

INFLUENCE OF THE CONTEMPORARY INDUSTRIAL AGRICULTURE ON CONSUMER HEALTH

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All agricultural systems affect significantly the environment. The contemporary problem concerns the risk to health brought about by chemicalization of agriculture. This article presents examples of the possible negative effects of today's agricultural methods on human health and provides solutions to these problems through the transformation of agriculture to one that is ecologically balanced and environmentally friendly. It also shows new trends in agricultural research and comprehensive points of view brought to the problem by interdisciplinary research.

agricultural systems; quality of products – consumers' health

Introduction

Contemporary production methods in agriculture, together with other activities of the industrial society, have an obvious negative effect on natural resources, the environment and live organisms. This state of affairs is due, among other reasons, to the effects of both the industrial methods and chemical inputs of the past several decades. Today's agriculture is a production process following the same rules that apply to other branches of industry. Its main goal is to produce foodstuffs as cheap as possible neglecting all other aspects except for the monetary policy. It is a well-known fact that human health very much depends on food. Since the past century foodstuffs have been mostly produced and processed with the use of synthetic chemicals that have not occurred in nature before. Other factors of intensification comprise cultivars unilaterally bred for quality traits and genetically modified crop varieties, as well as massive inputs in nutrients influencing the quality and composition of products. Man as a consumer and biological entity has been exposed to the modified products of industrial agriculture for a comparatively short period of his development. It should be kept in mind that hunter-gatherer diets consisted mostly of plant products belonging to at least 500 plant species for many millions of years. Agriculture that started several thousands of years ago reduced this assortment to a few crops, e.g. maize, rice, wheat etc.

Experts and laypersons currently debate on the potential health risks within the context of contemporary agriculture characterized by high inputs in chemicals which also casts serious doubts upon present ways of food production.

During the past several years, the attention of both society and researchers has been directed at the tangible problems of environmental pollution and the devastation of natural resources. In spite of this, the general impact of the modern farming system on human health has not been fully taken into consideration, particularly in terms of scattered and worsening parameters affecting fertility, immune and hormonal systems, allergies, malignant neoplasms etc. Medical research and related branches of science have started to study the occurrence of alien substances in foodstuffs (both natural and artificial), and their influence on consumer health.

Worldwide, there have been few studies dealing with the effect of agrotechnical factors, such as plant breeding and the selection of cultivars, fertilization, food and drinking water contamination by pesticide residues, animal husbandry systems, and the composition of products on consumers' health. Rare studies have shown that consumer fear is legitimate and these problems may grow to unpleasant proportions in the future.

Examples of contemporary problems

In Western Europe male fertility is decreasing. In Denmark, a comparison was made between a group of approximately 30 ecological farmers growing and consuming mostly bioproducts, and the mean of the Danish male population. Biofarmers had, on average, 105 mill sperms per 1 ml of semen, whilst the mean Danish population only 50–55 mill. Moreover, it should be emphasized that two generations ago a normal rate was 120 mill sperms per 1 ml of semen (Carlson et al., 1992).

Similar figures were found in Sweden where there has been nearly a 50% decrease in the number of sperms during the past several decades, i.e. from 113 mill to 65 mill per 1 ml of semen. The workers of the newly established Centre for Fertility Research reported a negative effect of some agricultural pesticides and plastics softeners on sperm count (Giwercman, 2000).

Research from Spain described correlations between retention of the testicles and pesticides consumption in different agricultural areas (García-Rodríguez et al., 1996).

Swedish farmers who currently use pesticides containing phenoxyacids (MCPA) transfer a genetic risk to their offspring of increased incidence of leukemia, lymph node and brain tumours (Flodin, 1995).

Small doses of DDT and its pesticidal substitutes that are not dangerous to mature animals can cause permanent changes in both the behaviour and the nervous system (brain injury) of newborn mice. They can also evoke increased sensitivity to some chemicals later in their life (Ahlbom, 1994).

DDT and low concentrations of registered insecticides (e.g. pyrethroids, organophosphates) can adversely influence the developing brain of babies in the prenatal period and immediately after birth (Eriksson, 2000).

Some American papers have reported that decomposites of DDT, PCB (DDE and PCE) and other pesticides and antioxidants in plastic bags (nonylphenols) have a similar molecular structure as estrogens, so that they may affect receptors and thus impair the human hormonal system (Begley, Glick, 1996).

A comparative study of mothers from Mexico show increased effects of DDE in mother's milk with duration of suckling (Barlow et al., 1999).

Possibilities of environmental contamination are of great concerns, in that the introduction of very small amounts of chemicals can significantly effect hormones which play such an important part in the functioning of our bodies. Polychlorinated biphenyls (PCB) and some pesticides that get into the food chain are referred to as endocrine disrupters. They were defined by the US Environmental Protection Agency as "an exogenous agent that interferes with the production, release, transport, metabolism, binding, action or elimination of natural hormones in the body responsible for the maintenance of homeostasis and the regulation of developmental processes". There is evidence that for example the organochlorine POPs pesticides DDT, dieldrin, toxaphene and chlordane, mirex, and endosulfan are endocrine disruptors. There are also results after accident with chlordane where exposed men had a lower sperm count. The dramatic decrease in sperm count in men all over the world may be due to unintentional exposure to endocrine disrupting chemicals (McLachlan, Arnold, 1996).

Numerous research centers have carried out different epidemiological studies dealing with the effect of xenobiotics on the human thyroid gland. Mechanisms causing thyroid gland enlargement and increased prevalence of thyroid disorders remain unclear. Long-term exposure to

the above compounds has multiple effects on the thyroid gland including possible damage to cell membranes, interference with metabolism of peripheral thyroid hormones, immunomodulatory and other non-specific effects. An estrogen-like effect on the thyroid gland could also be admitted, because some PCB estrogen effects may lead to thyroid gland growth (Langer et al., 2000).

According to a French experiment (Aubert, 1974) the content of chlorinated carbonates in maternal milk decreased with the rising amount of consumed bioproducts.

Residues of fungicides and their metabolites react at higher temperatures (cooking) with inorganic compounds to produce carcinogens and mutagens. The formation of nitrosoethyleneurea as a result of the reaction between ethylene-thiourea (dithiocarbamate decomposite) and nitrates serves as an example (Schüpbach, 1986).

A study conducted at the University in Odense warns that CCC growth regulator residues may participate in the development of testicular carcinoma. Another Scandinavian study in Denmark, Sweden and Finland recently reveals that the incidence of testicular cancer has been increasing in most industrialised countries (Adami et al., 1994).

Pesticide Lontrel Combi, at a rate of 3.5 kg per ha, contains 200 g MCPA, 400 g Mecoprop, and 21 g 3,6-dichloropicolinic acid. The residues of picolinic acid in 20 g flour obtained from the wheat treated with the above preparation reached a theoretical concentration of 0.0004 ppm that is difficult to assess by means of contemporary analytical methods. In a biological test with green peas where 1 kg soil was supplemented with 20 g flour obtained from experimental variants with 0, 3, 6, and 9 kg herbicides per ha; plant growth was inhibited at the rate of 3 kg and more (Ebbeisen, 1983).

A trial performed in New Zealand gave significant evidence of the incidence of small intestine adenocarcinoma in animals from pastures treated with the herbicides containing phenoxy- and picolinic acid (Newell et al., 1984).

Pesticidal substances and their residues are not only taken up by man through foodstuffs, but industrial farming systems also infiltrate waters. This is documented by a study of the occurrence of environmental toxins and residues of pesticides influencing hormonal systems in the underground waters of Europe (Ringvold, 1986).

Drinking water resources in the agricultural regions of nearly half of France contain more than 50 mg nitrates per 1 litre, and moreover, there are some residues of pesticides, too. The nitrate content is increasing at a rate of 1–5 mg per 1 litre per year. In 10 years, for example, 70% of water resources in Brittany will be unconsumable. Even if the input of alien compounds were to be stopped immediately, a decrease in toxic compounds in drinking water will only start in 10–15 years (Vadrot, 1986).

The level of mixture of pesticides (atrazin, aldicarb) and nitrates which correspond to common contamination

of groundwater in many U.S. agricultural regions change weight, level of thyroid gland hormones and aggressivity of laboratory mouse (Porter et al., 1999)

Nitrates contained in drinking water may influence the thyroid gland. There are some well-founded theories about how nitrates interact with intrathyroidal iodide stores. This can be particularly significant under conditions of threshold iodine levels which might hamper the supply of thyroideal hormones to the organism. The nitrates may even affect the peripheral thyroxine metabolism (Tajtáková et al., 2000).

Water resources in different countries contain perchlorate salts originating from some industrial fertilizers. There is some evidence that perchlorates can pass through the human placenta and thus could be harmful to a foetus due to a decrease in iodine stores in thyroid gland followed by its functional disorder (Lawrence et al., 2000).

Industrialization of animal husbandry as a part of contemporary agriculture and new methods of plant breeding are other factors increasing a risk of negative impacts of agricultural systems, e.g. the occurrence of bovine spongiforme encephalopathia (BSE), and at present, rare and poorly documented suspicions about the harmful effects of genetically modified organisms (GMO) on human health.

It is probable that the proportion of well-informed consumers concerned about food quality will increase in the information society of the 21st century. This suggestion is supported by public opinion polls performed in Germany and Sweden (Mathisson, Schollin, 1994; Meier-Ploeger, 1989). More and more, experts are pointing to more global and less visible changes in our ecosystems due to an excessive use of fossil fuels and all sorts of chemicals. This behaviour is starting to have negative consequences for humankind. Live organisms are exposed to the negative impacts via water, food-stuffs, air which are expressed as increased morbidity, mortality, impaired quality of life, higher incidence of malignant neoplasms and decreased fertility. There are some diseases, most probably related to environmental factors, namely atopic allergies and asthma, osteoporosis, Crohn's disease, soft tissue sarcomas, diabetes, non-Hodgkin lymphoma and malignant melanoma (Foucard, 1996).

Ecological agriculture as a possible solution to contemporary problems

It seems quite obvious that future research and development should be oriented toward new biologically, ecologically, socially and economically balanced sustainable agroecosystems.

One of the options is ecological farming in EU defined by CR (EEC) No 2092/91. This type of a production system was launched in Western Europe in the late 60's as a critical reaction to industrial farming methods. Organic farming was closely related to holistic, interdisciplinary thinking where a system is optimized as

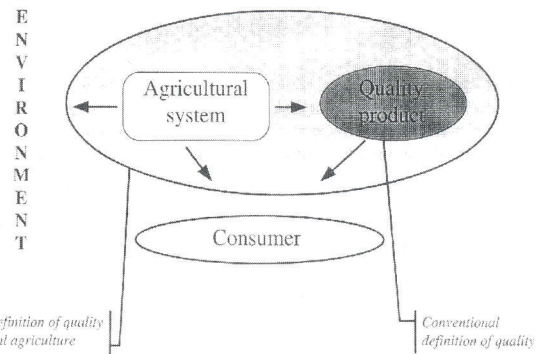


Fig. 1. Conception of quality

a whole structure to get higher efficiency, not only its elements, e.g. by means of once-through inputs in efficient chemicals.

At present, ecological farming is defined as a well-balanced, sustainable agroecosystem which is based as much as possible on local resources and their reclamation, and benefits from biological processes. In this system, nature is considered a compact unity characterized by its own inner value. Man has a moral duty and responsibility to apply proper farming approaches to make the landscape a positive part of nature.

Product quality is a crucial aspect of ecological farming closely related to the quality of the system itself. Much attention is being paid to the impacts on the environment, properties of products as well as sociopsychological and ethical aspects.

Some comparative studies (Dlouhý et al., 1996) have shown differences in the quality of products obtained from traditional and ecological farming. In general, bioproducts are characterized by the following properties:

- higher nutritional value due to increased content of vitamins, minerals and improved biological quality of proteins,
- better sensory and storage quality,
- absence of pesticide residues.

Feeding trials have confirmed that the animals fed with organic products normally exhibit

- increased fertility and resistance to infections, and
- the efficiency of feed is higher.

An important feature of ecological agriculture is the principle of cautiousness which is based on a condition that a lack of knowledge on the environmental and health risks of agrochemicals and genetic manipulations should exclude them from practical use. The absence of pesticide residues and therefore of certain types of risk, is considered one of the merits of a bioproduct.

Priorities for further research

In general, that way of thinking which has focused on the narrowest possible specialization has resulted in minimum communication among various branches of science. Consequently, agricultural experts concentrated

only on the production and technology issues, but unfortunately paid little or no attention to potential impacts studied by other disciplines, e.g. medical science. On the contrary, medical sciences neglected the fact that agricultural products could be affected by different cultural practices and further processing procedures (e.g. industrial fertilizers, pesticides, plant breeding, genetic manipulation, food additives etc.).

There is an urgent need to prepare prerequisites for system and interdisciplinary approaches to solve the above and many other problems including such issues as the exploitation of natural resources, product quality, and consumer health.

Contemporary industrial agriculture is dependent on external inputs, and ecological as well as biological imbalances are mostly managed by using synthetic pesticides, chemical fertilizers and chemotherapeutics. It is now quite obvious that this system cannot meet the requirements of sustainable development. In parallel, there is a serious suspicion that modern agriculture is threatening the health and well-being of consumers.

In the future, science and research should focus on developing new methods and production processes throughout society to satisfy such demands. It is necessary to reduce the depletion of raw material resources and minimize the change-over of this valuable wealth to dispersed pollutants. A major effort has to be directed to reducing environmental contamination by alien substances. All human activities in the landscape should respect its capacity and natural potential in the context of sustainable development.

To tackle the above problems will require new priorities in agricultural research focusing on:

- multidisciplinary and interinstitutional approach,
- definition of quality parameters and indicators of whole systems and their effects on the environment, product quality, consumers and efficiency,
- develop new farming systems that would have a positive impact on consumers and meet all the requirements of sustainable development.

Future farming systems should head towards

- better buffering capacity, lower vulnerability and higher tolerance to stress and variation of external factors,
- maximum biological diversity,
- ability of maximum exploitation of biological processes,
- maximum recirculation ability within closed systems,
- ability to produce high-quality and healthy products.

Conclusion

Contemporary production farming methods have a negative impact both on live organisms and their environment. The paper demonstrates numerous examples of adverse effects of industrial agricultural systems with chemical inputs on food-chain exposure and the incidence of diseases. The analyses have revealed the necessity for future development of agricultural systems that

will be environmentally friendly farming where food and healthy for consumers. One of the options is today's ecological quality is a priority, and where it is considered a result of the quality of the entire production system. It is also essential to define parameters and indicators for quality assessment in the context of a multidisciplinary approach in close cooperation with biomedical research. Medical doctors should also be involved in developing new agricultural production systems. Medical research should provide criteria for safe and healthy food products and agronomic research embody its realisation within food production.

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Vliv současného industriálního zemědělství na zdraví konzumentů.

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Produkční metody současných industriálních zemědělských systémů mají prokazatelně negativní vliv na přírodní zdroje, prostředí a živé organismy. Intenzifikace zemědělské produkce s vysokými vstupy pesticidů a minerálních hnojiv vyvolala diskusi o vzniku potenciačních rizik pro zdraví konzumentů. Negativní vliv moderního zemědělství, hlavně agrochemikálií, na lidské zdraví je ještě velmi málo zkoumanou otázkou. Existují však ojedinělé studie týkající se například problémů snížené fertility, poruch imunitního a hormonálního systému, alergií, malignit, jejichž příklady uvádíme v článku.

Jako jedno z možných řešení uvedených problémů je přechod na ekologické zemědělství, které používá pro prostředí šetrnější produkční metody a poskytuje produkty s prokazatelně vyšší nutriční hodnotou, lepšími senzoryckými i skladovacími vlastnostmi a hlavně bez nežádoucích reziduí. Pozitivní efekty konzumace ekologických produktů byly prokázány i v chovu zvířat, mj. zvýšenou fertilitou, zlepšenou imunitou a lepším využitím krmiv. Chápání kvality v ekologickém zemědělství tím zahrnuje nejen kvalitativní vlastnosti vlastních produktů, ale i kvalitu celého zemědělského systému a okolního prostředí i jejich souhrnný vliv na konzumenta. Kvalita produktu je tudíž výsledkem kvality celého produkčního systému. Otázka vlivu zemědělského systému na kvalitu produkce a na zdraví konzumentů je komplexní a vyžaduje interdisciplinární přístup, tzn. účast výzkumu jak zemědělského (vývoj nových produkčních metod), biologického a ekologického (vývoj indikátorů kvality prostředí), tak i lékařského (vývoj kritérií pro hodnocení zdraví a wellbeing).

zemědělské systémy; kvalita produktů – zdraví konzumentů

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