



Review Article

21st Century challenges in animal production and food security, additional positive and negative impacts on human health and the environment

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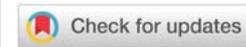
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Summary

Meat, milk and eggs are nutrient-rich products that could effectively boost nutrient-poor diets, either as part of the normal diet or if access is increased through enrichment with vitamins and minerals, among others. Scientific evidence on the role of livestock products in improving nutrition is limited, especially in low-and middle-income countries, during the first 1,000 days of a child's life. Beyond food production, the livestock sector has additional positive and negative impacts on human health, the environment, societies and economies that must be understood and managed..

Introduction

In the 21st century, the growth rate of the world population is at an annual average of 1.14%, estimating for the year 2022 to reach 8 billion inhabitants [1], of which about 784 million people (9.8%) will suffer from hunger [2]. After the COVID-19 pandemic, in 2021, there was hope in considering that the world would start to get better. However, problems related to food security and world hunger continued to increase even more in that year. About 3.1 billion people could not count on a healthy diet in 2020 due to rising costs [3]. This is reflected in inequalities between countries, sometimes exacerbated and with regional differences within them, whose origins are due to a pattern in the inequality of economic recovery and unrecovered income losses among those most affected by the pandemic of COVID-19 [2].

When considering food security, we must consider the following aspects, on the one hand, the availability and access to a sufficient quantity of food and, on the other hand, access to quality food. For this, it is important to assess their innocuousness, that is, that they are healthy and, when

ingested, do not affect the health of the consumer, in addition, nutritional safety and access to sufficient nutritious food, must be considered. However, little attention has been paid to the specific role of livestock products such as meat, milk and eggs (and their derived products) in nutrition and their potential to help achieve nutrition security goals.

The media in high, middle and low-income countries play a fundamental role in the population's nutrition because the information provided to consumers often influences their lifestyle habits. In recent years, reports critical of the role of meat, in particular and livestock-derived foods (e.g., milk and eggs), in general, as part of diets have predominated. Its environmental perspective and suggested adverse health effects are overt arguments used to promote a shift to diets containing little or no animal foods. However, you should expect that, behind the intentional or unintentional communication, there may be more fundamentalist and unchanging concerns about the use of animals. Furthermore, the information may have effects beyond the context in which it was intended. The general bad reputation of the consumption of products of animal origin, which can be accepted in industrialized



countries, tends to reduce the interest and investment in the advantages of consuming this type of food among the poor populations of low and middle-income countries that it desperately needs the high-value protein and micronutrients they contain [4]. There are environmental and sustainability concerns related to livestock production that require serious reflection with the evolution of farming systems and dietary patterns in various countries [5]. In many low- and middle-income countries, the livestock sector is a key contributor to national economies, accounting for between 15% and 80% of agricultural domestic product, providing a potential pathway out of poverty and essential livelihood for millions of people [6]. In those countries where there are high volumes of livestock production but there are also important problems of malnutrition, an important lost opportunity is constituted, failing to obtain food products derived from livestock that can optimize the nutrition of the most vulnerable [7].

Also, the double subjugation of malnutrition should be considered, characterized by the coexistence of malnutrition together with overweight and obesity, sometimes added to non-communicable diseases related to diet, affecting people throughout their lives. , households and populations [8]. This has great consequences on human health, nutritional problems affect more than 50% of the world's population, 1 in 10 people suffer from malnutrition while 4/10 are overweight and, among the latter, one will suffer from obesity. This also indicates that eating habits cause imbalances between what is produced and what is consumed (WHO, 2016).

On the other hand, considering our legal order - and in that of most countries in the world-, animals have had and, in many cases, still have the category of "things", with or without owners and in the latter case, susceptible to appropriation. As sentient beings owned by other individuals, their condition is comparable to that of human slaves under the socio-economic system of slavery. Recently some countries have begun to change their legislation considering animals as sentient beings. But there are different philosophical positions that condition the professional practice of the Veterinarian and generate ethical and moral concerns about the life of animals that frequently produce conflicts and often distrust in the producers, the people in charge of the animals and ultimately, in the intervention with animals. This article will summarize the current state of knowledge on the challenges of the 21st century related to animal production and food safety, highlighting the characteristics of possible additional positive and negative impacts on human health and the environment.

The challenge of controversial philosophical conditioning

One of the current challenges is the need to provide people who eat food of animal origin, such as meat, milk and eggs, among others, with scientific and ethical arguments that allow them to defend their food autonomy in the context of moral conflict that has emerged in societies around the consumption of products and by - products of animal origin. In addition, it is necessary to reflect on the criticism, even attacks, made on consumers of these foods by activists, ovo-lacto-vegetarians,

or vegetarians with eating habits that emphasize ethical and moral respect for animals. These people refuse to eat meat and animal products, but sometimes show disrespect for those who do. In recent decades, veganism and vegetarianism have reached a peak in some Western societies where it is often considered a healthy option for humans that, at the same time, favors animal and environmental welfare. While such diets can provide numerous benefits, they can also pose health risks by not providing the necessary dietary balance and supplements. Several researchers also agree that they are not appropriate for pregnant women, children, or carnivorous or omnivorous pets. Dietary regimens that lack animal protein often lead to the conclusion that these dietary changes, by themselves, do not reduce animal suffering or pollution generated by the meat, dairy, and poultry industries [9].

Food safety

The United Nations Organization (UN) in Resolution No. 73/250 mentions that "there is no food availability without food security"; and provides advice to help the entire production chain to ensure the supply of food in quantity and quality. To guarantee these principles, they encourage countries and government decision-making bodies, both agencies and institutions, as well as companies and society as a whole, to manage the appropriate measures to maintain the living conditions of the citizens. Governments, producers, and consumers must cooperate and be jointly responsible for food safety (WHO, 2020). The quality of food of animal origin must be considered throughout its supply chain, from the field to the consumer's table, to ensure that they are safe and do not harm health. Any event that affects food security can have detrimental consequences for public health, trade and the economy. Likewise, the Pan American Health Organization [10] highlights that food safety has an effective impact, favoring marketing, facilitating the creation of jobs, and reducing poverty. Furthermore, the pillars of the food chain, which in the COVID-19 context became evident when considering modern production systems are animal welfare, food safety and environmental protection.

Environmental challenges

The environment inevitably influences nutrition, as well as the quantity and quality of food produced. Environmental characteristics determine the type, availability and nutritional composition of foods, define eating habits and have cultural repercussions regarding food choices. When raising the relationship between food and the environment, is immediately linked to the negative impact of food production on the latter. Indeed, environmental pollution is currently a major problem that requires specific actions [11]. Agriculture and livestock occupy 50% of the land surface and employ a third of the world's working people [12-14]. The expansion of agricultural production towards territories not originally suitable [12,14] and sites of considerable biodiversity [12], as well as changes in the intensity of this production, has led to excessive use of non-renewable resources [12,13]. On the other hand, the intensification of animal production has absorbed part of this agricultural production and accentuated the pollution derived



from these activities [15], causing a significant environmental impact [12,16]. In parallel, the increase in the world population estimated for the year 2050 [17] suggests an increase in food production by 60% [16] if the models of production and consumption of food continue. Current foods are characterized by diets based on ultra-processed foods, with excess fats and sugars, which require a large number of resources for their production. Additionally, a large part of the food produced is lost in the first steps of the production chain, while another part is used to feed livestock and/or to generate energy [18]. Likewise, a high percentage of the food produced (30%) is discarded [19] due, in part, to the high-quality requirements of consumers who prioritize physical characteristics (shape, color, size, etc.) among others) over nutritional requirements [20]. This not only has a negative economic impact but also has enormous effects on the environment.

Soil degradation, water, and air pollution affect the health of people, as well as plants and animals. The increase in global temperature influences the productive, and reproductive potential [21–23] and the immune system of animals in production decrease the gene expression of certain cytokines and their receptors [24–29], which could increase susceptibility to opportunistic infections. This has direct and indirect repercussions on the economy of the producers [30] and, potentially, on the safety of food derived from these animals.

Several factors, such as poverty, social inequity, environmental pollution, and inefficient use of resources, among others, are associated with the lack of access of some sectors of the world population to a healthy diet in terms of quantity and quality. Current scenarios demand a new paradigm for animal production, emphasizing the development of new production systems and techniques that consider the ethical principles of sustainable development and the commitment to promoting well-being. This implies the development of production strategies that guarantee the conservation of the natural environment, that is, the preservation of natural resources, without endangering healthy communities and, in turn, ensuring the profitability of producers and the vitality economy that contributes to consumer satisfaction. According to Paranhos da Costa [31], sustainability in animal production can only be achieved under the concept of ONE HEALTH/ONE WELFARE.

To achieve sustainable production systems, it is necessary to radically modify current systems, choosing those that optimize efficiency in food production and the use of natural resources, recycling and reuse. It is necessary to implement policies that promote and strengthen the production of native animals [32], re-educate consumers in sustainable consumption, varied diets, rich in vegetables, and moderate consumption of products of animal origin that guarantee the incorporation of the necessary daily nutrients [15,33], reducing the consumption of ultra-processed products.

Final conclusions

Current food production is destroying the environment on which current and future food production depend. Deforestation, soil degradation, loss of biodiversity and water

pollution are some of their consequences. At the same time, environmental impacts are beginning to make food production more difficult and unpredictable in many regions of the world [34], while failing to ensure adequate and affordable nutrition for all [35–44]. Current consumption habits have the potential to exacerbate obesity/malnutrition problems and chronic diseases. It is necessary to adopt measures focused on both production and consumption and establish objectives based on the three pillars of sustainability: environment, economy, and society, which guarantee biodiversity, ecosystems, food and nutritional security, and healthy life for current and future generations. This will undoubtedly be one of the great challenges of the 21st century.

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