Institute of Food Science & Technology

Organic Food

The Institute of Food Science & Technology, through its Public Affairs and Technical & Legislative Committees, has authorised the following Information Statement, dated February 2005 and reviewed March 2005, which cancels and replaces the version dated July 2003.

[Special Note: This Information Statement represents an IFST overview of the present position in relation to this topic, and does not imply that IFST has adopted a position in relation to it].

SUMMARY

The last few years have seen significantly increased interest in organic food, that is, food grown using those husbandry principles and techniques that predated the introduction of modern agrochemicals and intensive farming methods. These husbandry principles are now applied with the benefit of modern scientific understanding and technologies to give a more sustainable system of food production. However organic food production in the developed world is still dependent on fossil fuels for production, transport and processing.

Organic food is a small but growing sector of the food industry with an identity defined and protected by law. Its existence provides an element of consumer choice.

The production of organic food requires the same involvement of professional food scientists and technologists and is subject to the same requirements of good manufacturing practice and food safety as the rest of the food industry, but is also subject to specific additional legal requirements regarding cultivation, composition and labelling.

Organic food is likely to contain lower residues of agricultural chemicals than its non-organic counterpart.

The use of animal waste as fertiliser, whether in producing organic or non-organic food, needs to be properly managed, but even so it may pose a risk of contamination with pathogenic micro-organisms, and consequent food poisoning from foods which are to be consumed without adequate, or any, cooking. In particular, fruit and salad vegetables, whether organic or non-organic, for consumption without cooking, should be thoroughly washed with potable water before consumption, and the public should be advised to do so by display notices and on consumer pre-packs.

INTRODUCTION AND DEFINITIONS

The term 'organic' is protected by European Union (EU) law. This means that the product meets the standards of an approved independent control body, which has inspected all aspects of its production. The UK Register of Organic Food Standards (UKROFS), which oversees the implementation of the organic regulation in the UK and approves control bodies defines organic

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farming thus:

> 'Organic production systems are designed to produce optimum quantities of food of high nutritional quality by using management practices which aim to avoid the use of agrochemical inputs and which minimise damage to the environment and wildlife.'

The Codex Committee on Food Labelling developed the following definition (Anon 2001):

> ‘ "Organic" is a labelling term that denotes products that have been produced in accordance with organic production standards and certified by a duly constituted certification body or authority. Organic agriculture is based on minimizing the use of external inputs, avoiding the use of synthetic fertilizers and pesticides. Organic agriculture practices cannot ensure that products are completely free of residues, due to general environmental pollution. However, methods are used to minimize pollution of air, soil and water. Organic food handlers, processors and retailers are required to adhere to standards to maintain the integrity of organic agriculture products. The primary goal of organic agriculture is to optimize the health and productivity of interdependent communities of soil life, plants, animals and people.’

These definitions serve to distinguish the use of the word 'organic' in this context from its more traditional scientific meaning as a description of a carbon-containing molecule. 'Organic' is the description used only in English-speaking countries; in other markets ‘Bio’, 'Oko' or 'Eco' are the more usual descriptions.

Organic food should never be defined as pesticide-free. Organic legislation specifies that land must be free from chemical inputs for two years prior to organic production. However the possible presence of pesticide residues from previous land use or from adventitious contamination means that low levels of pesticides can occasionally be found in certified organic food. The presence of pesticides in this way does not necessarily preclude the food being described as organic providing all other certification requirements have been fulfilled.

It is evident that “organic” describes a method of production rather than the characteristics of the food so described. For some producers and manufacturers it is so regarded, but for other proponents it amounts to a philosophy, a “movement” or even a “religion”. For example, the guiding worldwide principles for organic agriculture are defined by the International Federation of Organic Agricultural Movements (IFOAM) and are detailed below:

- To produce food of high nutritional quality in sufficient quantity.
- To interact in a constructive and life-enhancing way with natural systems and cycles.
- To encourage and enhance biological cycles within the farming system, involving micro-organisms, soil flora and fauna, plants and animals.
- To maintain and increase long-term fertility of soils.
- To promote the healthy use and proper care of water, water resources and all life therein.
- To help in the conservation of soil and water.
- To use, as far as possible, renewable resources in locally organised agricultural systems.
- To work, as far as possible, within a closed system with regard to organic matter and nutrient elements.

- To work, as far as possible, with materials and substances that can be reused or recycled, either on the farm or elsewhere.
- To give all livestock conditions of life which allow them to perform basic aspects of their innate behaviour.
- To minimise all forms of pollution that may result from agricultural practice.
- To maintain the genetic diversity of the agricultural system and its surroundings, including the protection of plant and wildlife habitats.
- To allow everyone involved in organic production and processing a quality of life conforming to the UN Human Rights Charter, to cover their basic needs and obtain an adequate return and satisfaction from their work, including a safe working environment.
- To consider the wider social and ecological impact of the farming system.
- To produce non-food products out of renewable resources, which are fully biodegradable.
- To encourage organic farming associations to function along democratic lines and the principle of division of powers.
- To progress towards an entire organic production chain, which is both socially just and ecologically responsible.

Many of the foregoing aspirations are equally applicable to, and followed by, non-organic food production and manufacture.

BACKGROUND

Brief History

In the UK Sir Albert Howard published *An Agricultural Testament* (1940), advocating that Britain preserve the 'cycle of life' and adopt 'permanent agriculture' systems, using urban food waste and sewage to build soil fertility. The first person to apply the term 'organic' to food production was J.I. Rodale in his 1942 publication *Organic Gardening and Farming*. In 1946 Lady Eve Balfour was inspired by Howard to set up the Soil Association, a pioneering organic farming charity that today is the major organic certification organisation in the UK. In 1960 the Soil Association opened the first shop in the UK selling organic produce. Interest in organic farming grew throughout Europe and the USA during the 1960's. In 1974 the Soil Association established the UK's first set of Organic Food Standards, which formed the basis of the EU regulation 2092/91 (See Section 4).

The Contemporary Organic Consumer

In 1997 in the UK MORI found that "six out of ten people would choose organic food if it was easily available and cost no more than conventional food". Among the reasons for buying organic food "health" was by far the most important, 46% of those buying organic food giving it as their primary concern... 40% claiming that organic food "tastes better." (See Section 5.5). The main reasons for not buying organic food have been cited (Anon 1999) as: Cost, 42%; Not seen in shops, 15%; and less variety 10%; with 4% not buying as it does not taste any better. A report by Taylor Nelson/Sofres (2002) indicated that in 2001, 79% of households made an organic purchase, however, only 8% of households made a purchase at least every two weeks or more which represented 60% of their annual spend on organic food. The life stage groups spending the most on organic are people with young families, households with older dependents and households whose children have left home.

Market Size

Total UK market size has topped £1.12B (April 04) and experienced growth of 10% during 2003/4 (Soil Association 2004) and now accounts for 1.2% of the total retail food market. However to put this into context, the UK retail bread market alone is worth around £2B.

Signs of market maturation are the development of supermarket own-label organic foods, which include chilled ready meals, dairy products and soups (UK) and high quality chocolate and biscuits (France). In the UK, the level of imports is slowly falling as UK supply increases but UK is still largely dependent for organic foods on imported fresh produce and cereals. A target of 70% home produced organic sales by 2010 has been stated in the Organic Action Plan but the earlier fall in imports is now tailing off. In 2003/4, 56% of all organic food by value was imported which is down on the 2001/2 figure of 65% but unchanged on the 2002/3 level. DEFRA backed initiatives for increased public procurement are starting to see development of purchases of organic and locally produced foods by schools and hospitals. The catering sector has also been identified as a very under developed area for organic consumption and DEFRA are investigating solutions to help this sector develop including a review by the DEFRA Certification Body Technical Working Group (CBTWG) of the application of the EU Regulation which is viewed as restrictive to catering operations.

Europe accounts for 24% of organic managed farmland. Germany has the largest organic retail market with a value of £1.6 billion representing 1.8% of their total food market. Italy commands the second largest retail market and the largest agricultural area at 1.1m hectares with durum wheat and citrus being major crops. Of the new accession countries, the Czech Republic has a well-developed organic production system but a less well developed market. Not surprisingly, the multiples dominate the retail market for organic produce at 70% with Tesco supplying the greatest range. (Vaclavik 2005).

A European Organic Action Plan was launched in June 04 to support the development of the organic market. The main aims are: increasing consumer awareness; improving market intelligence; reinforcing standards and including certification procedures. The action plan can be downloaded from http://www.europa.eu.int/comm/agriculture/qual/organic/plan/comm_en.pdf

Worldwide, the global organic market is estimated to be worth £17.5 billion, dominated by the US, Japan and Europe. However organic food sales only represent 1 - 3% of total food and beverage sales in these countries. Total area managed organically worldwide is believed to be 17 million hectares, with 30% in the Americas and the bulk in Latin America. Argentina and Brazil are significant producers of organic meat, coffee, fruit, vegetables and sugar. Asia and Africa are also developing organic production and export industries but currently only account for 5% of total organic area.

A report by Keynote (2001) further analyses the UK organic and healthfood sectors.

Market Outlets

As with non-organic foods, the multiple retails dominate organic sales at 80% by value. However direct marketing by farmers and the independent retailers has made a very small dent in this by increasing market share from 8% to 10% from 2001/2 to 2004. However direct marketing sales are increasing 50% faster than supermarket sales.

LEGISLATION

EU Legislation

In 1991 the EU passed Regulation 2092/91, which laid down in detail how crop products must be produced, processed and packaged to qualify for the description ‘organic’. The regulation also specified detailed criteria for the inspection and subsequent certification of food producers and processors. Provision was made for Member states to implement organic livestock production standards at national level. However in 1999, EU Regulation (EC 1804/99) (OJ No L 222; 24.8.1999) was passed which detailed European Standards for products of livestock origin. This regulation also prohibited genetic modification (GM) from use in organic production and food products (including 'contained' uses such as enzymes, and microbial preparations, e.g. dairy starter cultures and silage fermentation aids) (see also 5.6, below). The legislation has now been incorporated into EU Regulation EC 2092/91 and came into force on 24th August 2000. The annex to the Regulation covers livestock and livestock products from the following species: bovine (including babulous and bison species), porcine, ovine, caprine, equidae, poultry and bees.

A further EU Regulation (EC 331/2000) permits the use of the Community logo on the product label providing that the product conforms to the organic standards; but this symbol is hardly used in the UK.

Rules of production, labelling and inspection are provided for livestock. Livestock production is recognised as fundamental to the organisation of agricultural production on organic farms by providing organic matter and nutrients for the land, contributing to soil improvement. This needs to be done while avoiding pollution of crops, soil and water.

The main changes to UK standards were changes in non-organic feed allowances from daily to annual limits with a planned phasing out by 2005, although it is possible that non-organic feed may be allowed at reduced levels beyond 2005, maximum limits of manure applications to organic land of 170kg N per ha per year, requirement for breeding stock replacements to come from organic sources and a requirement for all livestock farms to have an animal health management plan detailing how reliance on veterinary products will be minimised or phased out.

The special features of beekeeping call for specific provisions, in particular to ensure that sources of pollen and nectar of adequate quality are available in sufficient quantities.

The Regulation is enforced in the UK by the Organic Products Regulations 2004. The Regulations provide for the continued administration, execution and enforcement of Council Regulation (EEC) No. 2092/91, as amended, (OJ No. L 198, 22.7.91, p. 1) ("the Council Regulation") on organic production of agricultural products and indications referring thereto on agricultural products and foodstuffs and of the Commission Regulations supplementing that Regulation. The Regulation was overseen by the United Kingdom Register of Organic Food Standards (UKROFS), however this was dissolved and its role divided between two bodies. The Advisory Committee on Organic Standards (ACOS) handles development and maintenance of organic standards. The Department for the Environment, Food and Rural Affairs (DEFRA) (Room 323B, Nobel House, 17 Smith Square, London SW1P 3JR) is the competent authority, which is responsible for the implementation of the standards and approving the sector bodies,

which undertake inspection and certification. DEFRA acts as the competent authority on behalf of the four Rural Affairs Departments within the UK.

Producers, importers and processors involved with the distribution of organic products covered by the Regulation are subject to an inspection system. For the purpose of enforcing Articles 9.9 and 10.3 of the Regulation (irregularities and infringements of the rules on labelling and production of organic products) the Minister must give the relevant local authority the means to enforce the organic labelling provisions in Article 5 of the Regulation.

By harmonising organic legislation throughout Europe the EU Regulation established a level playing-field for manufacturers. This in turn led to easier transfer of organic ingredients and finished organic foods within the EU. The Regulation also ensures that ingredients entering the EU have been produced to the same standards as ingredients produced within the EU. The Regulation enables consumers to buy organic produce with confidence, and has reassured producers and processors that their market will not be contaminated by fraud.

The accession of 10 new countries to the EU has created new challenges for European organic trade and control. These new countries have varying levels of organic control systems although countries such as Hungary and the Czech Republic already have systems considered equivalent to EU systems.

Organic processed foods are divided into two categories, depending on the proportion of organic ingredients present:

Category 1. Organic{tc "Category 1. Organic"}
Product contains a minimum of 95% organic agricultural ingredients by weight. Product can be labelled 'Organic' e.g. Organic Cornflakes

Category 2. Special Emphasis{tc "Category 2. Special Emphasis"}
Product contains 70 - 95% organic agricultural ingredients by weight. Product can be labelled 'Made with Organic Ingredients' e.g. Tomato Ketchup made with Organic Tomatoes.
However, very few products are now produced to the latter category content due to the wider availability of organic ingredients.

EU Regulation EC 2092/91 and its subsequent amendment place restrictions on the ingredients that a manufacturer of organic foods can use. Annex VI of the Regulation contains a list of the only non-organic agricultural ingredients that can be included in an otherwise organic food. Also detailed are ingredients of non-agricultural origin which are permitted – for example, water, salt, a limited range of permitted food additives, processing aids, microbial preparations, packaging gases and some flavourings. Preservatives, (with the exception of nitrate and nitrite for meat curing only, and sulphur for wines and ciders, low limits imposed) and colourings are prohibited. Organic regulations also specifically exclude the use of irradiation or genetic modification in organic food processing.

USA National Organic Program Legislation

The Organic Food Production Act of 1990 was the first stage of a national organic programme for organic regulations. Regulations had previously been developed on a state-by-state basis and

these continued to be the basis for certification until the full implementation of the National Organic Program (NOP) final rule in October 2002. An earlier draft of the NOP which allowed for the use of GM materials, sewage sludge and irradiation, generated a record response from the public. All three of these uses are now prohibited under the implemented NOP. All certification bodies now have to be accredited with the US Department of Agriculture (USDA) and an up to date list of these can be found on the USDA website.

The NOP allows for four categories of product - 100% organic, organic (at least 95% organically produced raw or processed agricultural products), made with organic (at least 70% organically produced ingredients) and product with less than 70 % organic ingredients (specific ingredients may be identified as organic). Land must be free from prohibited inputs for three years prior to organic harvest and this will be confirmed at the first inspection prior to organic harvest. There is no requirement for annual inspections during the conversion period as is required in the EU regulation. The use of non-organic feed is prohibited for organic animals and this is a potential barrier to the use of any ingredients of animal origin produced within the EU. Wine may be labelled as organic unless sulphites have been used in which case the product may only be labelled as "made with organic grapes" as in the EU regulation. There is a range of other differences from the EU regulation. The NOP standards can be found in full on the USDA website if comparisons need to be made.

Both the USDA seal and certification body symbol may be used, but both are optional and each may be used without the other. However all licensed products must refer to the certifying body on the label. Neither logo is permitted on product, which is identified as "made with organic ingredients" (i.e. 70 - 90% organic ingredients).

Synthetic inputs are not allowed unless specifically approved within the National List. In the event that contamination with a pesticide occurs (as a result of spray drift for example) or a pesticide residue is found through analysis, any product with a residue above 5% of the national tolerance level cannot be sold as organic.

Hall (2002) has written a useful review of the NOP.

Control of Imported Organic Food

The production of organic food throughout Europe is controlled by the same European legislation and organic food produced in Europe can be freely imported in to the UK. The legislation lays down requirements for importing food from outside of the EU and has divided non-EU countries into two groups, ‘Approved’ Third Countries and ‘Non-Approved’ Third Countries. Organic food products of crop origin produced in approved third countries can be imported into the EU without authorisation being obtained from the Competent Authority of the importing Member State. The UK importer however must be registered with an Organic Certification Body. The approved third countries are:

Argentina
Australia
Costa Rica
Israel
New Zealand
Switzerland

To import organic food from any other third country, the importer must obtain permission from the Competent Authority (DEFRA in the UK). The permission is granted on the basis of the certifying body being ISO65/EN45011 accredited and the organic standards being equivalent to the EU minimum. Permission is usually granted for a period of 2 - 5 years and is granted to a specified supplier for a specified product. Since Nov 2002, EU Commission Regulation 1788/02 requires that, for each consignment of organic product that is imported, a Certificate of inspection must be issued by the certification body of the supplier to confirm that the specified consignment has been produced to organic standards. This then has to be endorsed by the Port Health Authority in the UK to confirm that the quantity and lot/identity markings detailed on the certificate match those on the physical consignment when customs seals are broken and the consignment enters into free circulation. An extract of the certificate is generated for split consignments and this also has to be endorsed by the port health authority.

Certification Procedures

Throughout the EU each member state has a national Control Body: in the UK it is DEFRA. DEFRA regulates the activities of the UK Certification Bodies, which are the organisations charged with inspecting and regulating UK organic producers and manufacturers. The largest Certification Body is Soil Association Certification Ltd, which currently undertakes 75% of all certification in the UK. The other UK Certification Bodies are Organic Farmers & Growers, Scottish Organic Producers Association, Bio-Dynamic Agriculture Association, Organic Food Federation (OFF), Irish Organic Farmers & Growers Association, Organic Trust Ltd, Food Certification (Scotland) Ltd, CMi Certification, Farm Verified Organic and Organic Certification Ltd although the latter two no longer undertake certification activities in the UK. Other prominent EU certification bodies include Ecocert (France, Germany and Belgium), Naturland (Germany) and Skal (Holland), whilst OCIA, OGBA, QAI and FVO are the prominent certification bodies in the USA. There is now a move for organic certification bodies to become accredited to the EN45011 Certification standard. Organic inspection and certification is described in more detail by Parslow and Troth (2001).

PRODUCTION, QUALITY AND SAFETY

Guiding Principles for Organic Food Manufacture

The Organic Food Federation (OFF) website http://www.orgfoodfed.com/ quotes the following guidelines:

> Organic products cannot be sold without a valid Certificate of Compliance issued by a registered Organic Certification Body.
>
> When a Certificate is issued it applies only to the products listed thereon.
>
> Records must be kept of all organic material purchased and all organic units produced.
>
> All organic ingredients must be produced by an organically certified supplier.
>
> Organic ingredients must be used unless a non-organic version is permitted by the Regulation.

Organic raw materials and products must be clearly labelled and physically separated from non-organic products.

Quality and Safety in Production

Good Manufacturing Practice (GMP) is as important in organic food manufacture as in non-organic food manufacture. Current food safety regulations apply to organic, as well as non-organic, food production. It is essential that all appropriate food safety procedures are established and monitored by the food scientists and technologists involved and diligently operated by the manufacturers, including checks to ensure that mycotoxins are not developed during storage as a possible consequence of non-use of fungicides.

A key requirement of organic food production and processing is traceability. This is vital for manufacturers to demonstrate a positive link between a food product and the organic raw materials used in it. Some food processors are dedicated to organic production but the majority are not. In non-dedicated operations, manufacturers must employ operational procedures to ensure complete separation of organic product from non-organic. This must be demonstrated by adequate record keeping. Most opt to process as first operation after a full clean-down, although some employ purges for dry manufacturing operations.

Organic standards also have requirements on hygiene procedures and pest control. All food approved cleaning materials and sanitisers are permitted but 'no-rinse' sanitisers must be rinsed off prior to organic production. Pest control materials in food processing premises are also severely restricted by organic standards. Emphasis is placed on preventative measures such as good hygiene, housekeeping and exclusion. Freezing, heating and carbon dioxide are preferred for infested ingredients. Organophosphate and carbamates are prohibited except for very exceptional circumstances. 'Natural' pest control materials such as pyrethrum are allowed under restricted use. Approved rodent baits are not restricted.

A major EU funded project titled Quality Low Input Food is currently researching the impact of low input systems (including organic) on food safety and quality. (See www.qlif.org)

Microbiological safety

Farmyard manure and other animal wastes (FYM) are widely used in agriculture, both organic and non-organic. In the UK, the National Farmers' Union estimates the amounts of FYM applied annually in the UK are: 80M tonnes applied during farming practice and 120M tonnes by livestock during grazing.

The use of FYM as fertiliser, whether in organic or non-organic agriculture, gives rise to concerns about the possible contamination of agricultural produce with pathogens (especially *Escherichia.coli* O157) and the possible contamination of ground and surface water. The UK Royal Commission on Environmental Pollution (RCP) in its Nineteenth Report on the Sustainable Use of Soil (1996) reviewed the use of organic materials in agriculture, including their safety. It concluded that there is a potential risk to human and animal health from pathogens in animal wastes. A more recent report, written for MAFF titled ‘A Study on Farm Manure Applications to Agricultural Land and an assessment of the risks of Pathogen Transfer into the Food Chain’ (Nicholson *et al*, 2000), considers the risks associated with *Campylobacter, E.coli, salmonellae,*

Listeria spp., protozoa and viruses but does not discuss sporeforming pathogens such as *Clostridium perfringens*, *C.botulinum* and *Bacillus cereus*. It goes on to discuss the effects of manure storage and application on survival of these organisms, and the effects of various agricultural systems including organic management are discussed. It concluded that there is insufficient information available to state categorically whether the risk of pathogen transfer from organic farms differs significantly from the risk associated with conventional farming practices.

Whereas non-organic farming uses artificial fertilisers as well as FYM, the latter is universally used in organic farming. Thus, these concerns, and measures to try to address them, although applicable to all agriculture, inevitably focus particularly on organic agriculture. The paper by Nicholson *et al* (2000) makes a number of recommendations to minimise any potential risks of using animal manures on food crops.

The EU and UK Organic Regulations deal with generalities but do not go into specifics of manure management. In the UK, the Compendium of UK Organic Standards 2004 lays down standards for manure management and for precautions against contamination of water, for record-keeping and for a dual inspection system, by the Certification bodies and random checks by DEFRA itself. For example, in the Soil Association Standards for Organic Farming and Production (Revision 14 2002/2003) where Manure Management and Application is defined and regulated to address problems of this type, Standard 2.05.16 requires that for FYM from non-organic sources, a compost temperature of 60˚C be reached to facilitate the destruction of vegetative pathogens and that the compost heap be maintained for at least three months (an alternative regime is stacking for six months). However, Standard 2.05.08 provides that, for the use of FYM from organic sources, composting is not mandatory, but use is "preferably after being properly composted (see Standard 2.06.03)". It is difficult to see grounds for this differentiation. However standard 2.06.04 makes the following recommendations:

Table 1.

Material	**Non-organic origin**		**Organic origin**	
	Harvest interval	Treatment	Harvest interval	Treatment
Slurry	1 year	Aerated	1 year	Aerated
Fresh manure	-		Prohibited	- 6 months
Stacked manure	6 or 12 months	3 months	3 months	3 months
Composted manure	3 or 6 months	3 months	2 months	2 months

It is probable that these harvest interval periods will be required in the near future.

Manure treatment, storage systems and applications are expected to conform to the Statutory Code of Good Practice for the Protection of Water under Section 116 of the Water Act 1989. It is mandatory for every producer licensed by Soil Association Certification Ltd to follow these standards.

However, even the composting regime of three months and reaching 60ºC leaves open to question whether compost heaps always actually reach that temperature; and, if they do, whether the regime is efficacious. Knowledge of the critical times and temperatures needed to make composted manures microbiologically safe is incomplete [Tauxe, 1997]. Mixing is also a problem. The outer parts of heaps are always cooler. Continuous mixing (e.g. the Dano Composter) gives fast, uniform heating.

Even if composting is effective in destroying vegetative pathogens, it will not destroy spore-formers such as *Clostridium perfringens*, *Clostridium botulinum* and *Bacillus cereus*. The question of survival of viruses and protozoa during composting may also need to be considered. Tauxe *et al* (1997a) concluded:

> "the adequacy of existing methods and regulations governing the composting of manure for agricultural purposes needs to be reviewed".

The use of animal waste as fertiliser, whether in producing organic or non-organic food, needs to be properly managed, but even so it may pose a risk of contamination with pathogens, and consequent food poisoning from foods which are to be consumed without adequate, or any, cooking. In particular, fruit and salad vegetables, whether organic or non-organic, for consumption without cooking, should be thoroughly washed before consumption, and the public should be advised to do so by display notices and on consumer prepacks. Use of enhanced level of chlorine (i.e. above normal “town’s water”) for washing ready to eat fresh produce is common practice in non-organic ready to eat salad and vegetable processing. However organic standards prohibit this, so the organic industry now uses replacement products based on organic acids. Ozone, used within potable water levels, is also being investigated.

The paper by Nicholson (2000) makes a number of recommendations to minimise any potential risks of using animal manures on food crops. An IFT Expert Report stated that “The available scientific information is insufficient to ensure that foodborne pathogens are killed during composting (of manure) and soil application” (Institute of Food Technologists (2002)).

Future organic agriculture may become less reliant on animal manures, with research organisations such as Elm Farm and Henry Doubleday undertaking studies on stockless organic systems where fertility is generated by legumes, green-waste composts and use of a green manure crop, i.e. one that can be grown over a season when the bed is not in use, often autumn and winter, and later tilled into the soil to improve the fertility.

However, animal manures presumably represent an important resource that farmers are going to use. How will they dispose of these manures if they are not used on the land? Particularly in developing countries these wastes will be regarded as a resource, as also is human waste.

Despite the foregoing concerns, a survey of 3200 samples of organic uncooked ready to eat vegetables by UK PHLS (2001) did not detect *salmonellae*, *Listeria monocytogenes*, *Campylobacter* spp.or *E coli* O157 from any of the samples. Indicator organisms were also found to be within acceptable levels.

On the other hand, it has been reported from Denmark that organic poultry flocks showed a higher incidence of contamination with *Campylobacter* (100% of flocks) than conventional flocks

(36.7%) (Heuer *et al*, 2001). The species distribution was: organic flocks *C.jejuni*, 91%, *C.coli* 4.5% mixed infections *C.jejuni*/*C.coli*,4.5%); conventional flocks, *C.jejuni* 86.2%, *C.coli* 10.3%, mixed infections (*C.jejuni*/*C.coli* 3.5%), (i.e. no marked species difference). The UK Food Standards Agency's *Campylobacter* Strategy, discussed at the ACMSF Open Meeting on 20 March 2003, emphasized the need for biosecurity on intensive chicken farms (housed birds) to reduce *Campylobacter* contamination on poultry. It was noted that it would be much harder to reduce contamination with *Campylobacter* on extensively produced chickens (free range and organic) because their exposure to the environment cannot be controlled. At present it was stated that less than 5% of the UK flock is reared extensively and it was considered important that control measures for extensively produced poultry should be considered.

Agricultural chemical residues

Although organic foods cannot be defined as pesticide-free or herbicide-free, the direct use of other than "traditional" agricultural chemicals in prohibited. All herbicides are prohibited and a few pesticide ingredients are allowed under restricted use (prior permission required from certification body prior to use). These are (Soil Association Standards for Organic Farming and Production version 14, Standard 2.10.14):

- Copper sulphate; copper hydroxide; cuprous oxide; copper oxychloride; copper ammonium carbonate (maximum concentration of 25g/l) - a maximum of 8 kg Cu/ha/yr until 31 December 2005, and a maximum of 6 kg Cu/ha/yr thereafter.
- Derris (preparations from *Derris spp*., *Lonchocarpus spp*. and *Terphrosia sp*) a harvest interval of seven days must be observed.
- Azadirachtin extracted from *Azadirachta indica* (neem tree).
- Steam sterilisation or pasteurisation of soils in protected structures (glasshouses).
- Lime sulphur (calcium polysulphide).

In addition to most crop agrochemicals being prohibited for growing crops, organophosphate pesticides commonly used for fumigation of crop stores and crops during storage are also prohibited in organic agriculture.

A recent literature review of pesticide and herbicide contamination of non-organic and organic foods (Heaton, 2002) discusses the levels of contamination of non-organic and organic foods and highlights the fact that chemical residues are often not reduced by washing and only partially reduced by peeling of fruit and vegetables.

The Standards recognise the possibility of contamination and detail specific measures to prevent or minimise this. Operators are also bound to report any actual or suspected contamination. Increased surveillance and testing for both pesticide residues and GMO contamination is being undertaken by some certification bodies.

Organic crops are therefore likely to contain lower pesticide and herbicide residues than their non-organic counterparts, and to be free from the possibility of exceeding the legal limits for pesticide residues that very occasionally comes to light in ongoing surveillance.

Veterinary Drugs and Feed Additives Residues

Use of veterinary drugs in organic agriculture is severely limited. Systemic parasitic wormers (e.g. avermectin) are prohibited except where required under veterinary supervision (which means that treated stock then lose organic status). Anthelmintics can be used where need is demonstrated (based on worm counts in dung). Antibiotics can be used where clinical need is demonstrated. Extended withdrawal periods of at least double the statutory withdrawal period are required. All in-feed medication/antibiotics are prohibited and colourants (for yolk and salmon flesh) are prohibited from poultry and fish feeds. All prophylactic use of veterinary drugs is prohibited. There are therefore likely to be lower veterinary drug and feed additive residues than their non-organic counterparts. However, the organic poultry industry has recently been implicated in an antibiotic contamination scare (Food Standards Agency 2004). The product, nitrofuran, has been banned for all production by the EU since 1995. Contamination was, however, later traced to contamination of poultry drinking water by equipment previously used for non-organic poultry production.

Organic food and genetic modification

Prominent within vigorous campaigning against genetic modification are some organic organisations and their leaders. In part this is ideological and in part would appear to be commercial in that organic food is now “big business” and GM food is seen as its potential commercial competitor for the future in Europe and in many countries elsewhere as its actual present commercial competitor, especially in the USA.

However, concern among farmers in the organic food sector about possible cross-pollination of organic crops by pollen from GM crops grown in the vicinity relates to the perceived consequence that the crop would lose its organic certification. This has, however, been called into question, at least as far as the US National Organic Program is concerned, by Kershen (2002), who wrote

> “…..we all need to remember that organic production is a process of producing food and has nothing to do about quality or superiority. Remembering that organic production is a process is important because organic producers do not – I repeat do not – lose their USDA organic certification solely because pollen or seeds from transgenic crops can be detected in their organic products. What I have just said
> about USDA organic certification is also, from all that I have learned, true about the organic certification from the European Union.”
>
> “Let me quote the USDA-National Organic Program comments upon which I make my statement:
>
> > "When we are considering drift issues, it is particularly important to remember that organic standards are process based. Certifying agents attest to the ability of organic operations to follow a set of productions standards and practises that meet the requirements of the Act and the regulations. This regulation prohibits the USE (my emphasis) of excluded methods in organic operations.
> >
> > The presence of a detectable residue of a product of excluded methods alone does not necessarily constitute a violation of this regulation. As long as an organic operation has not used excluded methods and takes responsible steps to avoid

> contact with the products of excluded methods, the unintentional presence of the products of excluded methods should not affect the status of an organic product or operation."
> - USDA, National Organic Program, 65 Fed. Reg. 80548 (21 Dec 2000)."

The EU Council Regulation (EEC) 2092/91 as amended and the UKROFS UK standards refer to "use of " GMOs and provide no clear guide as to adventitious cross-pollination.

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In the UK the largest certifying body, the Soil Association, sets higher than the legal standards for its certification:

> "What makes our standards different?
> We believe it is vital that organic standards are kept high and enforced effectively. We aim to set the 'gold standard' for the organic industry and have led the way in the development of high organic standards.
> These not only meet the legal minimum requirements but are often higher, particularly in farm animal welfare."

In its on-line summary of its Farming Standards it states:

> "GMOs and their derivatives are strictly prohibited at every stage of production".

In the real world true zero tolerance is unattainable (especially when "zero" merely means not found by current analytical methods) but there is no provision in the EU or UK regulations, or in the certifying bodies' standards, for a threshold tolerance for 'contamination' by GM organisms/DNA as this would imply that a certain amount of contamination was acceptable. If a crop does become contaminated either by pollen or cross contamination during transport/processing, it would no longer be acceptable for inclusion into animal feed or used for processing thereby negating its organic status. This has reportedly been confirmed in 2003 by UKROFS when Soil Association Certification Ltd (SA Cert) had a case of animal feed testing positive for GM material which traced back to GM contaminated organic soya (this left Italy with a negative PCR result, arrived at UK and again tested negative, then arrived at the feed mill in question with a positive PCR result). The Certification Committee decided to remove the organic status of the livestock that had been fed the feed. This was referred to UKROFS who agreed with the SA Cert ruling. Similarly, it has been reported that Austria Bio Garantie test every load of organic grain imported into Austria for GM contamination and remove status if the result is positive.

Yet it would be unjust to condemn a farmer's organic crop as being non-organic because of adventitious cross-pollination with GM pollen or adventitious contamination in transit, just as it would be unjust to declare a GM crop as sub-standard due to adventitious cross-pollination or contamination with organic material. In this respect the USDA National Organic Program ruling, quoted above, is a sensible recognition of scientific reality. In January 2003 it was reported that the German "Association Organic Food Industry" made representations for an adventitious GMO-presence up to 0.5% for organic farming. The parliamentary group of the Christian Democrats welcomed this proposal as returning to the facts instead of "former scientifically unfounded and unrealistic demands for a zero tolerance".

Organic Seeds

So that organic agriculture is not reliant on non-organic farming systems, organic standards require the use of organic seeds to grow organic crops, although the parent crops for seed production can still be non-organic. The organic seed market is quite well developed across the EU although a number of varieties are older and less productive than the modern varieties favoured by the multiple retailers. In order to assist farmers in sourcing organic seed, the Organic Products Regulations 2004 authorised DEFRA to establish a national web-based database of organic seed availability. The Regulation authorised the Soil Association to manage the database, working in partnership with the International Society of Organic Agriculture Research (FIBL) and NIAB. The database can also be used for issuing derogations to farmers to use seed not yet available as organic. A second database, also managed by the Soil Association gives access to variety performance information. The 'organic organisation' Henry Doubleday Research Association (HDRA) maintains a bank of non-commercial and de-listed seeds, which acts as an important reservoir for genetic diversity.

Perceived quality and "healthfulness"

It is a requirement of the EU Regulation that no claims may be made on the label or advertising material that suggests to the purchaser that the indication of organic production methods constitutes a guarantee of superior organoleptic, nutritional or salubrious quality. However, explicit claims are unnecessary when, as a result of marketing, for many consumers the use of the word "organic" itself is implicitly synonymous with such superior qualities.

In its Report on Organic Farming (January 2001) the House of Commons Select Committee on Agriculture after taking and considering all the evidence, was well-disposed towards the future of organic production in the UK, but also included the following extracts

> "There is clearly a strong consumer demand for organic products but we are very conscious that the consumer may attribute benefits to organic products which cannot be sustained in the present state of scientific knowledge and which cannot legally be claimed by producers. We have reservations about the claims made for organics and we believe that far more work needs to be done to establish a scientific basis for these claims. This would then sustain a rationale for the standards applied and, together with research into technical issues, could lead to great advances by organic farmers. It is vital that consumers get what they believe they are paying for, which is why we attach such importance to clear standards. It is also vital that the taxpayer gets what he or she is paying for, which is why we support an organic stewardship scheme under which Government grants would reward proven environmental benefits."
>
> "The term 'organic' refers to a process, not the final product. The entitlement to label vegetables, meat or any other foodstuff as organic depends upon the way in which it was produced and the procedures involved in processing, rather than any intrinsic, testable quality in the food itself. Many claims have been made for organically produced foods, ranging from food quality, food safety, animal welfare, support for rural communities and fair trade, and benefits for the environment. We have seen no evidence to enable us to state unequivocally that any of these claims are always and invariably true. All claims need to be properly evaluated in order to help consumers

make their own judgements on the benefits of organic produce. Indeed, the organic movement itself, in general, is careful not to assert such claims as provable."

"We believe that there are three reasons why research into the claims made for organic farming is essential and should be carried out by a reliable source, independent of either the conventional or the organic sector. First, it is important that Government policy be based on hard fact, rather than supposition. Second, it would assist the organic sector if it were known that there was a scientific basis for the demands they were making of their producers in setting standards and the promises they were offering to consumers. Third, such research should also isolate the elements within organic production protocols which lead to the desired benefits, with the result that these techniques may be applied more effectively both on conventional and organic farms".

"We recommend that MAFF (now DEFRA) commission additional research into the environmental implications, technical issues, animal welfare and verification of claims made in connection with organic farming on public policy issues such as food safety to supplement its existing programme".

"We stress the benefits of treating organic and conventional production as part of the same spectrum, with the outcome of research in one sector being applied to the other".

Flavour

Comparison of organic crop products with their non-organic counterparts requires all other things to be equal. However there is so much flavour variation among different varieties, different degrees of ripeness or freshness or length of storage of the same fruit or vegetable, that it is very difficult to be sure of making valid comparisons. In any event, comparisons in individual instances cannot provide a valid generalisation. As regards processed composite foods, there are so many additional formulation variables that valid comparisons cannot be made.

Nutrition

Detailed literature reviews of all recent research on quality, safety and nutrition have been published by Woese et al (1997) and Heaton (2002).

Bourn and Prescott (2002) in a similar review carried out a meta-analysis comparing nutritional value, sensory qualities and food safety of organic and conventionally produced foods, in which they found few well-conducted studies capable of making a valid comparison. They found no strong evidence of differences in concentration of various nutrients, except for nitrate content, which was somewhat lower in organic vegetables.

Lampkin (1990) notes that so many factors play a role in determining the overall physiological value (*sic*) of food that it is often difficult to isolate those, which result directly from the production system.

Asami *et al* (2003) analysed marionberries, strawberries, and corn for total phenolics (TP) and found them higher in plants grown with organic farming methods, by "sustainable farming methods" than by conventional techniques. TPs are not nutrients, but include the flavonoids or pigments found in plants, thought to act as antioxidants. The authors point out there have been

150 previous studies comparing nutritional content of organic versus conventionally grown plants and most have shown no differences. The TPs are not considered nutrients because they are not required by the body. As the authors also point out, phenolics are made by plants in response to insect attack and the finding of greater amounts in products grown organically may be the result of more extensive attack by insects. Damage made by the insects also allow moulds to grow there, leading to more spoilage and the possibility of mould toxins. However, a subsequent critique of the Asami et al paper [Folsot and Rosen (2004)] argues that it contains "significant technical and conceptual flaws". A rebuttal paper by two of Asami's co-authors [Mitchell and Barrett (2004)], though accepting the correctness of some of Folsot and Rosen's paper responds to it point by point particularly in respect of how future research on this topic should be conducted.

Unpublished work by Robertson, J & Fanning, C, 2004, suggests that organic milk contains higher omega 3 levels than non-organic milk, largely as a result of increased grass and forage intake and a reduction of compound concentrate feeds.

In January 2003 four European research institutes announced that have joined forces to found a new research association that aims to encourage, co-ordinate and disseminate research in the field of organic food and health. This research association will aim to meet the increasing demand for scientific evidence about the potential health benefits of organic food from industry, consumers and policy makers.

Founding research members of the new association are the University of Kassel, Germany, and its department for organic food quality and food culture, the Louis Bolk Instituut in the Netherlands, Swiss Research Institute of Organic Agriculture (FiBL), a private foundation comprising organic farmers, scientists and politicians and the Biodynamic Research Association Denmark (BRAD), a research institution that focuses on the quality of organic plant products and developing methods for possible application in food quality control.

The new group is inviting research institutions and stakeholders to work together on research projects focusing on a range of questions posed. These include can consumption of organically produced food improve human health, do organic farming methods have an effect on the nutritional quality of food, do food products of an organic production method have distinct or special quality characteristics, and does organic food processing influence the risk of allergic reactions?

FUTURE PROSPECTS

Market Development

The close regulation of organic food production within the EU has contributed to an increase in consumer confidence and a clear set of standards that can be adhered to by new companies entering the organic food industry. Raw material availability in both quantity and variety is increasing rapidly worldwide to satisfy the growth of the market. The amount of land being cultivated organically is continuing to increase with Europe-wide Government support. The UK organic market has increased rapidly in recent years, with growth rates of 30% to 50% per annum. Sales in 2000/01 amounted to £802 million, up by 33% on the previous year. 2001/02 sales were estimated at £920 million.

According to DEFRA (2002), the current market share of home-grown, conventional produce was 74.7%, by volume, of the total conventional market; the market share of home-grown, organic produce was 30%, by value (£) of the total organic market. These figures for produce include dairy, meat, eggs, cereals, fruit, vegetables and baby food. "By the end of 2001 organically managed land accounted for 2.5% of all English farmland, over the whole of the UK, 3.9% was under organic management. Secretary of State Margaret Beckett MP proposed that the sector could experience a three-fold increase - taking it from 3% of UK agriculture to around 10%" (DEFRA 2002).

Although in the UK 80% of organic food is retailed by the major multiple supermarkets, an increasing number of farmers are beginning to undertake further processing of their products and marketing directly to the consumer in an attempt to realise higher prices for value added products rather than just producing basic commodities. The rise of the 'vegetable box scheme and meat box scheme' pioneered by organic producers enables them to offer a mixture of fresh produce or meat, which is selected by the producer. This is sold for a fixed price for the 'box'. Although consumers are not usually able to choose the contents, it reduces the waste created by fickle customer selection and ensures that more of the crop and the less favoured cuts of meat (forequarter beef for example) are used.

The Organic Action Plan

The Policy Commission on the Future of Farming and Food was set up in August 2001 as one of three inquiries launched in response to the Foot & Mouth Disease epidemic.
Its remit was England only. It received c.1300 written responses (including 7 from organic organisations) and took oral evidence

Following the publication of what became known as the Curry Report, the Government launched an "Action plan to develop organic food and farming in England" on 29 July 2002. The plan had 21 measures including:

- Introduction of on-going financial support for all organic farmers
- Clarification that schools, hospitals and other public purchasing bodies can buy organic food to minimise the environmental impact of their catering operations
- A review by the supermarkets by the year-end of their sourcing of organic food to identify the sectors where they can reduce imports and how to achieve this.
- £5 million of industry/Government funding for organic research over the next five years (on top of the £2.1million annual DEFRA budget for organic research).
- The Government's pilot demonstration farm network to include organic farms
- Commitment to high organic production standards, including continued development of the EU standards.
- A compendium of organic standards to be published by April 2003.

It was also agreed that work would continue on other key issues, including small abattoirs, organic exports, and increasing the consumption of UK organic fruit and vegetables.

In addition, DEFRA adopted a target that at least 70% of UK organic sales of indigenous produce should be sourced from the UK by 2010, up from 35%. The plan has since been taken forward by the working group.

The Commission report and English plan prompted similar activity in Scotland. On 4 February 2004, the Scottish Executive published an organic action plan for Scotland. The proposals which include a commitment to consult on capital payments for arable farmers, extra conversion support for fruit and vegetable growers, and the option of on-going payments for organic farming. It includes two targets: to decrease the level of organic imports of indigenous-type produce to 30% of the Scottish market for those produce, and to double the organic land in productive areas, i.e. in arable and improved grassland areas by 2007.

Further information can be found at http://www.defra.gov.uk/farm/organic/actionplan/index.htm

Can Organic Farming Feed The World?

In discussions on organic farming in relation to food security (Woodward, 1996; Geier, 1998; Goklany 2001) this question is inevitably posed by considerations of lower yields (estimates vary from 20% to 50% lower), greater losses to pests and even debate about soil erosion.

Woodward argued that "whilst technically there would be no overwhelming problems in feeding the UK, Europe and even the USA organically, the structure of agriculture would have to change significantly with massive implications for land access, investment, labour and skills...the question of feeding the world organically has less to do with the technical ability of organic farming to produce adequate nutrients and is more about systems of distribution, markets, finance and political structure".

On the other hand, the nearest equivalent to organic production for which data are available is 1961, preceding the introduction of modern intensive agriculture. Goklany (2001) pointed out that “had technology - and therefore yields - been frozen at 1961 levels, then producing as much food as was actually produced in 1998 would have required more than a doubling of land devoted to agriculture. Such land would have increased from 12.2 billion acres to at least 26.3 billion acres, that is, from 38 to 82 percent of global land area. (And this optimistically assumes that productivity in the added acreage would be as high as in the other areas). Cropland alone would have had to more than double, from 3.7 to 7.9 billion acres. An additional area the size of South America minus Chile would have to be plowed under.”

Moreover, that is to ignore the developing countries where the largest part of the difficult problem of “feeding the world” exists, and where future population growth is foreseen to be greatest.

Leaving aside the question of whether the changes mentioned by Woodward are likely to happen, even if they did agriculture would be incapable of feeding the world’s escalating population over the next few decades, without maximising yields, greatly reducing pre-harvest and post-harvest losses and making use of new technologies such as genetic modification. In all three respects organic farming seems far less likely to be able to feed the world. While this does not exclude a continuing role for organic production, it may imply an eventual practical limit to its growth.

Implications For The Mainstream Food Industry

It is possible to see the current interest in organic foods as a reaction to consumer unease over pesticide use, recent food scares and a resultant lack of trust in the mainstream (non-organic) food industry. It is possible that further food scares may generate further rapid market growth for

organic foods but food scares resulting from microbiological contamination are at least as likely from organic as from non-organic foods. Interviews with consumers reported in health-food trade magazines suggest that, for some, another factor driving sales is a wish to avoid foods containing GM ingredients. Therefore the way these issues are handled by the mainstream food industry may influence the rate at which this market develops.

However, price is still an important factor on purchasing decision for non-regular purchasers. Organic food can never be as cheap as non-organic due to reduced yields, lower stocking rates and requirements for fallow/fertility building periods. Increased costs are also caused by less developed distribution systems and costs incurred by processing smaller volumes.

CONCLUSIONS

In the EU organic food has become established as a part of the food industry with an identity defined and protected by law. Whilst currently it is a small part of the food supply in most markets there is potential for continued future growth in the market for organic food. It provides an element of consumer choice.

Organic food is likely to contain lower residues of agricultural chemicals than its non-organic counterpart.

Although concerns over microbiological safety do not yet appear to have been realised, the use of animal waste as fertiliser, whether in producing organic or non-organic food, needs to be properly managed, but may still pose a risk of contamination with pathogens.

IFST recommends that :

- Whole fruit and salad vegetables (whether organic or non-organic) for consumption without cooking should be thoroughly washed with potable water before consumption;
- all retailers should provide in-store advice to that effect and it should be printed on the packaging of consumer pre-packs of whole fruit and salad vegetables

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Organic seed websites: www.organicXseeds.co.uk and www.cosi.org.uk

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Competence, integrity, and serving the public benefit lie at the heart of IFST philosophy. At all times IFST aims to:

- Benefit the public supply of safe, wholesome, nutritious, tasty and attractive food through the application of sound science and technology;
- Improve public knowledge and awareness of important issues relating to the supply, production, safety and quality of food;
- Develop and communicate the knowledge underlying food science and technology, and further the education of food scientists and technologists;
- Safeguard the public by defining, promoting, and upholding professional standards of competence, integrity and ethical behaviour; and
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