliated to a Social Controlled Organization and registered at MAPA.

Although more associated to fresh and non-processed products, organic foods can also be industrialized, as long as 95% of the ingredients are organic and the food has not been socially and environmentally mischaracterized by processing (Brasil, 2009).

Consumers know very little about what increases the price of ecologically based food products. Normally they are not aware that expenditures with certification, land conversion period, isolating barriers, larger labor requirements, smaller productivity and scale, transporting and distributing difficulties, can substantially add to the cost of the product, as compared to conventional food products.

The market for organic products in Brazil has been growing as it happens all over the world. According to the 2014 International Federation of Organic Agriculture Report, organic foods global revenue was US\$64 billion in 2013 (FiBL & IFOAM, 2014), led by the USA with US\$30 billion, followed by Germany with US\$7 billion. Brazil has the largest market in Latin America, with a revenue of around US\$2 billion in 2014, but the segment grows 30% per year, in average. These numbers reflect little historical data available, but the percentage is encouraging, as world's growth is less than 10% per year.

Market consolidation depends on larger investments on the organic production chain; technical assistance; research, innovation and technology transfer support. Organic production revives old agricultural practices, adapting them to newer technologies, in order to improve productivity and diminish environmental interference. Tax incentives for products that generate less environmental impact and responsible consumption awareness campaigns could also be effective to balance offer and demand, resulting on price reduction.

Within this scenario, the relationship between the producer and the consumer is never overemphasized. Darolt (2012), one of the speakers of the event, discusses short marketing chains, an alternative very frequent in European markets, as a strategy to strengthen and structure ecological base agriculture.

Besides creating closer links between consumers and producers, this kind of commercialization can diminish the use of packaging. Nevertheless, even ecological food products are still commercialized in Styrofoam or plastic wrapping, which are not sustainable materials, but must be used, especially in longer chains of supermarkets and convenience stores, as well as internet shopping. Nanotechnology is one of the technologies that resulted from research of new more environmentally sustainable materials.

Nanotechnology deals with materials at a nanometric scale, which means one billionth of a meter, same order of magnitude of atoms and molecules. It is the merge of different knowledge fields including chemistry, material sciences, biology, electronics, computing and physics.

The possibility of manipulating matter at the nanoscale is relatively recent, it was first proposed by Richard Feymann, Nobel Prize, in 1959 (Marques, 2014), but the term "nanotechnology" and its definition was established only in 1970's. The research continued from then on, although research centers effectively started working on that area after 2000 (Laboratório Central em Nanotecnologia da UFPR, 2013).

In Brazil, there was an incentive for joint work between universities and enterprises which resulted in the creation of research networks, such as "Agronano – Rede de Nanotecnologia aplicada ao Agronegócio (Agrobusiness oriented Nanotechnology Network)". In 2012, SisNANO – Sistema Nacional de Laboratórios em Nanotecnologia (National Nanotechnology Labs System) was created. It has fostered research activities aiming the development of processes, products and instrumentation related to nanoscale science and technology (Brasil, 2012a).

Some of the results of these studies are:

- In agricultural production, agrochemicals release nanoparticulate systems which reduce chemicals application and environmental damage.
- In products and processes quality control, high-level organoleptic sensors, such as the "electronic tongue", developed by EMBRAPA, give quicker, more precise and objective answers (Empresa Brasileira de Pesquisa Agropecuária, 2015).
- In fruits and vegetables storage and distribution, edible protecting coatings delay deterioration, preserving appearance and nutritional quality for longer periods, decreasing waste.
- In general packaging, degradable biofilms are obtained from agro industrial residues.

Many other innovations are envisioned, creating a vast new field to be developed and studied as in regard to its advantages and potential effects, including undesirable ones (Cerqueira et al., 2011).

A movement towards a specific regulation is observed worldwide, concerning consumer and environment safety risks. In August 2014, ANVISA created the *Comitê Interno de Nanotecnologia* (Nanotechnology Internal Committee) with the task to elaborate and implement actions to this regulatory act (Brasil, 2014b).

To introduce the fifth and last axis: “Future food and health”, we have to go back in time.

In 1968, when the movie “2001, a space odyssey” was launched it aroused fury, indignation and stupefaction in most people who saw it. The movie is considered a fiction masterpiece and presents the director’s vision of what life would be 33 years ahead its time. He tried to foresee a future era, that is already past for us, what allow us to make a critical analysis of his forecasts.

For food scientists, the most important issue in the film is its relationship with the food, which is very strong. Even many film critics and analysts consider the film as being completely related to food (Eddy, 2015).

The film starts with an ape colony munching grass among a herd of tapirs, then the leader finds out that a simple bone can become a weapon; a tapir falls on the ground and the apes feast over the dead body.

Jumping to the future, the first activity showed in a mission to Jupiter is astronauts eating some sort of colorful pure served in a cafeteria type of plate coming out of a machine.

The film forecasts analysis for a future that is already our past illustrates that many of them have not come true, even the food related ones. Maybe this is the reason why these futurology insights are not very well seen at the academia, and this may be the reason why there were only very few articles presented in this axis, in the Symposium.

Whenever food future is the issue, there are two main approaches. The first one derives from Thomas Malthus Theory (North & Thomas, 1970), who, at the end of the XVIII century, predicted that humanity would grow at a much faster rate than food production would. That would lead to a death and human race extermination scenario, if drastic measures would not be taken. Although other factors have influenced the non-materialization of Malthus’ Theory, it is still the theoretical base for many studies of the second approach, the “Green Revolution”, much praised by many but also execrated by just as many.

Nowadays, even if the numbers are less terrifying than those presented by Malthus, and better than those 20 years older, FAO still indicates that some regions in the globe have more than 20% of its population in a state of undernourishment (Food and Agriculture Organization, 2015). The FAO Hunger Map is similar to the world financial map, with the worst results in the same spots, and even in those countries with the worst numbers, there is an uneven distribution of resources among social classes. There is an abundance and wastage of money and food for the richest whereas for the poorest they lack quantity and quality, in all aspects, including nutritionally.

According to Food and Agriculture Organization (2009), we will have a 9 billion persons population by 2050, forcing an

increase of food production on the available ecoagrosystems, resulting in even higher pressure on the environment. Land, water, forests, fish and biodiversity resources shortage is expected.

These figures served as inspiration for researchers of non-conventional food sources in Brazil, but very appreciated and consumed in countries such as Mexico, China and Thailand: Entomophagy, which is using insects for human feeding.

Van Huis et al. (2013) present that livestock production accounts for 70 percent of all agricultural land use, and as an increase in demand of the same order is expected by 2050, search for alternative protein sources is absolutely necessary. On top of that, insects have a much more efficient feed-conversion rate than traditional mammals. Just as an example, crickets need 12 times less feed than cattle, 4 times less than sheep and half than pigs and poultry, to produce the same amount of protein.

This future food alternative was the subject of the talk of Eraldo Medeiros da Costa, from the *Universidade Estadual de Feira de Santana*, in Bahia. He said the main problem related to entomophagy is that most occidental populations see insects as plagues or harmful beings that have to be exterminated. According to him, it is necessary to change this view that insects are dirty, bad and evil, to a more harmonious one, or, at least to a more indulgent one, mainly concerned to nutritional issues, as there are many studies indicating that insects have many nutritionally important compounds for humans (Costa-Neto, 2002).

Whilst Eraldo searches sources used for thousands of years by Indians, other researchers believe the solution is something more associated to futuristic techniques. Prof. Mark Post is the leader of a team that researches meat production from livestock *in vitro* cells at Maastrich University, in Holland. The first so called “Frankenburger” was presented to special guests in London, on August 2013. This is another possibility for humankind protein supply. However, for these results to change meat industry, a good deal of time, research and development are still needed, as well as a gradual change of what we consider meat (Post, 2012).

The relationship between food and health in the future can also be discussed from a completely different point of view. In the 4th edition of the Symposium, Jumar da Silva Pedreira spoke about “Mega tendencies for the food sector”, which were very similar to those identified by the Brasil Food Trends 2020 (Federação das Indústrias do Estado de São Paulo, 2010) after analysis of strategic reports produced by international research institutes.

For this edition of the Symposium, the entrepreneur Raul Matos brought his vision about this issue, which is fundamental for the survival of the industry he directs. Although all catastrophic forecasts, Matos (2012) foresees, an optimistic view for the world in 2040. According to him, internet will create an automatic consumption relationship that will change the balance of power between industry and the consumers; consumers will assume a leading role on establishing their food preferences.

For most people, even in the academia, the terms nutrigenomics and nutrigenetics are more associated to science fiction than to food habits reality, but the ISNN – International Society of Nutrigenomics and Nutrigenetics exists since 2005 and already congregates 39 countries, including Brazil. Anyway, what is nutrigenomics and nutrigenetics?

Nutrigenomics “aims to reveal the intimate inter-relationships between nutrition and the genome and to provide the scientific basis for improved public health through dietary means” (Bergmann et al., 2008).

Nutrigenetics is a study of gene-based differences in response to dietary components and understanding compatibility of various dietary factors with health or disease for individuals based on their genetic makeup (Subbiah, 2008).

According to Thomas Ong (Patricio & Ong, 2013), one of the Symposium's speaker, this recent field of science has the main objective of establishing personalized diets, based on the genotype, for health promotion and reduction of NCD, such as cardiovascular diseases, cancer and diabetes.

Nevertheless, it is very rewarding to realize that many of the forecasts made over food have not become true. Among those, the idea that, by now, humans would be feeding from pills containing all the components necessary for a good nutrition, but without one of the main ingredients for good health: the pleasure of a good meal, including all its meanings, such as cultural, sociological, emotional and anthropological.

This conclusion was endorsed by the final speaker, Sophie Deram (2014), who has reinforced the importance of having pleasure, instead of guilt, on eating, exemplifying with American and French women's behavior as in regard to food and diets. For her, the pleasure of having a nice meal around a table with friends or family is being replaced by an instinctive act, performed quickly and with guilt, that changes quality for quantity, resulting in the obesogenic environment that the world is becoming.

As final remarks, we can realize that the relationship between food and health will only grow stronger in the future, with tools and developments worthy of science fiction. There will always be different angles from which the situation can be approached, but it is certain that “food health” is essential for “men's health” and they are directly linked to “society's health”, which leads to “environmental health”, either today or in the future.

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