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About the Fundamental Standards of Nutrition, Food Security and Food Sovereignty

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Abstract- Today, an estimated one billion people are hungry and undernourished, with detrimental effects on the growth and learning abilities of children and on the ability of adults to lead fully productive lives. Most of these people are in parts of the world where the food available to them is often contaminated or adulterated, increasing the risk of foodborne illness and pandemic gastrointestinal illnesses. Today's reality highlights the existential need for developing countries to improve food safety and quality measures and the challenges associated with meeting these needs. This review article addresses the need to improve food quality and safety systems in developing countries in the context of food security, public health and international trade, and provides evidence and tools to address these challenges using new approaches to capacity building and providing technical assistance on food and nutrition technologies.

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I. To Meet the Needs of Developing Countries, it is Necessary to Combine the Cognitive Resources of the Academic Environment

To define hunger among the population in the works of FAO, there is a division into the concepts of "hunger" and "malnutrition". The first is a chronic lack of calories in food, the second is the lack of any important nutritional elements - proteins and vitamins.

The term "malnutrition" (or, should be understood as the insufficiency of both general caloric and specific protein. This is due not to the severity of the consequences of both types of malnutrition for the human body (since the consequences of a lack of vitamins can be no less dangerous to health), but the causes and extent of their spread.

The quantitative criterion in the latter case turns into a qualitative one - the lack of both calories and proteins is a social problem, the solution of which requires significant changes in the entire socioeconomic structure of the region where the population suffers from calorie or protein deficiency.

Lack of protein in food can cause severe dystrophy in children – *kwashiorkor* [1]. The occurrence of serious diseases (dysentery, food poisoning and etc.) is associated with nutrition. *Kwashiorkor* is a disease marked by severe protein malnutrition and bilateral extremity swelling. It usually affects infants and children, most often around the age of weaning through age 5.

The disease is seen in very severe cases of starvation and poverty-stricken regions worldwide. In the 1950s, it was recognized as a public health crisis by the World Health Organization.

However, there was a delay in its recognition, because most cases of childhood death were reported as being from diseases of the digestive system or infectious etiology.

Since then, various relief efforts were aimed at eradicating it. As scientists continued to investigate the natural history of the disease in children, they discovered something very striking.

Children who were dying from "digestive system diseases" and presenting with diarrhea, cough, coryza, and shortness of breath also were having symptoms of *kwashiorkor* during this time (pitting edema, anorexia, skin changes, etc.).

This finding led to the medical conundrum of whether kwashiorkor was the primary or the secondary cause of death. It was concluded to be the secondary cause of death because many cases of the disease would not have developed without the precipitating stress of diarrhea, dehydration, and other infectious diseases such as HIV and measles.

While *kwashiorkor* is a disease of edematous malnutrition, marasmus is similar in appearance. Marasmus is known also known as a wasting syndrome (malnutrition without edema). Children typically have a depletion of body fat stores, low weight for height, and reduced mid-upper arm circumference.

Other features of the disease can include thin, dry skin; a head that appears large relative to the body; an emaciated, weak appearance; bradycardia; hypotension; hypothermia; and thin, shrunken arms, thighs, and buttocks with redundant skin folds [1].

This problem reviews the evaluation and treatment of patients with *kwashiorkor* and highlights the

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role of the interprofessional medical and biological team in successfully managing this condition.

The diseases associated with protein-energy malnutrition include: cachexia, kwashiorkor and insanity. The most vulnerable group of the population in relation to the lack of protein is children, especially during breastfeeding and the first years of life - from 6 months to 4 years.

The disease of children, which developed as a result of protein deficiency - *kwashiorkor.* It is characterized by a slowdown in the growth and development of the child, a change in the color of the skin and hair, depigmentation, a change in the state of the mucous membranes, a deterioration in the functions of many systems, especially the digestive system.

In severe cases, edema and mental disorders are observed. In addition to children, pregnant women and nursing mothers suffer the most from hunger.

Protein deficiency occurs more often with a general lack of food, is accompanied by "hungry edema" and is characterized as alimentary dystrophy.

Having many children under conditions of malnutrition worsens the health of both mother and children. In cases where between two consecutive births of one mother passes less than two years, infant mortality doubles on average.

According to experts, the shortage of protein foods is most acute in the world food shortage. The situation is better with the production of carbohydrates and fats.

Today, the deficit of food protein is from 10 to 15 million tons per year. By 2050, it will reach 30 million tons. And already now, about half of the world's population suffers from protein deficiency, and this affects the health of generations and their mental development.

70% of all agricultural land in the world has already been given over to animal husbandry, and in general, 30% of all land has been developed for agricultural land in the world.

In other words, further expansion is no longer possible on a significant scale.

The right to food is an inclusive right. It's not just a right to a minimum intake of calories, protein, and other specific nutrients. It is the right to all the nutrients a person needs for a healthy and active life, as well as the means of accessing them.

The right to food can be described [2] as follows: The right to adequate food is realized when every human being, man, woman and child, alone or in community with others, at all times has the physical and economic means to access adequate food or has the means to do so receipt.

Sufficiency means that nutrition should meet nutritional needs, taking into account age, living conditions, health status, professional responsibilities, gender, etc. person. For example, if children's nutrition does not contain the nutrients necessary for their physical and mental development, it is not sufficient.

Another example of malnutrition would be the consumption of energy-intensive and low-nutrient foods, which can contribute to obesity and other diseases.

Food intended for human consumption must be safe and free from harmful substances, in particular contaminants arising from industrial or agricultural production, including pesticides, hormones or veterinary drugs.

Adequate nutrition must also be culturally appropriate. For example, food aid that contains food that is religiously or culturally prohibited among recipients, or food that is inconsistent with their eating habits, will not be culturally acceptable.

Many people think that the right to food means that governments have an obligation to distribute free food to anyone who needs it.

They conclude that this would be impractical or could lead to dependency. This opinion is wrong.

The right to food is not a right to be fed, but primarily a right to self-sufficiency in a dignified manner. In other words, people are supposed to satisfy their own needs through their own efforts and using their own resources.

In order to be able to do this, a person must live in conditions that allow him to either produce food or buy it. Man needs land, seeds, water and other resources to produce his own food, and money and market access are needed to buy food.

The right to food obliges states to provide an enabling environment in which people can use their full potential to produce or purchase foods that enable them to provide themselves and their families with adequate nutrition.

However, if people are not able to feed themselves using their own means, for example, because of an armed conflict, a natural disaster, or while in prison, then the state itself must provide them with food.

The denial of the right to food does not stem from the lack of food in the world It can be imagined that people face a denial of their right to food because there is not enough food to satisfy everyone. However, according to the FAO, the world produces enough food to feed the entire population of the planet [3].

The root cause of hunger and malnutrition is not lack of food, but lack of access to available food.

For example, people's access to food is hindered by poverty, social exclusion and discrimination not only in developing countries but also in some of the most economically developed countries where food is plentiful.

However, given factors such as population growth, the impact of possible climate change and

limited natural resources, governments must also make efforts in the long term to develop sustainable food production to ensure the availability of food for future generations.

The right to food is distinct from food security and food sovereignty. These three concepts, while somewhat overlapping, are nevertheless different. According to the FAO, food security exists "when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences and promotes an active and healthy life" [3].

This is a precondition for the full enjoyment of the right to food. However, the concept of food security as such is not in itself a legal concept and does not impose obligations on stakeholders, nor does it empower them.

Food sovereignty is an emerging concept whereby peoples determine their own food policies and patterns of food production (particularly agriculture and fisheries), determine the extent to which they want to be self-sufficient, and protect domestic food production and regulate trade in order to fulfillment of sustainable development objectives.

The concept of food sovereignty is proposed as a concept to promote an alternative agricultural model, trade policy and practice that works in the interests of people's rights to food and safe, healthy and environmentally sustainable food production. The right to food sovereignty is enshrined in a number of national laws [4].

However, there is currently no international consensus on this concept. The right to food is a human right recognized in international law that entitles individuals to have access to adequate food and the resources necessary for the sustainable enjoyment of food security.

The right to food places legal obligations on States to overcome hunger and malnutrition and to realize food security for all. The right to food also covers the cross-border obligations of states, including those related to trade.

For example, the International Covenant on Economic, Social and Cultural Rights places an obligation on States parties to take the necessary measures to ensure that the world's food supply is equitably distributed [5] in accordance with needs (art. 11, para. 2 b).

While it does not prescribe any particular model for achieving such distribution, it does oblige States to ensure that their trade and other policies serve this purpose.

The right to food is also recognized in other international conventions for the protection of specific groups, such as the Convention on the Elimination of All Forms of Discrimination against Women [6] (1979), the Convention on the Rights of the Child [7] (1989) and the Convention on the Rights of Persons with Disabilities [8] (2006).

The right to food is also enshrined in some regional treaties, notably the Additional Protocol to the American Convention on Human Rights in the Area of Economic, Social and Cultural Rights, known as the San Salvador Protocol [9] (1988), the African Charter on the Rights and Welfare of the Child [10] (1990, 2003) and the Protocol to the African Charter on Human and Peoples' Rights on the Rights of Women in Africa [11] (2003).

Recognition of the right to food is also implied in the context of the realization of other rights. As interpreted by the African Commission on Human and Peoples' Rights, the right to food is implicitly protected by the African Charter on Human and Peoples' Rights [12] (1981) in the provisions relating to the right to life, the right to health and the right to economic, social and cultural development.

According to the Human Rights Committee, which oversees the implementation of the International Covenant on Civil and Political Rights (1966), the protection of the right to life requires states to take positive measures, in particular measures to eliminate malnutrition [13]. The Committee against Torture, which oversees the implementation of the Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment (1984), has noted that the lack of adequate food in prisons can amount to inhuman and degrading treatment [14].

International humanitarian law also provides for the protection of civilians' and prisoners of war's access to food and water in times of armed conflict [15] and the prohibition of the deliberate use of civilian starvation as a method of warfare [16].

Under international criminal law, violations of these protections constitute war crimes. The deliberate creation of a famine, whether in wartime or in peacetime, can also qualify as genocide [17] or a crime against humanity [18].

A number of non-legally binding international human rights instruments, including recommendations, guidelines, resolutions or declarations, are also relevant to the right to food [19]. They are also called legal documents of a recommendatory nature.

They are adopted by States and used to guide the realization of the right to food [20].

One such legal instrument of a non-binding nature, which is also the most explicit and detailed, is the Voluntary Guidelines to Support the Progressive Realization of the Right to Adequate Food in the Context of National Food Security (hereinafter referred to as the Right to Food Guidelines).

The Right to Food Guidelines [21] were adopted by consensus by the FAO Council in November

2004. They are a practical tool to help realize the right to adequate food. While they are not legally binding in and of themselves, their purpose is to reflect existing human rights standards and provide useful guidance to States on how they can implement their existing obligations.

They cover the full range of measures that governments should consider at the national level in order to create an enabling environment for people to feed themselves in a decent manner and to create appropriate safety nets for those who are unable to do so, as well as measures to hold governments accountable before the copyright holders.

The Right to Food Guidelines are intended for both States parties to the International Covenant on Economic, Social and Cultural Rights and non-parties, and for both developing and developed countries.

States are encouraged to use the Right to Food Guiding Principles when developing their national strategies and programs to combat hunger and malnutrition.

The Right to Food Guidelines also provide for the involvement of non-governmental organizations (NGOs), civil society organizations and the private sector in promoting and strengthening the progressive realization of the right to adequate food.

The vast majority of people suffering from hunger and malnutrition live in rural areas in destitute and marginalized conditions, struggling to survive. About 50% of the people suffering from hunger are smallholders and 20% landless villagers [22]. Another 10% live off cattle breeding, fishing and forest management. The remaining 20% live in urban areas [23].

The rural poor often have limited access to sufficient productive resources, such as land, water, fertilizers and seeds, as well as markets, information and technology.

Very often, lack of access to land and other productive resources can lead to the denial of the right to food, as most individuals and households in rural areas depend on such resources either to produce food for their own consumption or as a source of income to buy the food they need. For example, denial of access to land may occur in the context of unfair competition for land from large agribusinesses, extractive industries or development projects.

With such competition, the rural poor are often at a severe disadvantage as a result of discrimination and violations of various human rights, including exclusion from decision-making and from access to justice. Sometimes the denial of access to land takes the form of forced evictions.

Even where they are able to produce agricultural products, lack of access to markets may prevent them from selling their produce and purchasing other food items needed for an adequate diet.

Lack of access to education, including vocational training, and to information and technology may also prevent them from improving productivity and protecting the environment or gaining knowledge about nutrition.

Landless workers, such as harvesters and agricultural workers, face denial of their right to food when they cannot afford adequate food and other basic needs due to excessively low wages. They also cannot enjoy the freedom of association needed to negotiate job security and decent wages.

Few countries have social security systems that work particularly well in rural areas. During times of economic hardship, rural poor people can face food insecurity. People living in poverty in urban areas are also highly vulnerable to violations of the right to food. Most of them provide themselves with food by buying food.

Therefore, paid work, including self-employment, is very important. When they find it difficult to find work, or when they receive meager wages that prevent them from purchasing food and other basic needs, such as health care, education and housing, this can undermine their right to food, as they have no other means to get food. For the self-employed, their access to food can also be negatively affected by discrimination in access to economic resources, such as credit, or access to market places.

When food is too expensive or their income too low, they may compensate by reducing the quality and quantity of food they eat, for example by choosing cheaper but less nutritious or less safe foods. In such cases, they cannot be considered to enjoy the right to food because the food they consume is insufficient.

Failures in the functioning of welfare programs or other safety nets, as well as their complete absence, further undermine the enjoyment of the right to food for those who have lost the means to provide for it themselves. As in rural areas, for people living in urban poverty, the inability to feed themselves is often attributed to social exclusion, in particular exclusion from education and training opportunities, access to information, decision-making in public affairs and from access to justice.

There is often a link between violations of the right to food in rural and urban areas. Hunger and malnutrition in rural areas are forcing people to move to urban areas in search of better living conditions. However, the right to food is often not realized in urban areas either.

The affected population may not be trained for employment in the jobs available in urban areas. Social protection schemes, even when they exist, may not be available to those who do not have proper documentation, such as residence registration, or who work in the informal economy.

According to the International Covenant on Economic, Social and Cultural Rights, States parties to it must take measures, including specific programs, to improve the methods of production, storage and distribution of food through the widespread use of technical and scientific knowledge, the dissemination of knowledge of the principles of nutrition and improving or reforming agricultural systems in such a way as to achieve the most efficient development and use of natural resources (Article 11).

The FAO Right to Food Guidelines provide detailed guidance on ensuring sustainable, nondiscriminatory and secure access to resources and assets, including labor, land, water, genetic resources for food and agriculture, services, etc. (guiding principle 8).

In order to guarantee the right to food to the poor in rural and urban areas, it is also necessary to ensure the realization of other human rights, such as freedom from forced eviction, the right to take part in public affairs and participate in rural development, freedom of association, the right to enjoy the benefits of scientific progress and its achievements, the right to work and other labor rights, the right to education and information, and the right to social security.

And the other hand, can the open data save the world from hunger? GODAN [24] is a British non-profit organization dedicated to the dissemination of open data. With the aim of making information about agriculture and food available, as the organization believes it helps to ensure food security in the world.

What is open data? Open data is data that is available to anyone for free use and re-publication without restrictions of copyright, patents or any other control mechanisms. *Open Data* can only be practical when it is shared in a way that people can understand. They need to be distributed in a standardized format and easily traceable to where the data was collected. Created in support of Open Data, GODAN's latest report is titled "Open Access and Open Data in PUSH Universities". PUSH[1] is an American organization known as Presidents United to Solve Hunger. GODAN[2] notes that they currently have over 700 partners working with them, including national governments, non-governmental organizations, international organizations and the private sector.

Open Data has proven to be one of the most important tools for disseminating scientific knowledge, spurring collaboration and creating innovation around the world. If we want to see progress towards global food security, then we must think about innovation.

As leaders in the creation and storage of knowledge and data, universities are natural partners in this global effort. Land-grant universities, many of which are part of PUSH, are already sharing their knowledge and best practices in agriculture and nutrition. PUSH and UFWH[3] - Universities Fighting World Hunger, want to help highlight the importance of open data as a resource for ending world hunger. By engaging universities and students in the collection and analysis of Open Data, PUSH and UFWH encourage both scientists and future leaders to find innovative ways to fight hunger on a global scale. UFWH is a growing global network of universities working in partnership to amplify the voice of the rising generation - a voice calling for a world free of hunger and malnutrition.

With widespread hunger, malnutrition and climate uncertainty around the world, university research [25] is essential to addressing some of the world's most pressing problems.

In a dynamic and diverse field such as agriculture and nutrition, effective data-driven solutions can help ensure sustainable livelihoods and drive progress towards the Sustainable Development Goal of Zero Hunger.

Researchers collect, analyze and reuse data, and the new knowledge they create helps make important decisions. governments and industry, while university librarians organize and curate data in large repositories [26].

Unfortunately, much of this data has been lost or locked up in closed vaults kept within university walls. If all the universities in the world developed an open data policy and published their data, much more effective decisions could be made. PUSH can pave the way. Its 99 universities whose presidents have pledged to unite in this endeavor.

The global fight against malnutrition and hunger has a unique opportunity to show by example, to demonstrate that it really saves lives and can improve the well-being of every person around the world. On the other hand, open access (OA) to information is free (for

[1] *Push Universities:* The sharing of research findings, as well as other data, is believed to increase the pace of innovation, research breakthroughs, and collaborative problem-solving. Often, however, these data are not readily available, visible, or accessible, resulting in needlessly duplicated research or critical gaps in information. This has led many public research funders (e.g., NSF, NIH & USAID), as well as private donors, to require public universities and other higher education institutions to develop or enhance data management plans that allow for open access and data sharing. While creating a culture with policies and infrastructure platforms that allows for open access and open data is a challenge, it is a challenge that is becoming increasingly necessary for universities to address //http://wp.auburn.edu/push/?page_id=1087.

[2] The Global Open Data for Agriculture and Nutrition (Godan) initiative seeks to support global efforts to make agricultural and nutritionally relevant data available, accessible, and usable for unrestricted use worldwide.

[3] UFWH is a growing, global network of universities working in partnership to amplify the voice of the rising generation – a voice calling for a world free from hunger and malnutrition. http://wp.auburn.edu/ufwh/

users), fast, permanent, full-text access in real time to scientific and educational materials, implemented for any user in the global information network, carried out mainly to research peer-reviewed journals.

The Internet has fundamentally changed the practical and economic conditions for the dissemination of scientific knowledge and cultural heritage. The Internet has provided a first-of-its kind opportunity for a comprehensive and interactive presentation of human knowledge, including cultural heritage, with guaranteed access to it from anywhere in the world.

For example, the Berlin Declaration, the purpose of which is to support the development of the Internet as a functional tool for the global dissemination of scientific knowledge and human reflection, as well as to formulate the necessary measures that will be considered by policy decision-makers, research organizations, support and development funds, libraries, archives and museums. The Berlin Declaration on Open Access to Scientific and Humanitarian Knowledge[4] [27] whose mission of dissemination of knowledge will only be partially fulfilled if information is not available to society in a simple and universal form. Continuing the development of traditional methods, the development of new opportunities for the dissemination of knowledge via the Internet on the principle of open access (the Open Access paradigm) should be increasingly promoted.

Open Access is defined as a comprehensive source of universal knowledge and cultural heritage recognized by the scientific community. To realize the idea of a comprehensive and public presentation of knowledge, the Internet of the future must be characterized by such properties as stability, interactivity and transparency. Information and software should be freely available and have a high degree of interoperability.

Open access as a desired method ideally involves the active participation of every copyright holder in the field of scientific publications and every manager of cultural heritage. Publications that comply with the Open Access principle cover original research results, source data and metadata, source materials, digital versions of photographic materials and graphics, as well as other scientific works in multimedia form.

II. Complex Problem of Protein Deficiency for Humanity

In the 21st century, the problem of protein deficiency nutrition for the global community continues to be existential. There is a tendency towards a decrease in the quality indicator of total protein, due to a quantitative decrease in animal proteins in the diet.

Based on an assessment of the amino acid composition, its adjustment taking into account the principles of mutual enrichment with the most rational ratio of nutrients, it is possible to create products whose biological value would approach the requirements of an ideal protein.

Correcting the qualitative inferiority of the protein component of food products is one of the main tasks in the meat processing industry, which is only possible by attracting the gold reserve of products of plant origin.

Of the nutrients necessary to meet human vital needs, the most valuable are proteins. The indispensability of their functions and the absence of mechanisms for the synthesis of a number of protein substances in the body clearly pose the problem of adequate protein nutrition to ensure human health and normal functioning.

The living and working conditions of modern man continue to place new demands on food: the need for fats decreases, and the need for protein increases. According to FAO/WHO, the norm of its consumption for humans is 90–100 g per day, including 60–70% protein of animal origin.

Proteins constitute the most expensive and scarce component of food rations, and therefore the desire to justify acceptable and realistic ways of direct use in nutrition of that part is quite obvious. Protein, which until recently was a food deficit and was utilized with low efficiency in animal husbandry.

Over the past years, the search for new sources of proteins, the development of technologies for protein preparations and the substantiation of ways of their rational use were implemented in a number of directions; for example, we can cite the industry of stress proteins production with their functional features.

Slowing down and eliminating the trends of an ever-increasing gap between the demand and production of protein with the subsequent elimination of its deficiency is most realistically achieved in two ways - the intensification of traditional methods of production of protein-containing products and the utilization of new proteins for food purposes as an additional source of increasing the stock of food protein.

One of the richest sources of protein is vegetable raw materials. A large number of proteins of plant origin and relatively low production costs make it

[4] Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities, with mission of disseminating knowledge is only half complete if the information is not made widely and readily available to society. New possibilities of knowledge dissemination not only through the classical form but also and increasingly through the open access paradigm via the Internet have to be supported. We define open access as a comprehensive source of human knowledge and cultural heritage that has been approved by the scientific community. In order to realize the vision of a global and accessible representation of knowledge, the future Web has to be sustainable, interactive, and transparent.

possible to significantly compensate for the protein deficiency in human nutrition.

In the global food balance, plant proteins account for about 80%, and animal proteins for about 20% [28]. Plant sources are characterized by high protein content, low fat content, compared with animals, plant proteins have fewer sulfur-containing amino acids.

To obtain 1 kg of vegetable protein with intensive agricultural production consumes approximately 11 thousand kcal of fuel energy, per 1 kg of animal more than 75 thousand kcal. In livestock farming, unit labor costs are also 16 times higher: 53 kg per person hour, vegetable protein and only 3.2 kg of animal protein.

For economic reasons and promising functionality to solve the shortage problem to obtain complete dietary protein, it is necessary to use the entire variety of plants: oilseeds, legumes, grains, vegetables, vegetative organs of wild and cultivated plants.

III. Stress Proteins From Plants

The study of the reaction of the protein synthesizing system to stress in various living organisms has revealed the universality and conservatism of this phenomenon. Changes in the functioning of the genetic system are very similar among different eukaryotes, and in some cases have been identified in prokaryotes. Conservatism in the response of the protein synthesizing system of living organisms to stress clearly indicates that the biosynthesis of stress proteins is a fundamental and vital process that contributes to the adaptation and survival of organisms in extreme conditions.

The term “stress” (English stress - pressure, tension) was introduced into biological science by G. Selye in 1936 to characterize a similar reaction that occurs in the body under the influence of various stimuli. The state in which the body finds itself during such circumstances, is considered stressful and lasts from the beginning to the end of the stressor. Stressors include strong short-term exposure to environmental factors environments causing changes in sequence stages and reactions ending either in the adaptation of the living system to the damaging effects, or in the depletion of the reserve forces of the organism and its death.

As a rule, adaptive changes metabolic processes are the driving force evolution of organisms and the basis of survival in the environment. To understand the adaptation mechanisms of living organisms to unfavorable influences, responses at various hierarchical levels are studied levels, ranging from population to molecular. Particular attention is paid to studying features of protein biosynthesis under stress conditions.

The first information about reversible changes in protein system of living cells under the influence of high temperatures (up to 45 ^{o}C) appeared in the 60s XX-century Italian researcher Ferruccio Ritossa[5] discovered that under the influence of a temperature of 37 ^{o}C, giant puffs of Drosophila chromosomes.

It was later found that this phenomenon is associated with the de novo synthesis of a specific group of proteins, which are called “heat shock proteins” (HSPs). Today's synthesis HSPs in response to heat stress have been identified in a wide range of organisms - from bacteria to humans.

As a result of research carried out in a number of laboratories around the world, the spectrum of HSPs of various higher plants, in particular soybeans, corn, tobacco, carrots, lilies, cotton, etc., has been studied in detail. The synthesis of HSPs begins within 15 minutes after the action of a heat shock and lasts 6–8 hours.

Maximum synthesis of HSP occurs during the first 2.5 hours. As a result of heat shock, high and low molecular weight proteins are formed. Most HSPs synthesized in plants, unlike other living organisms, belong to the category of low molecular weight (molecular weight 15–18 kDa - kilodalton). High-molecular-weight plant HSPs are less diverse in compared to HSPs from insects, mammals and yeast. The process of HSP biosynthesis involves the nuclear and cytoplasmic genetic systems, while the proteins themselves are localized primarily in the cytoplasm, forming heat shock granules.

Heat shock granules allow the plant to maintain mRNAs necessary for rapid transition to repair processes. The formation of HSPs is preceded by de novo synthesis of heat shock mRNA, which occurs in the first 3–5 minutes of stress exposure and lasts from 1 to 4 hours, after which it gradually decreases [29].

Stress proteins (SPs) are a diverse group of proteins that are synthesized at increased levels when cells are exposed to either intracellular or extracellular stressful stimuli. They exhibit protective effects against stresses. Stress proteins include heat shock proteins (HSPs), RNA chaperone protein (RNPs), and proteins mainly function in the endoplasmic reticulum (ER): peptidyl-propyl isomerases, protein disulfide isomerases (PDIs) and the lectin-binding chaperone system.

SPs are ubiquitously expressed in all kind of cells, triggering signal cascades for neutralizing and eradicating the stresses occurring both intracellularly (e.g., pathogen invasion) and extracellularly (e.g., starvation, stimulation by cytokines/chemokines or hormones).

[5] Ferruccio Ritossa (February 25, 1936 – January 9, 2014) was an Italian geneticist best known for his discovery of the heat shock response in the model organism Drosophila (fruit flies) - https://en.wikipedia.org/wiki/Ferruccio_Ritossa.

Responses triggered by SPs can either activate pathways to promote cell survival or initiate cell death (i.e., apoptosis, necrosis, pyroptosis[6] or autophagic cell death) for eliminating the damaged cells to protect a particular organ/tissue under given conditions.

It is widely noted that the dysregulation of stress proteins is associated with a variety of human diseases, including cardiovascular diseases, neurodegenerative diseases (e.g., Parkinson's diseases, Alzheimer disease), stroke, human cancers and infectious diseases.

As SPs also attract a great interest as potential antiviral targets (e.g., COVID-19), interesting the present progress and challenges in this area of HSP-based drug development, as well as with compounds already under clinical evaluation [30].

Interest in the heat shock proteins (HSPs), as a natural physiological toolkit of living organisms, has ranged from their chaperone function in nascent proteins to the remedial role following cell stress.

As part of the defense system, HSPs guarantee cell tolerance against a variety of stressors, including exercise, oxidative stress, hyper and hypothermia, hyper and hypoxia and improper diets.

For the past couple of decades, research on functional foods has revealed a number of substances likely to trigger cell protection through mechanisms that involve the induction of HSP expression.

Summarized the occurrence of the most easily inducible HSPs and describe the effects of dietary proteins, peptides, amino acids, probiotics, high-fat diets and other food-derived substances reported to induce HSP response in animals and humans' studies [31].

The authors [32] of an extensive scientific review came to interesting conclusions regarding the function of stress proteins: Heat shock proteins (HSPs) encompass both extrinsic chaperones and stress proteins. These proteins, with molecular weights ranging from 14 to 120 kDa, are conserved across all living organisms and are expressed in response to stress.

The upregulation of specific genes triggers the synthesis of HSPs, facilitated by the interaction between heat shock factors and gene promoter regions.

Notably, HSPs function as chaperones or helper molecules in various cellular processes involving lipids and proteins, and their upregulation is not limited to heat-induced stress but also occurs in response to anoxia, acidosis, hypoxia, toxins, ischemia, protein breakdown, and microbial infection.

HSPs play a vital role in regulating protein synthesis in cells. They assist in the folding and assembly of other cellular proteins, primarily through HSP families such as HSP70 and HSP90.

Additionally, the process of the folding, translocation, and aggregation of proteins is governed by the dynamic partitioning facilitated by HSPs throughout the cell. Beyond their involvement in protein metabolism, HSPs also exert a significant influence on apoptosis, the immune system, and various characteristics of inflammation.

The immunity of aquatic organisms, including shrimp, fish, and shellfish, relies heavily on the development of inflammation, as well as non-specific and specific immune responses to viral and bacterial infections.

Recent advancements in aquatic research have demonstrated that the HSP levels in populations of fish, shrimp, and shellfish can be increased through non-traumatic means such as water or oral administration of HSP stimulants, exogenous HSPs, and heat induction. These methods have proven useful in reducing physical stress and trauma, while also facilitating sustainable husbandry practices such as vaccination and transportation, thereby offering health benefits.

Hence, the present review discusses the importance of HSPs in different tissues in aquatic organisms (fish, shrimp), and their expression levels during pathogen invasion; this gives new insights into the significance of HSPs in invertebrates.

IV. Instead of a Conclusion

Some evidence for decision making in food strategy and food science

From a wide list of high-quality literature for making decisions and teaching both food and nutritional strategies, we can gratefully mention the monographic textbook compiled by Bibek Ray - "Fundamental food microbiology" (Third Edition) [33].

Introductory food microbiology is a required course for undergraduates majoring in food science. In some form it is also taught in several other programs, such as microbiology, public health, nutrition and dietetics, and veterinary science.

For the majority of food scientists, except those majoring in food microbiology, this single course forms the basis of the study of microorganisms and their interactions to food.

Food microbiology is probably the only course that provides information on the interaction of food and microorganisms.

[6] Pyroptosis has received more and more attention because of its association with innate immunity and disease. The research scope of pyroptosis has expanded with the discovery of the gasdermin family(the main effector of inflammatory regulated cell death (or pyroptosis) - https://www.nature.com/articles/s41575-023-00743-w. A great deal of evidence shows that pyroptosis can affect the development of tumors. Pyroptosis is a double-edged sword for tumors. The rational use of this dual effect will help us further explore the formation and development of tumors, and provide ideas for patients to develop new drugs based on pyroptosis. https://www.nature.com/articles/s41392-021-00507-5

This book was written with the major objective of relating interaction of microorganisms and food in relation to food bioprocessing, food spoilage, and foodborne diseases.

Thus, it will be useful as a text in the introductory food microbiology courses taught under various programs and disciplines.

In addition, it will be a valuable reference for those directly and indirectly involved in food and microbiology, including individuals in:

- academic institutions;
- research institutions;
- federal, state, and local government agencies;
- food industries;
- food consultants;
- and even food lobbyists.

The subject matter is divided into seven sections. For undergraduate teaching, the first six sections can be taught as a semester course;

Section VII (Appendices) can be used as advanced information for an undergraduate course which contains materials that are either taught in other courses, such as advanced food microbiology, or food safety courses and laboratory courses.

Section I describes the history of food microbiology, characteristics of microorganisms important in foods, their sources, and significance. Section II deals with microbial growth and metabolism of food, and the significance of microbial sublethal injury and bacterial sporulation in foods.

Section III explains the different beneficial uses of microorganisms, which include starter cultures, bioprocessing, bio preservation, and probiotics.

Section IV deals with spoilage of foods by microorganisms and their enzymes and methods used to determine food spoilage. In addition, there is a chapter on problems and solutions of some emerging spoilage bacteria in refrigerated foods.

Section V deals with foodborne pathogens associated with intoxication, infections, and toxic infections and those considered to be opportunistic pathogens, as well as pathogenic parasites and algae. In addition, a chapter has been included on emerging pathogens and a chapter on indicators of pathogens.

Section VI discusses different methods used to control undesirable microorganisms for the safety and stability of food. A chapter on new nonthermal methods and a chapter on the hurdle concept in food preservation are included.

The materials in each chapter are arranged in logical, systematic, and concise sequences.

V. Globally Universal GS1 System: Accepted by Consumers, Businesses and Governments

Tracking the movement and location of goods is a set of measures that allows you to identify products throughout the supply chain in accordance with one or more criteria (for example, batch number or expiration date, etc.).

The focus is on tracking the movement of a product from its point of origin to its point of use.

Origin tracking allows you to determine the place of origin and associated characteristics of a specific product at any stage of the supply chain using several search criteria.

The globalization of trade, the increasing complexity of production processes and just-in-time supply chains, and the centralization of production and distribution processes require a fundamental reconsideration of most ways of delivering the “right” products to the consumer.

From an information process management perspective, the implementation of supply chain traceability systems requires all trading partners involved to systematically integrate the physical flow of materials, semi-finished and finished products with the information flow describing them.

All this requires a holistic view of the supply chain, which is best achieved by using a common language of business communication - the GS1[7] system.

Accepted by consumers, businesses and governments, this global, universal system provides a unique foundation to enable all required processes in traceability systems.

With the ability to globally uniquely identify trading and logistics units, participants and locations, the GS1 system is best suited for traceability.

GS1's unique global identifiers are the keys that provide access to all product history, application and location data.

VI. The GS1 Discovery APP[8]

In contrast to one-dimensional brochures and PowerPoint presentations, this web app – with its interactivity and flexibility – will help users to engage with GS1 in a new, modern way.

The GS1 Discovery App is an easy-to-use tool that shows GS1 standards "in action" throughout the supply chain – and the interoperability that standards-based business processes bring. This way we can all speak the "language of business" in a fun and engaging way.

[7] https://www.gs1.org/about
[8] https://discover.gs1.org

What better way to tell the story of supply chain visibility than tracing the travels of select products, as they make their way from source to consumer. It is easy to understand and allows users to create and explore connecting stories that show how GS1 standards benefit business. The GS1 Discovery App can be accessed anywhere and anytime on all computers and tablets.

VII. Food Industry and the Implementation of HACCP Systems

The National Advisory Committee (USA) on Microbiological Criteria for Foods (Committee) reconvened a Hazard Analysis and Critical Control Point (HACCP)[9] Working Group in 1995.

The Committee again endorses HACCP as an effective and rational means of assuring food safety from harvest to consumption. Preventing problems from occurring is the paramount goal underlying any HACCP system. Seven basic principles are employed in the development of HACCP plans that meet the stated goal.

These principles include hazard analysis, CCP identification, establishing critical limits, monitoring procedures, corrective actions, verification procedures, and record-keeping and documentation. Under such systems, if a deviation occurs indicating that control has been lost, the deviation is detected and appropriate steps are taken to reestablish control in a timely manner to assure that potentially hazardous products do not reach the consumer.

In the application of HACCP, the use of microbiological testing is seldom an effective means of monitoring CCPs because of the time required to obtain results. In most instances, monitoring of CCPs can best be accomplished through the use of physical and chemical tests, and through visual observations. Microbiological criteria do, however, play a role in verifying that the overall HACCP system is working.

The Committee believes that the HACCP principles should be standardized to provide uniformity in training and applying the HACCP system by industry and government. In accordance with the National Academy of Sciences recommendation, the HACCP system must be developed by each food establishment and tailored to its individual product, processing and distribution conditions.

In keeping with the Committee's charge to provide recommendations to its sponsoring agencies regarding microbiological food safety issues, this document focuses on this area. The Committee recognizes that in order to assure food safety, properly designed HACCP systems must also consider chemical and physical hazards in addition to other biological hazards.

For a successful HACCP program to be properly implemented, management must be committed to a HACCP approach. A commitment by management will indicate an awareness of the benefits and costs of HACCP and include education and training of employees. Benefits, in addition to enhanced assurance of food safety, are better use of resources and timely response to problems.

Conflicts of Interest

The author declares no conflicts of interest.

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