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Organic Food

Summary

Organic food, for which there is a Codex Alimentarius definition (Anon, 2001), is food grown using husbandry principles and techniques that predated the introduction of modern agronomy. These husbandry principles are now applied with the benefit of modern scientific understanding and technologies to give a supposedly sustainable system of food production but one incapable of feeding the world. Moreover, organic food production in the developed world is still water dependent and largely dependent on fossil fuels for production, transport and processing.

Organic food is a small sector of the food industry with an identity defined and protected by law in many countries. In recent years it has been growing but in the current economic climate its growth has declined. 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 as to 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 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 pre-packs.

A comprehensive review has shown that there is no significant nutritional or health difference between organic food and that conventionally produced (Dangour et al, 2009).

Definition and Principles

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.'

This definition serves 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" 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 Agriculture Movements (IFOAM) are those of health, ecology, fairness and care. These are set out and amplified on the IFOAM website http://www.ifoam.org

Legislation

In 2008, there were 47 countries (including 27 in the EU) with fully implemented organic regulations. Thirteen countries, including Canada, were in the process of implementing regulations. Seventeen countries were in the process of drafting regulations (6 in Latin America). In North America, the United States introduced the National Organic Program in 2002. In February 2006, the Mexican Government announced passage of its Organic Products Law.

EU Legislation

EU organic standards were originally established in 1991 with Regulation 2092/91, which laid down in detail how crop products must be produced, processed and packaged to qualify for the description 'organic'.

The new framework of EU organic standards came into effect on 1 January 2009. These standards are set out in

- Council Regulation (EC) No. 834/2007 of 28 June 2007 on organic production and labelling of organic products and repealing Regulation (EEC) No. 2092/91.

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:189:0001:0023:EN:PDF

- Commission Regulation (EC) No.889/2008 of 5 September 2008 laying down detailed rules for the implementation of Council Regulation (EC) No. 834/2007 of 28 June 2007 on organic production and labelling of organic products with regard to organic production labelling and control.

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:250:0001:0084:EN:PDF

and

- Commission Regulation (EC) No. 1235/2008 of 8 December 2008 laying down detailed rules for implementation of Council Regulation (EC) No 834/2007 as regards the arrangements for imports of organic products from third countries.

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:334:0025:0052:EN:PDF

In the UK, the Department of Environment, Food and Rural Affairs (Defra) issued in December 2008 a "Guidance Document on European Union Organic Standards" to assist those who produce, prepare, store, import from a non-EU country or market organic products (referred to in this document and in the EU Regulations as operators) and the inspection bodies which license them (referred to in the document and in the EU Regulations as control bodies) with implementing the new framework of EU organic standards.
http://www.defra.gov.uk/farm/organic/standards/pdf/guidance-document-dec2008.pdf

One of the objectives of the review of EU legislation on organic standards preceding the development of 834/2007 was to set out a vision of the objectives which should inform organic production and set out a coherent set of overall principles on which organic production should be based. These

objectives and principles, which are set out in Articles 3 and 4 of 834/2007, form the general basis on which the appropriateness of operators' activities and planned activities are to be judged.

Article 9 of 834/2007 expressly prohibits GMOs or substances produced from or by GMOs. Article 10 prohibits the use of ionizing radiation.

Article 28 (1) of 834/2007 explains that those in the EU who produce, prepare, store, import from a non-EU country or market organic products must make themselves known to the competent authority for the Member State in which they are situated and comply with the control system for organic production. This is done through registering with a control body. The list and contact details of control bodies in EU Member States is given in
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2008:013:0003:0028:EN:PDF

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.
http://www.ams.usda.gov/AMSv1.0/nop

All certification bodies now have to be accredited with the US Department of Agriculture (USDA) and up to date lists of domestic and foreign certifying agents can be accessed on the USDA website.
http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5074486
http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5074487

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). The name of the certifying agent of the final product must be displayed on the information panel. 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 allowed to be used 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. More recently an Institute of Food Technologists Scientific Status Summary on Organic Foods (Winter and Davis, 2006) includes a detailed review of the NOP.

Canadian Legislation

The key acts and regulations are the Canada Agricultural Products Act and the Organic Products Regulations 2009. As of June 30 2009, the Organic Products Regulations require mandatory

certification to the revised National Organic Standard for agricultural products represented as organic in international and inter-provincial trade, or that bear the federal organic agricultural product legend (or federal logo).

A useful “Questions and Answers” on the Organic Products Regulations 2009 is provided at www.inspection.gc.ca/english/fssa/orgbio/qeest2e.shtml

A list and contact details of Certification Bodies accredited by the Canadian Food Inspection Agency (CFIA) is given at www.inspection.gc.ca/english/fssa/orgbio/cbliste.shtml

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 equally apply to 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 cleandown, 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.

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 vegetative pathogens (especially *E.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, 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), considered the risks associated with *Campylobacter, E coli, Salmonella, Listeria,* protozoa and viruses but does not discuss sporeforming pathogens such as *Clostridium perfringens*, *Clostridium botulinum* and *Bacillus cereus* which could be transmitted by the crops to humans. 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.

However, even a 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. A few seconds at 60 degrees C will kill 5-6 logs of most vegetative cells so if the temperature is reached it should be effective. However, 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,* which could be transmitted by the crops to humans. The question of survival of viruses and protozoa during composting should also 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 paper by Nicholson (2000) made 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)).

The UK Food Standards Agency (FSA) has issued a report “Managing Farm Manures for Food Safety: Guidelines for growers to reduce the risks of microbiological contamination of ready-to-eat crops” (2009).
http://www.food.gov.uk/multimedia/pdfs/manuresguidance.pdf

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.

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 the UK Public Health Laboratory Service (PHLS) (2001) did not detect *Salmonella*, *Listeria monocytogenes*, *Campylobacter* 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). There is a need for biosecurity on intensive chicken farms (housed birds) to reduce *Campylobacter* contamination on poultry. It would be harder to reduce contamination with *Campylobacter* on extensively produced chickens (free range and organic) because their exposure to the environment cannot be controlled.

Agricultural chemical residues

Although organic foods cannot be defined as pesticide-free or herbicide-free, the direct use of other than “traditional” agricultural chemicals is prohibited. All herbicides are prohibited and a few pesticide ingredients are allowed under restricted use.

Organic food and genetic modification

There is no valid scientific justification for the banning of GMOs from organic production. It is an arbitrary position that has become embedded in legislation. Prominent within vigorous activist 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.

A 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. Such perceived loss has, however, been called into question, at least as far as the US National Organic Program is concerned, by Kershen (2002). The USDA National Organic Program states:

> "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 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."

Likewise, the EU Council Regulation (EC) No 834/2007 states:

> “Genetically modified organisms (GMOs) and products produced from or by GMOs are incompatible with the concept of organic production and consumers' perception
> of organic products. They should therefore not be used in organic farming or in the processing of organic products.
> The aim is to have the lowest possible presence of GMOs in organic products. The existing labelling thresholds represent ceilings which are exclusively linked to the adventitious and technically unavoidable presence of GMOs.”

In the real world, true zero tolerance is unattainable (especially when “zero” merely means not found by current analytical methods). 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 organically grown material.

Perceived quality, nutrition and “healthfulness”

Whether or not it is explicitly claimed that organic production methods constitutes a guarantee of superior flavour, nutrition or healthfulness, explicit claims are unnecessary when, as a result of marketing, for many consumers the use of the word “organic” itself is implicitly (but mistakenly) synonymous with such superior qualities.

An independent review commissioned by the UK Food Standards Agency (FSA), and published in July 2009, shows that there are no important differences in the nutrition content, or any additional health benefits, of organic food when compared with conventionally produced food.

The study, which took the form of a 'systematic review of literature', was carried out by the London School of Hygiene and Tropical Medicine (LSHTM). LSHTM's team of researchers, led by Alan Dangour, reviewed all papers published over the past 50 years that related to the nutrient content and health differences between organic and conventional food. This systematic review is the most comprehensive study in this area that has been carried out to date. This research was split into two separate parts, one of which looked at differences in nutrient levels and their significance, while the other looked at the health benefits of eating organic food.
http://www.food.gov.uk/multimedia/pdfs/organicreviewappendices.pdf
http://www.food.gov.uk/multimedia/pdfs/organicreviewreport.pdf

The nutrition study has been peer-reviewed and published:
Dangour et al (2009). "Nutritional quality of organic foods: a systematic review", *American Journal of Clinical Nutrition*, DOI: 10.3945/ajcn.2009.28041

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 cultivars, 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.

Can Organic Farming Feed The World?

In discussions on organic farming in relation to food security [Woodward (1996); Geier, (1998); Goklany(2001), Goulding and Trewavas (2009)], 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) points 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 and/or economic development are 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.

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