Contaminants and micro-organisms in organic and conventional food products.

L.P.L. van de Vijver, L.A.P. Hoogenboom, N.J.G. Broex, J. van der Roest, J.G. Bokhorst, M.D. Northolt, D. Mevius, J.A.C. Meijs

Abstract - In the Netherlands we investigated animal and plant products on potentially hazardous contamination with heavy metals, mycotoxins, pesticide residues, pathogenic micro-organisms and nitrate. In most cases, the organically produced foods had equal or lower amounts of contaminants than conventionally produced products. These results conflict with a common idea that organic farming theoretically increases food safety risks. For many contaminants organic food showed a large diversity in the amount of contamination. Experience with organic farming, managing and manure use partly explain these differences. Understanding of these cultivation parameters can help in further improvement of organic cultivation practices.[1]

INTRODUCTION

Organic farming is a cultivation system which theoretically can lead to problems concerning food safety. One of the common ideas in conventional farming is that organic products will contain more mycotoxins and that micro-organisms such as Salmonella and E. coli will be more common on organic plants because of the use of organic manure. Further, the outdoor run of animals might enhance the chance of bacterial contamination and therefore is thought to be more common in organic farming.

To further investigate these potentially hazardous contaminants a study was undertaken in which the organic farming system was investigated and compared with data from conventional farming, partly from this study, and partly from other ongoing monitoring studies. The analytical data were combined with information on cultivation system, to investigate the underlying reasons for the observed differences.

METHODS

In this study several plant and animal food products were investigated on the presence of contaminants and pathogenic micro-organisms. Wheat, lettuce, potato and carrot were selected because these foods are the most successful organic products in the Netherlands and give a reasonable good impression of the Dutch food pattern. Further fattening pigs, dairy cows, laying hens and eggs, and broilers were investigated. Contaminants investigated were; heavy metals, mycotoxins, pesticides, nitrate, Salmonella, E.coli O157, Campylobacter, antibiotic-resistant bacteria and veterinary medicines. In table 1 the investigated food items and the parameters for contamination are presented.

Table 1. food products and parameters

Food product	Contaminants
Wheat	Heavy metals, mycotoxins, pesticides
Lettuce	Heavy metals, nitrate, pesticides, salmonella, E coli O157
Carrot	Heavy metals, nitrate, pesticides
Potato	Heavy metals, nitrate, pesticides
Fattening pig	Salmonella, E coli O157, Campylobacter, antibiotic resistant bacteria in manure, heavy metals and veterinary medicines in meat and kidney
Dairy cows	E coli O157 in manure, veterinary medicines in kidney
Laying hens	Salmonella in manure, heavy metals, antibiotics and coccidiostatica in eggs
Broiler	Salmonella, E coli O157, Campylobacter and antibiotic resistant bacteria in manure

The samples were collected at the farms. During the visits background information on management and cultivation techniques was gathered. This included information on soil properties, plant variety, sowing- planting- and harvesting dates, manure use, irrigation system and type of water, way of harvesting, history on crops, green manuring and applied manure (type and amount) over the past 6 years and processing and packaging after harvest (for lettuce). This information could be helpful in interpreting the analytical results. Further this information might increase the potential of relating an analytical outcome to one of the cultivation parameters which may lead to an advice to the farmers.

In this study organic wheat samples are collected at 20 farms, lettuce at 24, carrot at 35 and potato at 21 farms. If possible, more foods were sampled at the same farm. For the animal production, 31 pig-farms (of the 58 Dutch organic farms), 10 farms

L.P.L. van de Vijver, J. Bokhorst and M. Northolt ; Louis Bolk Instituut, Driebergen, the Netherlands (l.vandeVijver@louisbolk.nl; j.bokhorst@louisbolk.nl). M. Northolt made a major contribution to this study. He retired in January.

L.A.P. Hogenboom, N.J.G. Broex, J. van der Roest; RIKILT, institute on food safety, Wageningen University, Wageningen the Netherlands. (r.hoogenboom@WUR.nl)

D.Mevius, Central Institute for Animal Disease Control, Lelystad, the Netherlands

J. Meijs, Biologica, Utrecht, the Netherlands

with dairy cows, 10 farms with laying hens (out of the circa 100 Dutch organic farms) and all Dutch organic broiler farms (n=9) were visited and samples were collected.

All samples were taken in the years 2003 and 2004.

Results

Vegetables

In most conventional and organic wheat samples the concentrations of the 7 mycotoxins were low and beneath detection limit. Only after a rainy period (end of august 2004) higher levels of DON and zearalenone were found in both cultivation systems.

Levels of the heavy metals cadmium, lead, arsenic and mercury were below the legal limits. No differences were found between the two cultivation systems.

The major part of the conventionally produced cabbage lettuce had nitrate levels above the legal limits, whereas this was true for only one out of 19 outdoor and 1 out of 10 greenhouse organically produced cabbage lettuce. For iceberg lettuce no differences were found. In carrot the nitrate content ranged from 11-864 mg/kg for organic and from 70 to 180 mg/kg for conventionally cultivated carrots. The organic carrots contained 3 times as much nitrate as the conventional carrots.

No residues were found on organically and conventionally produced wheat, carrot and potato. Only in 2 samples conventionally produced cabbage lettuce residues were found but levels were beneath the legally allowed levels.

Despite the use of dung, none of the samples organic lettuce contained Salmonella or E.coli.

Animal products

The contamination with Salmonella in fattening pigs appeared to be dependent on the experience within organic farming. On the farms with little experience (1-4 y) around 50% of the manure was contaminated with Salmonella, whereas this was true for only 1 out of 14 experienced farms (6-14 y). In conventional farming systems the contamination is around 30%. Campylobacter contamination was comparable between organic and conventionally produced pigs (around 55%)

In none of the organic poultry farms (laying hens and broilers) Salmonella was found. In conventional farming Salmonella is known to be present around 10% of the farms (in 2002 respectively 13 and 11%). On all organic broiler farms campylobacter was detected, whereas this was only 40% at the conventional farms.

Conform expectations, in kidney and meat of fattening pigs and kidney of dairy cows from the organic system no antibiotics were detected. Also no residues of antibiotics or coccidiostatics were found in organically produced eggs.

In organic practices the use of antibiotics is restricted. This was confirmed with the lower numbers of antibiotic-resistant bacteria in organically compared to conventionally produced poultry and pigs, except in Campylobacters from poultry where the resistance levels were similar in both production systems

Discussion

In this study, in which both plant and animal products were analysed on their content of potential hazardous contaminants and micro-organisms, overall the organic produce scored better or equally good as conventionally produced products. Only in carrots we observed a higher mean nitrate content in organic compared to conventional produce and in organic broilers Campylobacter was more abundant. The range of nitrate in carrots was large (11-864 mg/kg). From the collected information on the farm management it is indicated that manure practise, crops in previous years and green manuring are parameters which influence the nitrate content. This information can be used for further improvement of organic cultivation.

In pigs we also saw a difference in Salmonella contamination between those farmers with a long experience in organic production and the farmers who just started with organic production. This information is very valuable to explain underlying reasons for the differences, but also to support a further improvement of the organic production. The high levels of resistant campylobacters in organic poultry may be explained by introduction of these campylobacters from the environment.

Conclusions

In conclusion, though because of the organic cultivation system, risks concerning food safety aspects might be expected, this study showed that overall organic produce scored better or equally good as conventional produce. Further improvements can be made by learning from the experience of other farmers.

Acknowledgement

The study was financed by the Dutch ministery of Agriculture, Nature and Food Quality and the Dutch Food Safety Authority.