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Review

Risks and controversies in the social construction of the concept of healthy food: the case of soy

ABSTRACT

Controversies and risks in the social construction of the concept of healthy food are discussed, using soybean as the object of study. Studies concerning the impacts of soy on human health and the effects of its cultivation on the social-environmental domain were reviewed to analyze the political context of the discussion surrounding soy and the socio-environmental repercussions of its cultivation. Based on the sociology of scientific knowledge and the environmental sociology, a thin line between healthy and risky food was identified, vulnerable to different reflexively constructed influences. It is important to broaden the concept of healthy food to healthy alimentation and to consider its cultural and social-environmental dimension.

DESCRIPTORS: Health Food. Social Marketing. Environmental Health. Soybeans. Soy Foods. Review. Risks. Controversies. Healthy eating.

INTRODUCTION

Giddens[17] and Beck[4] have highlighted the question of risk as the key to understanding our current society by engaging in debates about social conflicts, the relationship between non-experts and experts and the new role of science. For these authors, risk is one of the central characteristics of reflexive modernity and is a byproduct of the doubts and problems that cannot be solved by science previously. According to Giddens,[17] the concept of reflexivity is central to understanding the changes occurring in the world today, including in science. The term "reflexivity" relates the fact that, today, "social practices are constantly examined and reformed in the light of renewed information about these very practices, thus changing its character constitutively" (p. 465). As a consequence of reflexivity, questions of risk are a widespread characteristic of modern critical reasoning, permeating life and lending an existential dimension to the world and modern science.[17]

Parallel to the study of risk, the study of controversy has become a methodological tool for understanding the sometimes invisible social and political dimensions of science. Within this field, it is possible to learn about the dynamics of the effective production of science and technology as it relates to society. Areas of disagreement facilitate investigations of the metaphors, clashes and assumptions embedded in apparently neutral discourses.[41]

Throughout history, culturally diverse food habits have been gradually replaced by a standard diet, as defined by scientific parameters and the perspective of the modern system of food production.

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This dominant system is based on technological breakthroughs and scientific discoveries in agriculture (e.g., the use of synthetic fertilizers and pesticides, genetic improvements and mechanization of food production); large-scale production (local and global); industrialization; the disconnection of the food supply from seasonality; distribution and marketing at major retailers; the availability of choices to anyone who can afford food; inequalities in nutrition between and within societies; and the social and environmental impacts related to the model of production.[3] More recently, biotechnology has been applied to the food system, as evidenced by the development of transgenic crops and foods produced by nanotechnology.

The accumulation of scientific research on production and food quality since the eighteenth century has increased our knowledge concerning nutrients and their functions. The laws of chemistry applied to agriculture have helped to produce food on a massive scale, and advanced technology has been used to create new food products while preserving others.

Innovations in production, processing, preservation and distribution have generated greater food availability, adequate sanitation and food at fairer prices. Because such practices have resulted in many positive advances, it is difficult to accept the fact that many populations are still subject to living with risk and uncertainty with regard to the current agricultural food system.[20]

However, uncertainties surrounding the food-health-disease triad have recently intensified or have at least been expressed more intensely. In addition to the risks that have long accompanied human expansion, e.g., food shortages and biological contamination, there are now global risks that occur in contemporary society, arising from the chemical contamination of food and the use of new technologies in both food production and food processing, such as irradiation, genetic modification and nanotechnology.

Doubts concerning which foods are healthful and which foods are risky to ingest have become current topics in the science of nutrition and health. Such questions bring uncertainties for both non-experts and experts and raise the following question: how are relations of power established between the various expert systems in defining what 'health food' means?

To answer this question, the social construction of the concept of health food is described below, using soy as a case study, which is only one of among many products that might be used to address the issue of risk and scientific controversies.

The consumption of soy has increased significantly and appears to be linked to health benefits. However, there are a few unknown controversies surrounding this topic. We also discuss the socio-environmental risks related to soy cultivation, which are often ignored in the definition of soy as a healthful and safe food.

CONTROVERSY IN SOYBEAN RESEARCH

Since the 1990s, soybean research, which has focused on the functional aspects of the grain with a concentration on noncommunicable diseases, has become one of the most dynamic within the field of nutrition.

Soy gained the status of a functional food based on the research of authors such as Clarkson, who studied its preventive action in cardiovascular diseases.[9] Moreover, the daily consumption of legumes has also been associated with the prevention and treatment of disorders such as hypertension,[18] hypercholesterolemia[55] and osteoporosis.[38] Research long these lines[38, 50] suggests that the presence of phytochemicals in soy make it a functional food, capable of playing a role in the prevention of menopausal symptoms, whereas other studies claim that eating soy helps to prevent the development of some types of tumors, such as prostate cancer,[19, 54] breast cancer[14, 29, 53] and urinary tract cancer.[49]

The controversy surrounding the soybean emerged from a survey concerning contraindications to the regular consumption of non-fermented soy. Such restrictions already exist in the food culture of ancient Asia, which is a culture that regularly consumed fermented soybeans in the form of *miso*, *shoyu*, *natto* and *tempeh* and that used the non-fermented grain only for green compost.[47]

Studies discouraging the intake of non-fermented soy have identified different nutritional disorders associated with its consumption, including the iron[11,22] and zinc[34,48] malabsorption, the inhibition of trypsin,[2,31,42,43] the accumulation of kidney stones[36] and the induction of soy allergies.[44,52]

Other studies suggest the correlation of soybean with disorders such as hyperplasia and nodule formation in the pancreas.[32,33] Groups of researchers have identified isoflavones as a potential agent in the etiology of thyroid dysfunction in adults and children.[8,13,16,26,27] Research also suggests that isoflavones inhibit the synthesis of estradiol and other steroid hormones, causing hormonal disorders.[6,10,28] Such hormonal imbalances may have a particularly strong impact on male newborns, who are particularly vulnerable to the action of these substances.[23,24,45] Finally, recent research has associated high soy consumption in men with infertility in adults[7] and dementia in the elderly.[21]

Some specific controversies can be highlighted in these studies. The relationship of soy phytates and their iron blocking activity has been mentioned in some research[11,22], whereas it has been questioned in other studies.[5,35] Thus, there is no definitive conclusion on this

issue. In addition, the Food and Drug Administration (FDA)[a] considers the evidence in the area research of soy phytate effects on zinc absorption [34, 48] to be inconclusive and difficult to interpret.

Other controversies have appeared in the literature with respect to soy consumption and the incidence of breast cancer. Although some studies[29,30] show that soy is protective against breast cancer, others warn that the estrogenic effects of isoflavones may be harmful for women prone to this hormone-dependent cancer.[12,30,39,40] A recent review suggests that such a relationship does not exist, and this topic must be investigated in more depth.[51]

Although these disputes have not been resolved and the actual risk of this food product has not yet been determined, scientific dilemmas always come with the recommendation that more studies should be conducted. Given the inconclusiveness of the data, the food industry has chosen to emphasize only those studies that help to boost their sales and raise the awareness of health experts.

It is known that 60% of processed foods available in American grocery stores contain soy.[15] Among these products are soy extract-based juices, veggie burgers, chicken and meat sausages, cakes, ice cream, milkshakes, cereal bars and even fruit-flavored water. In Brazil, the amount of invisible soy consumed via industrialized foods does not differ much from that found in the United States and is progressively increasing. This increase is a result of a strong marketing strategy backed by scientific research and targeted at consumers who are particularly concerned with health issues.

POLITICAL CONTEXT OF RESEARCH ON SOYBEAN PRODUCTION

The scientific process is a social one that includes the relationships between the interest of scientists, their institutions, and various others who may or may not want to make an issue relevant.[25] Policy issues have an impact on this discussion and relate directly to the soy consumer market.

Scientific evidence concerning the properties of isoflavones in reducing cholesterol levels were presented by Anderson et al.[1] in a study funded by DuPont Protein Technology International (PTI) in 1995. PTI is an American marketer of soy protein and fiber-based ingredients, which, in the same year, requested FDA approval for soy isoflavones in relation to cardiovascular health.

Various institutions responded to this study, and subsequent studies showed the adverse effects of isoflavones.[b] In 1998, the FDA requested a rewrite of the PTI's petition, removed the references to isoflavones and substituted isoflavones with the term soy protein. Rewriting a petition is against the regulations of the U.S. Federal Court, because the FDA is only authorized to make rulings on substances presented by the petition. Even with the change of the term isoflavones to soy protein, the FDA was obligated to review the concerns of scientists regarding the effects of protein and other substances found in soy. One of the strongest objections came from government researchers at the National Center for Toxicological Research, the Toxicological Research Center of the FDA itself, which questioned the method used in the research by Anderson et al.[1] and asked for warning labels concerning the adverse effects of isoflavones to be placed on all products based on isolated soy protein. Such warning labels were considered unnecessary by the regulator. Instead, the regulator authorized the label to report that soy was beneficial in preventing some types of cardiovascular diseases.[a] This particular labeling regulation brought attention to this food product and increased its media support. As a result, there was an increase in the sale of the product and its consecration as a functional food.[15]

Other types of research support can be cited. The United Soybean Board, which is the American institution of soybean producers that manages the research and marketing development of the legume, maintains the Soy Health Research Program. This program encourages scientific research by offering grants to qualified researchers who intend to study the consumption of soy and its impact on human health. Scientists can submit their research and receive prizes of up to US$10,000. In 2010, US$100 million was invested in the field of soy research.[c] Most states have their own research centers, also known as State Soybean Boards, which fund studies on soy and human health.

Another source of grants is the Soybean Promotion and Research Order, which was authorized by the Soybean Promotion, Research, and Consumer Information Act.[d] This 1990 decree authorized the establishment of a national program for consumer information and the promotion of national research on soybeans inspected

[a] Food and Drug Administration. Food labeling: health claims; soy protein and coronary disease. *Fed Regist* [Internet]. 1999 [cited 2007 Oct 5];64(206):57699-733. Available from: http://www.fda.gov/Food/LabelingNutrition/LabelClaims/HealthClaimsMeetingSignificantScientificAgreementSSA/ucm074740.htm

[b] IEH Laboratories & Consulting Group. Assessment on phytoestrogens in the human diet: final report to the Ministery of Agriculture, Fisheries and Food, UK. 1997. p.11.

[c] United Soybean Board. Soy Health Research Program [cited 2010 Mar 5]. Available from: http://dor.umc.edu/RT/2010%20Application%20Instructions%20&%20Cover%20Form.pdf

[d] Soybean Promotion, Research and Consumer Information Act [cited 2008 Dec 9]. Available from: http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELDEV3099445

by the Agricultural Marketing Service of the United States Department of Agriculture (USDA). The program's goal is to strengthen the favorable position of the grain and to maintain and expand its local and global market. American soybean producers invest between 0.5% and 1% of the net market price of the grain. The total value of that is around $80 million; this sum is intended to fund research and consumer information, which strengthens and expands the consumption of soy products.

Specific symposia, supported by the United Soybean Board and the Soyfoods Association of North America, are regularly promoted, with a focus on research that encourages the consumption of soy and reports its benefits to human health. Among them, there are the different versions of the International Symposium on the Role of Soy in Preventing and Treating Chronic Disease, which are attended by health professionals and executives from the food industry.[37]

In Brazil, Embrapa Soja has been dedicated to expanding the human consumption of soybeans since 1985. Initially, the program focused on improving the organoleptic characteristics of soybeans with the support of genetics and food technology. This was followed by a program of popular education and the dissemination of soybeans, which included the development of experimental cooking, the sharing of recipes and the promotion of classes, courses and lectures for non-experts and health professionals. Currently, Embrapa Soja offers well-structured communications advice, which encourages the placement of research developed by the company and feeds soy reports to the media.

A soybean research network has also been developed in Brazil that involves federal and state governments, with financial support from companies like Swift, Anderson Clayton and Samrig. With the Plant Variety Protection Act (LPC - *Lei de Proteção de Cultivares*) in the 1990s, new private research programs were established in the country; among these are Monsoy, the Mato Grosso Foundation, Syngenta, Pioneer and Milênia.[e] Since 1997, the LPC has provided a form of intellectual property protection rights for researchers to encourage investment in agricultural research. Since it was enacted, a plant variety protected by the seed producer can only be used upon authorization by the creator of the cultivar, which may or may not require payment of royalties for its commercial exploitation.[f]

ENVIRONMENTAL RISKS OF SOYBEAN PRODUCTION

According to the World Health Organization,[g] environmental health is the part of the public health sector that deals with the life forms, substances and conditions surrounding human beings that may exert some influence on their health and wellbeing. Environmental risks can be observed in various types of crops that are linked to the modern productive pattern. These risks should shape the concept of healthy food, as environmental balance is linked to the concept of human health. Health practices imply a perception of the environment and its positive or negative condition. They both increase concerns about the world and demand an ethical position with respect to the regulation of new environmental conditions.[46] Ecology, which had previously been focused on external studies of the environment, has increasingly become a study of its relationship with humans, thus expanding the notion of environmental health.

Analysis of the concept of healthy eating from the perspective of current Brazilian public policies, especially the Food and Nutrition Security and School Meals, shows that new concerns are being incorporated. The theme of access to food, which had been the focus of previous policies, has been amplified by concerns related to the quality and growth conditions of food, its cultural components and the socio-environmental aspects related to its production and origins.

In general, the soybean crop fits into the modern agricultural production system, in which production adopts farming practices that have a major environmental impact, including effects on soil fertility, the biological diversity of flora and fauna, water pollution and climate. Ecosystems with high biodiversity, such as the Atlantic forest, the Cerrado and the Amazon rainforest, are highly affected by the promotion of planting areas. More recently, the use of transgenic seeds has had a negative impact on the habitat as well as the health and quality of life of human beings.[h]

The socioeconomic dimension must also be considered in assessing risks. Given the current pattern of production, farmers' dependence on agricultural technology companies has resulted in the exodus of native peoples from cultivated areas and excludes small farmers from a production process that is not economically viable for them. According to the Second Report of the Brazilian Platform on Human, Economic, Social,

[e] Vidor C, Fontoura JUG, Rocha CMC, Marcos Filho J. Tecnologias de produção de soja: Região Central do Brasil, 2003 [cited 2007 Feb 22]. Available from: http://sistemasdeproducao.cnptia.embrapa.br/FontesHTML/Soja/SojaCentralBrasil2003/index.htm
[f] Bragantini C. Lei de Proteção dos Cultivares. [cited 2011 Apr 5]. Available from: http://www.agencia.cnptia.embrapa.br/Agencia4/AG01/arvore/AG01_118_131120039558.html
[g] World Health Organization. Environmental health indicators: framework and methodology. Geneva; 1999. (WHO/SDE/OEH/99.10) [cited 2003 Jul 5]. Available from: http://whqlibdoc.who.int/hq/1999/WHO_SDE_OEH_99.10.pdf
[h] Dros JM. Administrando os avanços da soja: dois cenários da expansão do cultivo de soja na América do Sul. Amsterdã: AIDEnvironment; 2004 [cited 2007 Mar 27]. Available from: http://assets.panda.org/downloads/managingthesoyboomportuguese_d7mr.pdf

Cultural and Environmental Rights,[i] soy production is also tied to the socio-cultural disintegration of the native population from regions of cultivation and to the concentration of land ownership, including land grabbing and slave labor actions.

Although soy is a generator of wealth, the proceeds of its production do not always reach the base of the social pyramid. A study by Dros[j] showed that food safety and the land ownership rights of disadvantaged populations have not improved in areas where soy production has expanded.

Considering the concepts of environmental and social health as dimensions that shape and expand the concept of human health, the question that arises is how healthy can a food be if it promotes environmental pollution, the loss of biodiversity and social exclusion. The production of healthy food, along with the preservation of the environment and social inclusion, often conflicts with the dominant model of food production.

FINAL CONSIDERATIONS

The varying scientific views involving soy as a healthy or risky food become a legitimate social construction when the complexity of the context in which the risks arise and in which the controversies are researched is considered. Without such consideration, any position that is taken, regardless of whether it favors or opposes soy consumption, can only be irrational.

This is because each of the concepts expressed carries only a part of the truth, because science and its representatives utilize resources that cannot be understood in a logical or illogical perspective, but must be understood sociologically.

The practice of reflexivity, which drives many of the social transformations of modernity, should be considered here in the process of social analysis, because it has become increasingly difficult to actually define health food. Various food choices have been subjected to constant revisions, based on new studies and information. With so many options, there are also many uncertainties. Thus, one can say that doubts about what is a healthful or risky food are the product of reflexivity and are a part of modernity, two concepts whose boundaries are tenuous and vulnerable to different influences that are reflexively constructed.

The research on soy is another example of a debate that science has not yet resolved. In light of our findings, it is clear that the discussion surrounding the use of soy for human consumption will not be moving toward a consensus in the short-term and will likely remain a growing controversy. This is due to the fact that, although debate between experts is still incipient in Brazil (in contrast with the United States, for example), the local media has been repeating the research questioning whether soy is a healthy food, and the socio-environmental impact of soybean crops is becoming better known. Despite the complex social and environmental components that may hinder the resolution of disputes, the discussion is gradually involving more actors, and a recognition of the risks should promote reflexivity and contribute to diluting the controversy. More scientific studies alone cannot resolve the complex controversies around the concept of healthy food.

We also highlight the fragility of this concept, given the innumerable determinants of health. Therefore, we must think not only in terms of healthy food but also in terms of healthy food placed in a broader context of wellness. Even with the trend towards standardization of the concept of healthy eating, which is based on restrictive practices and the modern rationalization that emphasizes the energy-quantitative perspective, this concept is becoming more porous and flexible and includes the cultural and socio-environmental dimension, which involves the act of eating, as well as its polysemic nature.

[i] Plataforma Brasileira de Direitos Humanos Econômicos, Sociais, Culturais e Ambientais. Relatorias Nacionais em Direitos Humanos Econômicos, Sociais, Culturais e Ambientais - Informe 2006. [cited 2008 Feb 8]. Available from: http://www.direitos.org.br/index.php?option=com_remository&Itemid=99&func=startdown&id=256

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