

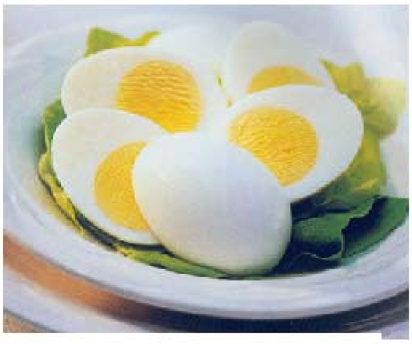

Organic Poultry Production in Ireland

Problems and possible solutions




A report commissioned by

The Partnership Expert Working Group

(a sub-group of the National Steering Group for the Organic Sector)

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1. Background

Organic farming is a minor, but growing, part of agricultural production in Ireland. It is Irish government and EU policy to encourage the expansion of organic farming and the Report of the Organic Development Committee (April, 2002) stated that a target of 3 % of land area in organic farming here in Ireland by 2006 is achievable. There is no specific target for organic poultry production.

1.1 Objectives of the study

In June 1991 Council Regulation (EEC) No. 2092/91 was introduced detailing rules for the production of organic crop produce. With effect from 24 August 2000, Council Regulation 1804/99, which supplemented Regulation 2092/91, brought organic livestock and livestock produce within the ambit of EU rules (previously private standards only existed).

The National Steering Group for the Organic Sector was established by Mr. Noel Treacy TD, Minister for State in 2002, with responsibility for organic food and farming. A Partnership Expert Working Group was set up as a sub-group of the Steering Group, charged with the task of looking at specific areas of advice, education and research. Because of concerns with poultry nutrition, the sub-group felt that research in the organic poultry area was a priority. After a number of meetings it became clear that there were many problems in the nutrition / choice of strains / and management areas that could threaten to severely restrict the development of the industry. The introduction of Regulation 1804/99 prohibited the use of synthetic (crystalline) amino acids in animal feeds in the organic sector. The objectives of this study therefore were to compile a report detailing the problems facing the organic poultry sector, and to make some recommendations as to possible areas of research that could address and provide solutions for solving difficulties in the sector.

1.2 What is 'Organic Farming'?

An organic label indicates to the consumer that a product was produced using certain production methods. In other words, organic is a *process claim* rather than a product claim

(FAO, 1999). In June 1991 the European Council adopted Regulation (EEC) No. 2092/91 on organic production of agricultural products and indications referring thereto on agricultural products and foodstuffs. This Regulation has been added to on several occasions, in particular in 1999 when the Council extended its scope to cover organic livestock production (Regulation (EC) No. 1804/1999).

There are many definitions for organic agriculture. The International Federation of Organic Agriculture Movements (IFOAM) defines organic agriculture as *'a whole system approach based on a set of processes in a sustainable ecosystem, safe food, good nutrition, animal welfare and social justice'*. Organic production therefore is more than a system of production that influences or excludes certain inputs (Anon 2002a).

The Codex Alimentarius Commission was created in 1963 by the FAO and WHO to develop food standards, guidelines and related texts such as codes of practice under the Joint FAO/WHO Food Standards Programme. Codex Alimentarius defined the concept of organic farming based on contributions from experts from all over the world. According to them, organic farming involves '*holistic production management systems (for crops and livestock) emphasising the use of management practices in preference to the use of off-farm inputs*'. This is accomplished by using, where possible, cultural, biological and mechanical methods in preference to synthetic materials (cited by Guillou and Scharpé, 2000).

According to Council Regulation (EC) No. 1804/1999 supplementing Regulation (EEC) No. 2092/91 (organic production of agricultural products and indications referring thereto on agricultural products and foodstuffs to include livestock production) livestock production forms an integral part of many agricultural holdings practising organic farming. Livestock production must contribute to the equilibrium of agricultural production systems by providing for the nutrient requirements of crops and by improving the soil's organic matter. It can thus help establish and maintain soil-plant, plant-animal and animal-soil interdependence. As part of this concept, landless production is not in conformity with the rules of the Regulation. Stock must have access to a free-range area and the number of animals per unit area must be limited to ensure integrated management of livestock and crop production on the organic unit, so minimising any form of pollution, in particular of the soil and surface or ground water. An organic production unit is a unit that complies with the rules set down by the Regulations governing organic production.

Based on the principles set down by the Council Regulations, the Irish Organic Farmers and Growers Association (IOFGA), Organic Trust (OT) and Demeter Standards Ltd. define organic (biological) agricultural and horticultural systems as systems that are designed to produce food of optimum quality and quantity. The principles and methods employed result in practices which:

a) co-exist with, rather than dominate, natural systems
b) sustain or build soil fertility
c) protect and enhance the environment with particular regard to conservation and wildlife, thus minimising damage to the environment
d) minimise the use of non-renewable resources
e) ensure the ethical treatment of animals

With regard to livestock production, minimum indoor and outdoor area requirements are set, which allow the animals to exhibit natural behaviours. Breeds are selected taking into account their resistance to disease. Use of antibiotics and growth promoters in regular feed is prohibited. If treatments must be used, they should be based on natural medicinal and homeopathic products. If necessary antibiotics and other chemical allopathic treatments may be used, but under strict conditions and control.

1.3 Poultry production systems

Poultry production systems can be divided into four categories:

1. ***Intensive (commercial)***

   Intensive broiler production involves rearing chickens indoors on litter with a controlled environment and feeding a sequence of high nutrient diets. The birds are slaughtered at 35 to 56 days of age when their liveweight reaches up to 3 kg. The breeds used are selected for rapid growth and have a high proportion of breast meat. Intensive egg production encourages the production of up to 290 eggs per bird per laying cycle (which can last up to 52 weeks).

2. Free range

Free-range table bird production allows access to the outdoors. In order to be classified as 'free range' birds must have continuous access to range for at least half of their lifetime and be slaughtered at not less than 56 days. There are further restrictions on stocking density and feed, shown in Table 1.

There are further legal requirements (Teagasc, Factsheet 14) that must be adhered to in free-range egg production systems (as well as conforming to standards for egg production in general). They include:

- hens must have continuous day time access to open-air runs
- this access ground must be covered in vegetation
- max. stocking density cannot be greater than 1,000 hens per ha of ground available to the hens
- the land must be dedicated to free-range stock
- hens must be accommodated in a well constructed insulated house with a floor space of 1 m^2 per seven birds
- pop-holes 45cm high and 60 cm long must be provided at four per 1,000 hens.

2. Label Rouge

This is a French pasture-based production system with branding and certification. Broadly similar to free range, this system has a market 'image' as a result of 40 years of tradition. There are some limitations on ingredient use (e.g. no GM feeds) but it is more liberal than organic (i.e. permitted use of crystalline amino acids and non-organic cereals). Label Rouge diets must contain at least 65 % cereals.

Label Rouge pullets are identified by a ring on their wing, put there by the certifying organisation at six weeks of age. After eight weeks of age, the density of Label Rouge pullets must not be more than 13 per m^2. The pullets are submitted to a light and nutrition programme which brings them into lay at 21 weeks. Records of any events, medications etc. must be kept for inspections, which are carried out at least once every two months. The hen house cannot be more than 10 m wide, with litter covering at least a third of the area. Hens must have access to an outside run, which has vegetation, at no later than 28 weeks of age from 11 am until twilight, in a long run which has a canopy (1.5 m high) and a gutter. Space allowance in the run of 2.5 m^2/bird must be provided, with no more than 10 birds per m^2 overall. There must also be a minimum of 15 cm of perch space per bird (Anon 1998a).

4. ***Organic***

Organic table birds and layers must be produced in accordance with the standard practices set out by the European Council Regulations and monitored by the certifying bodies in each country.

Table 1 shows a summary of some of the main differences between conventional, free-range and organic broiler production.

Table 1. Main points of difference between poultry meat production systems

	Production system		
	(a) Intensive	(b) Extensive	
	Broiler[1]	Free-range table bird[1]	Organic[2]
Minimum age at slaughter (days)	None, generally 39-45	56	81 if not slow growing
Breed specification	None	None	None as such, but slow growing preferred
Max house stocking density (fixed housing)	34.0 kg LW/m^2	13 b/m^2 or 27.5 kg LW/m^2	6 b/m^2 (layers) or 10 b/m^2 (fattening) max 21 kg LW/m^2
Max house stocking density (mobile housing)			16 b/m^2 (fattening) max 30 kg LW/m^2
Flock size	Unlimited	Unlimited	4,800 chickens, 3,000 layers or 2,500 turkeys per poultry house
Access to range	Not required	Continuous daytime access required for at least half their lifetime	Weather permitting, for at least 1/3 of their life
Pasture allowance	None	1 m^2/bird	So that not more than 170 kg/N/ha/yr
Feed specification	None	Finisher contains at least 70 % cereals	At least 65 % cereals, no synthetic amino acids, 100 % organic ingredients. However a derogation exists that allows 20 % from non-organic sources

Source: from [1]Gordon and Charles, 2002 and [2]Council Regulation 2092/91

1.3.1 United Kingdom

The expansion of the organic poultry sector in the UK for the last eight years has been substantial but is still a small proportion of the market. In 1996 there were only 25-40 organic egg producers in the UK and 10-15 organic poultry meat producers out of a total of 820 certified organic farms, the majority of the poultry farms producing on a very small scale (e.g. less than 25 layers). Larger scale commercial organic producers could be counted in single figures for both meat and eggs. Typically operations were in the range of 200-1,000 table birds per week and 500-5,000 layers. The size of the organic poultry industry in the UK in 1996 was unlikely to be greater than 20,000 layers producing 0.5 million dozen eggs with a retail sales value of £1.0 million, and 85,000 table birds with a retail sales value of £0.85 million annually (Lampkin, 1997).

According to Shepard et al., (2003), in 2001/02, organic food sales reached £920 million. However, 65 % of organic food bought by UK consumers was imported. DEFRA statistics (Anon 2002b) show that in June 2002, the area of organically farmed land was 699,879 ha (approx. 3.8 % of agricultural land). According to DEFRA (Anon 2004a) the number of organic poultry birds slaughtered in the UK rose from an estimated 1.3 million in the year 2000/01 to 2.1 million in 2001/02 and farm gate value increased from £7.2 million to £10.5 million in the same period. Expansion continued rapidly with an estimated production of 4.5 million birds in the year 2002/03. About 0.5 % of the total table poultry produced in the UK are organic. The supply of organic chicken increased from 230,000 birds in 1999 to around 4.5 million in 2003 (almost a twenty fold increase).

Poultry meat accounts for 15 % of the organic meat market in the UK with the retail price per kg in the range of 300-500 p/kg. Approximately 45 % of organic poultry meat originated from outside the UK in 2002 but the market is now considered to be self-sufficient (Anon 2004a).

The expansion in organic egg production over the past few years was also substantial, though smaller than that of broiler production. Sales increased from £39 million in 2000/2001 to £40 million in 2001/02. This was due to the increased use of organic eggs in processed foods.

The market is currently 100 % UK supplied, however, prices have fallen by 24 % since 2001 (Anon 2004a)

1.3.2 Northern Ireland

In the Statistical Review of Northern Ireland Agriculture (2003) carried out by the Department of Agriculture and Rural Development, there were 1.074 million ha of agricultural land in Northern Ireland. The area of land under organic management in Northern Ireland increased from 215 ha in January 1998 to 5,000 ha in December 2001 (approx. 0.02 – 0.46 % of total agricultural land). The Department of Agriculture and Rural Development set a target of 30,000 ha (2.79 % of total agricultural land) to be reached by 2006 (Alexander, 2002). According to DEFRA (Table 7), in 2002 there were 136 organic farmers and growers and 40 organic processors and / or importers, with 6,145 ha (0.57 % of total agricultural land) in organic production in Northern Ireland.

1.3.3 France

France has a national logo for organic products - the AB-Logo (AB = Agriculture Biologique), which is owned by the French state. Organic products can be labelled with this logo when they contain more than 95 percent organic components, were produced or processed within the EU, and were certified by one of the inspection bodies accredited according to EN 45011. Since the introduction of Regulation (EC) No 1804/1999 supplementing Regulation (EEC) No 2092/91 the development of organic poultry production in France has stopped and the number of units in conversion is low. French organic table chicken production decreased by 24 % during 2002 (down to 4.9 million organic chickens).

In 2002 in France there were 497 organic poultry meat producers, providing 4,877,219 broilers and 90,665 turkeys. Four hundred and fifty-nine producers raised 1,327,389 laying hens. The strains used for meat production were slow-growing special strains (slow growing strains are considered in France as those whose commercial liveweight is obtained beyond the age of 81 days in the case of broilers) for the ‘Label Rouge’, with a slaughter age of more than 81 days, or older indigenous strains suitable for poultry meat. Conventional strains or special free-range strains were used as laying hens (M. Monod, French Ministry of Agriculture, email communication).

Table 2 shows the difference in production practices and performance in France between conventional, certified, Label Rouge and organic chicken production.

Table 2. Technical results from France

	Broiler	Certified	Label Rouge	Organic Chicken
Stocking density (b/m^2)	22.0	18.0	10.9	10.0
No. of production cycles	6.40	5.04	3.36	3.21
Slaughter age (days)	39.6	57.7	86.1	89.8
Live weight (g)	1.93	2.22	2.20	2.15
Feed conversion (LW)	1.88	2.21	3.07	3.21
Mortality (%)	4.80	2.50	2.32	3.04

Source: ITAVI (2001)

Breeds used for Label Rouge and organic productions are slow-growing strains, whereas breeds used for 'certified' production are intermediate strains. Both Label Rouge and organic chickens have access to an outdoor area. Certified chicken is less intensively reared than conventional chicken, although not to the standard of Label Rouge chicken, and the quality cannot be guaranteed.

1.3.4 Ireland

In 2002 there were 29,850 ha of organic agricultural land in Ireland. Of this, 24,432 ha were fully organic and 6,418 were in conversion. Overall there were 4.4 million ha of agricultural land in Ireland, giving 0.7 % organic (Cowan et al., 2002). The market for all organic food in Ireland was valued at €25 million in a report by Cowan et al. (2001), which was 0.4 % of the total food market (EU average for organic food is 2 % of the food market). However, the organic food market was expected to grow to €86 million by 2006. Forty three percent of all organic sales in Ireland are of fruit and vegetables. Organic meat is the second biggest sector at 25 %, mainly beef, with some lamb. Organic poultry and pigmeat sales were almost negligible, due to limited supply.

Tables 3 shows data from the Census of Organic Production in Ireland in 2002 which was compiled by the Department of Agriculture and Food. Table 4 shows the size of the organic poultry flocks in other European countries. It is clear from the tables that organic poultry production in Ireland is quite small compared to that in countries like France and the UK.

Table 3. Number of producers and birds involved in organic poultry production in Ireland in 2002

	Total number of producers*	Total number of birds
Broiler hens	11	1,935
Laying hens	64	18,793
Turkeys	5	**

Source: Anon 2002e

* Producers with poultry numbers or 10 or more ** insufficient data

Table 4. Number of organic laying hens and number of organic chickens produced per country (in thousands in 2002)

	Ire[a]	Fr[b]	UK[b]	Ger[b]	Aus[b]	Den[b]	Swe[b]	Bel[b]	Neth[b]	Ita[b]
Laying hens	19	1390	840	1200-1400	250	400-500	190		150-240	650 (layers and table poultry)
Chickens	2	5700	1300 (poultry)	650	600	700	200	600-700	250-350	
Turkeys		90		270[c]						

[a]Anon 2002e [b]ITAVI (2002) [c]2001 Ire: Ireland, Fr: France, UK: United Kingdom, Ger: Germany, Aus: Austria, Den: Denmark, Swe: Sweden, Bel: Belgium, Neth: The Netherlands, Ita: Italy

1.4 Organic certification bodies

In the United Kingdom there were 14 organic certification bodies (OCB's) approved by DEFRA in 2002 (Anon 2002c). They were:

1. United Kingdom Register of Organic Food Standards (UKROFS)
2. Organic Farmers and Growers Ltd (OFG)
3. Scottish Organic Producers Association (SOPA)
4. Organic Food Federation (OFF)
5. Soil Association Certification Ltd (SA Ltd)
6. Bio-Dynamic Agricultural Association (BDAA)
7. Irish Organic Farmers and Growers Association (IOFGA)
8. Organic Trust Limited (OTL)

9. Cmi Certification (Cmi)
10. International Certification Service (GB) Ltd trading as Farm Verified Organic (ICS)
11. Organic Certification Ltd (OCL)
12. Food Certification (Scotland) Ltd. Organic certification of farmed salmon in the UK
13. Quality Welsh Food Certification Ltd
14. Asisco Ltd

The certification scheme of UKROFS has now ended. The OCL are in the process of merging with OFG and ICS (GB) Ltd is no longer certifying.

Table 5 indicates the number of organic operators divided by organic certification body and also indicates the organic area involved in the UK.

Table 5. The number of organic operators and organic area in hectares

Sector body	Farmers & Growers	Processors &/or importers	Total	Year 1	Year 2	Organic	Total
SA Ltd	2,308	1,435	**3,743**	16,211	41,441	157,714	**215,367**
OFG	945	6	**951**	15,968	20,873	86,332	**123,173**
SOPA	558	0	**558**	23,045	86,403	269,249	**378,697**
BDAA	108	55	**163**	154	396	1,983	**2,533**
OFF	105	214	**319**	263	464	2,414	**3,141**
Cmi	12	8	**20**	366	1	131	**498**
IOFGA	10	5	**15**	3	10	249	**262**
UKROFS	9	3	**12**	150	123	557	**830**
OTL	2	1	**3**	0	5	17	**22**
ICS	0	1	**1**	0	0	0	**0**
OCL	0	215	**215**	0	0	0	**0**
Total	**4,057**	**1,943**	**6,000**	**56,160**	**149,716**	**518,647**	**724,523**
Country	**Farmers & Growers**	**Processors &/or importers**	**Total**	**Country**	**Year 1**	**Year 2**	**Total**
England	2,608	1,649	**4,257**	26,285	42,228	170,130	**238,643**
Scotland	698	147	**845**	25,029	95,593	301,223	**421,845**
Wales	615	107	**722**	4,596	9,972	43,322	**57,890**
Northern Ireland	136	40	**176**	250	1,923	3,972	**6,145**
Total	**4,057**	**1,943**	**6,000**	**56,160**	**149,716**	**518,647**	**724,523**

Source: DEFRA, Anon 2002d

As of 2001, there were six inspection bodies accredited according to EN45011 by the Ministry of Agriculture in France. They were:

1. Ecocert SARL
2. Qualité France
3. Ulase
4. Agrocert
5. Certipaq
6. Aclave.

At present there are three OCB's approved by the Department of Agriculture in Ireland. They are:

1. Irish Organic Farmers and Growers Association (IOFGA)
2. Organic Trust (OT)
3. Demeter Standards (DS).

Table 6 shows the size of the organic industry in Ireland and the number of people involved.

Table 6. Organic production data from Census of Irish Organic Production 2002

Total Organic Sector	In conversion	Organic	Total
Producers	176	747	923
Area (ha)	6,418	23,432	29,850

Employment	Full-time	Part-time	Seasonal	Total
Number of people	777	993	1,769	3,539

	Number of producers	Number of hens	Number of eggs/birds sold
Laying hens	64	18,793	257,000
Broilers	11		2,000
Turkeys	5		3,000

Source: Anon 2002e

It is clear from these figures that the organic poultry industry in Ireland is quite small. It is still well below the EU average as regards proportion of agriculture. Because of its size, there is relatively little information available on the structure of the industry, physical performance standards on organic systems, production costs or the problems that are encountered.

2. Outline of study

This study was carried out by collecting and analysing published information, attending meetings, and/or telephone conversations with participants in the industry. Contact was made with researchers in organic poultry in the UK and France. In addition, one of the authors (KOC) attended the World Poultry Science Association (UK Branch) Meeting in York, England on April 5-7, 2004.

Relevant published reports are listed in the list of references at the end of this report. The list of persons consulted is shown in Appendix 1.

After discussions, we were able to separate and identify some of the problems associated with organic poultry production in Ireland. Prohibiting the use of synthetic amino acids in organic poultry diets affects the performance and welfare of the birds. Without synthetic amino acids the protein content of formulated organic diets increases due to the difficulty in providing adequate sulphur amino acids (methionine plus cystine, SAA) from vegetable sources alone. The increased protein content leads to increased nitrogen output in manure, waste of feed energy by the bird and a decline in feed efficiency. Deficiencies of SAA in the diet are a factor in feather pecking, which can lead to cannibalism and poor performance of the birds. With reduced feather cover the birds use energy from the diet to maintain body temperature, leading to poorer overall efficiency of feed use.

The organic system requires that birds should be slow-growing so that they can be slaughtered at a later age than conventional birds. Using birds that are bred for conventional systems is not very satisfactory in organic broiler and turkey production. Conventional birds in the organic system cannot be slaughtered before 81 days (broilers), or 140 days (turkeys) which means that the birds become too heavy. Skeletal development is inadequate for the heavy weights and mobility problems occur which is also a welfare concern. It was thought that the problems would be exacerbated in organic turkey production, but most producers seem happy to rear a traditional strain of bird, and report few adverse effects of the prohibition of the use of synthetic amino acids as yet.

3. Management factors

3.1 Stocking density

Stocking density is a function of group size and space allowance per bird. If the stocking density is too high, or there are too many birds in a given space, the welfare of the birds will be compromised and they will under-perform (in terms of growth rate, egg production etc.). This is generally not the case in organic production systems which are, by definition, extensive systems. However, there are guidelines and standards set down for maximum stocking densities. Conventionally reared birds for egg production can be stocked as high as 22 birds/m^2 in poultry houses (there may be several tiers of cages) and meat birds up to 17 birds or 34 kg of body weight per m^2. Tables 7, 8, 9 and 10 show the recommended stocking densities for birds in organic and conventional production in Ireland and the UK.

Table 7. Recommended stocking densities (Codes of Recommendations for the Welfare of Livestock of the United Kingdom Ministry and Departments of Agriculture)

Broilers			Parent stock		
Liveweight kg	Birds/m^2	m^2/bird		Males (birds/m^2)	Females (birds/m^2)
1.0	34.2	0.03	Litter	3-4	4-7
1.4	24.4	0.04	Litter/slat	4-5	7-10
1.8	19.0	0.05			
2.0	17.1	0.06			
2.2	15.6	0.06			
2.6	13.2	0.08		Males and Females (birds/m^2)	
3.0	11.4	0.09	Litter	3.5-5.5	
3.4	10.0	0.10	Litter/slat 60/40	4.75-6.0	
3.8	9.0	0.11			

Source: Ross Breeders 1 & 2

Table 8. Recommended stocking densities for indoor housing and facilities

	Layers		Broilers	Turkeys
	Organic Trust	Soil Assoc		
Max Stocking rate in fixed housing, b/m^2 (kg/m^2)	6	6	10 (21)	2
- or stocking rates in mobile housing, b/m^2 (kg/m^2)	6		16 (30)	3
Min perch space cm/b	18	18	-	40
Max no b/nest	6	6	-	-
- or communal nests (min cm^2/b)	120	120	-	-
Max slatted floor area (%)	50	50	50	50
Min exit/entry pop-holes (m length / 100 m^2 floor)	4	4	4	4
Max area of house per unit (m^2)	1,600	1,600	1,600	1,600

Source: Organic Trust and Soil Association Organic Standards

Organic Trust allows up to 620 laying hens or broilers per ha. The maximum bird numbers are set out below, but are only allowed provided that the limit of 170 kg N/ha/yr is not exceeded.

Table 9. Maximum outdoor stocking rates of poultry

Layers	Broilers	Turkeys	Ducks	Geese
1,000 b/ha	2,500 b/ha	800 b/ha	2,000 b/ha	600 b/ha

Source: Organic Trust and Soil Association Organic Standards

Table 10. Permitted number of birds in a housing unit

Layers	Broilers	Turkeys	Ducks	Geese
500 birds	500 birds	250 birds	500 birds	250 birds

Source: Organic Trust and Soil Association Organic Standards

Table 11 shows the maximum flock size permitted under organic regulations in the UK and Ireland.

Table 11. Maximum housing unit size

Layers	Broilers	Turkeys	Ducks	Geese
2,000 birds	1,000 birds	1,000 birds	1,000 birds	1,000 birds

Source: Organic Trust and Soil Association Organic Standards

There is some confusion over the interpretation of the term 'housing unit' or 'poultry house'. The Council Regulations impose a maximum of 3,000 laying hens, 4,800 chickens or 2,500 turkeys per poultry house. For laying hens in France the CC REPAB-F (standards for organic livestock production in France) defines a building as a '*unit with its own feed and water distribution system, its own egg collection system and its own access to outdoor areas. If buildings are next to each other, only the technical premises and egg stocking premises can be common to buildings*'. Using the term 'poultry house', some countries allow buildings containing several poultry houses. So if the maximum size of 3,000 hens, 4,800 chickens or 2,500 turkeys is interpreted as flock size and not number of birds per building, then several flocks can be in the same building. The maximum number of permitted birds per hectare (equivalent to 170 kg N/ha/yr) in France is 580 broilers or 230 laying hens.

Overstocking reduces growth rate, liveability, litter quality and leg health. Poor litter quality will increase carcass downgrading due to breast blisters, hockburn, bruising and scratching. Council Regulations indicate that at least one third of the surface area of a poultry house must be of solid material and must be covered with litter such as straw, wood shaving or peat. There must be perches of a number and size depending on the type of bird. The entry / exit hatches (popholes) must have a combined length of at least 4 m (in length) per 100 m^2 of accessible surface area (accessible to the birds) of the building.

3.2 Feeding space

Feeding and drinking space required by birds are determined by bird size and increase as the bird becomes older (Tables 12 and 13).

Table 12. Recommended feeding space for birds

Age	Feeding space cm/bird
Females	
0-35 days (0-5 weeks)	5
35-70 days (5-10 weeks)	10
70 days (10 weeks) – depletion	15
Males	
0-35 days (0-5 weeks)	5
35-70 days (5-10 weeks)	10
70-140 days (10-20 weeks)	15
140-448 days (20-64 weeks)	18

Source: Ross Breeders 1

Table 13. Recommended drinking space for birds

	Rearing period	Production period
Automatic circular or trough drinkers	1.5 cm/bird	2.5 cm/bird
Nipples	One/8-12 birds	One/6-10 birds
Cups	One/20-30 birds	One/15-20 birds

Source: Ross Breeders 1

3.3 Lighting

Day length and light intensity during the bird's life have a key role in the development of the reproductive system and both duration and intensity must be considered when establishing effective lighting patterns. It is the difference in daylength and light intensity between the rearing environment and the laying environment that controls and stimulates ovarian and testicular development.

In extensive systems, such as organic, it is difficult to control the light duration and intensity. Intensities of about 10 lux are recommended for egg production in organic systems (Charles et al., 2002). This is quite dark as 40 lux is the intensity of light required to read a newspaper. In intensive systems intensities much over 10 lux are usually avoided in order to decrease feather-pecking. Supplementary artificial lighting will normally be necessary to ensure continuity of egg production. However, 'daylight' should not exceed 16 hours and should only extend the day in the morning. The day must end with a natural dusk (Council Regulation No 1999/1804).

In the case of laying hens, natural light may be supplemented artificially to ensure a maximum of sixteen hours of light per day, with a continuous nocturnal rest period without artificial light of at least eight hours. Birds must have free access to an open-air run for a part of the day and for at least one third of their life. The external poultry runs must be covered mainly with vegetation, have protective facilities and allow the animals to have easy access to a sufficient number of watering and feeding devices.

3.4 Ventilation

Minimum ventilation rate is the quantity of air required per hour to supply sufficient oxygen to the birds and maintain air quality in terms of humidity, ammonia and carbon dioxide. A minimum ventilation rate of 1.95×10^{-4} $m^3/s/kg^{0.75}$ has been proposed for the UK (UK Agricultural Development and Advisory Service, ADAS cited in Ross Breeders 2). Maximum ventilation rate is the quantity of air required per hour to remove metabolic heat such that the temperature within the building is maintained at not greater than 3 °C above external temperature. A maximum summer ventilation rate of 2.00×10^{-3} $m^3/s/kg^{0.75}$ has been proposed for the UK (ADAS cited in Ross Breeders 2).

3.5 Litter

Litter must be replenished regularly and kept in a dry and friable condition suitable for scratching and dust bathing. Materials used must satisfy the requirements of moisture absorption, biodegradability, comfort and cleanliness, low dust level, freedom from taint and be available from a biosecure source. Fresh litter should be used for each crop of birds.

3.6 Slaughter

The minimal age at slaughter for non-slow growing organic broilers is 81 days and for non-slow growing turkeys is 140 days. Slow growing strains are permitted to be slaughtered before this time, but if they are, they must still go through a 10 week conversion period i.e. if bought in as day-olds they cannot be slaughtered before 70 days.

The average liveweight of an organically produced bird at a slaughter age of 81 days is estimated to be between 2.0 and 2.5 kg (Gordon and Charles, 2002). World-wide broilers are today slaughtered at an age of 42 days and weight of 2.65 kg. In 1976 the weight attained at the same age was 1.05 kg and it is projected that in 2007, 42-day old broilers will weigh 3.00 kg (Italian Ministry, 2004).

In France, according to the organic standards the minimum age at slaughter is 81 days for chickens, 140 days for whole turkeys of festive strains, 101 days for female turkeys of strains intended for cutting up and 126 days for male turkeys of strains intended for cutting up. However, in practice the chickens are slaughtered later than that due to the fact that there was a regulation imposing a minimum slaughter age of 91 days before the EU Regulations came into force. Table 14 shows the observed slaughter age across a number of countries.

Table 14. Observed slaughter age for organic broilers

	France	Austria	Belgium	Denmark	Netherlands	UK	Germany
Observed slaughter age	Min 81 d (in practice av. age in 2001 was 89.8 d)	68-78 d	81 d min	81 d min	81 d min	70 d	Min 70 d (conventional chicks) 55-60 d (organic chicks)

Source: ITAVI 2002

3.7 Resting land

For health reasons, buildings must be emptied of livestock between each batch of poultry reared. The buildings and fittings are to be cleaned and disinfected during this time. In addition, when the rearing of each batch of poultry has been completed, runs must be left empty to allow vegetation to grow back, and for health reasons.

4. Nutritional factors

4.1 Organic poultry diets

For organic poultry diets, the feed formula used in the fattening stage must contain at least 65 % of a mixture of cereals, protein crops and oilseeds (Council Regulation 599/03). This ensures that the protein content of the diet remains low, so that the birds will grow slowly. However, as will be seen in Section 7.2, modern commercial strains will still be too heavy on low protein diets. Prior to the introduction of Council Regulation 1804/99, synthetic amino acids were permitted in private standards and this did not pose a problem. However, without synthetic amino acids, in order to ensure the levels of amino acids required by the birds are supplied, it is necessary to increase the protein content of the diet, which in turn causes problems for the birds and for manure.

Organic poultry must have access to grit. Up until 24th August 2005, where organic feeds are not available, non-organic feedstuffs may be fed up to a total of 20 % of the **annual intake**, with a maximum **daily intake** of 25 % (calculated as a percentage of total dry matter of the agricultural ingredients).

In France, from 30 August 2000, 40 % of organic poultry feed must be produced on the holding. This proportion is calculated annually over the period from July to June and may be supplied under contract to a livestock feed manufacturer and purchased as processed feed. There are some instances where this proportion can be reduced, but in any case, not less than 10 % of feed must be produced on the holding and grazing may not be included in this 10 %. The maximum authorised percentage of conventional feeds per year is 10 %. The maximum authorised percentage of conventional feeds in the daily intake shall be 25 %, calculated as a percentage of dry matter. In the case of poultry at the fattening stage (from day 28 for chickens and day 42 for turkeys), the feed formula must comprise at least 65 % cereals and 90 % organic ingredients (ITAVI, 2002).

Soil Association organic regulations state that organic poultry must be fed a diet that contains a minimum of 60 % certified organic feed. No more than 20 % of the diet should come from *approved* non-organic feeds. The balance can be made up of 'in-conversion' feeds, which are harvested during the second year of organic conversion, or additional certified feed. The rule allowing the use of non-organic feeds is being reviewed and after 2005 all feed must be fully organic.

Organically reared birds need 20-50 % more food per unit of weight gain than conventionally reared birds, mainly because of increased activity and the (lower) temperatures in the run. Layers that are not fully grown at the onset of lay must partition nutrients for maintenance, egg production and growth. Fully-grown birds do not need to divert nutrients to growth functions. Besides the ratio between protein and energy being important, birds should not receive excess feed, as they will pick out some parts over others, which might result in an imbalanced diet. Scattering grain and providing roughage is a good way of keeping the hens busy and healthy (M. Bestman, email communication). However, if feeding a compounded diet, the nutrient content of the 'scatter grain' will affect the overall nutrient intake of the birds, and could lead to imbalances. The average daily intake of conventional and organic poultry is shown in Table 15.

Table 15. Daily feed intakes of conventional and organically reared birds

	Conventional	Organic[1]
Layers	118	130
Table birds	77	85
Turkeys	138	152

Source: Nutrient Requirements of Poultry 9th Edition

[1]Calculated as conventional intake plus at least 10 percent

4.2 Nutrient requirements of poultry

A table bird chick weighs about 38 g, and contains about 80.8 g N/kg, 10.2 g P/kg and 2.0 g K/kg. Between 1 and 81 days of age, an organically grown broiler will consume about 6.9 kg feed and it can be assumed this consists of 0.635 kg/bird starter, 1.63 kg/bird grower and 4.635 kg/bird finisher (Gordon and Charles, 2002).

A typical layer hen in an intensive system should produce 260-310 eggs per hen housed in 52 weeks in lay, with a crude protein content of 106 g/kg egg (6.2 g CP per egg) or 16.96 g N/kg (1 g N per egg) (Shrimpton, 1987). A whole raw egg (excluding the shell) contains about 200 mg P/100 g and 130 mg K/100 g (Holland et al., 1991). Assuming a mean egg weight of 59 g, with 9.5 % shell containing negligible P and K (Larbrier and Leclercq, 1994), a whole raw egg will contain 107 mg P and 69 mg K.

Bodyweight and feed consumption of immature layer chickens, broilers and turkeys are shown in Tables 16 and 17. These figures refer to modern breeds reared in intensive systems.

Table 16. Body weight and feed consumption of immature layer chickens and broilers

	Brown-egg-laying strains			
Age (Wks)	Body wt[a] g	Feed consumption (g/wk)		
0	37	70		
4	325	280		
8	750	380		
12	1,100	420		
16	1,380	470		
20	1,600	550		
	Broilers			
	Body wt g Male	Body wt g Female	Feed consumption (g/wk) Male	Feed consumption (g/wk) Female
1	152	144	135	131
3	686	617	487	444
5	1,576	1,344	960	738
7	2,590	2,134	1,281	1,081
9-11	3,551	2,842	1,577	1,246

Source: Nutrient Requirements of Poultry 9th Edition

[a] Average genetic potential when feed is consumed on an *ad libitum* basis

values for broilers are based on well-balanced diets providing 13.4 MJ ME/kg

Table 17. Body weight and feed consumption of turkeys

Age (Wks)	Body wt kg Male	Body wt kg Female	Feed consumption (kg/wk) Male	Feed consumption (kg/wk) Female
1	0.12	0.12	0.10	0.10
4	1.0	0.9	0.70	0.59
8	4.0	3.0	1.73	1.21
12	8.2	6.0	2.99	2.18
16	12.6	8.9	3.97	3.00
20	16.1	11.5	4.74	3.40
24	19.4	[a]	5.28	[a]

Source: Nutrient Requirements of Poultry 9th Edition

[a] no data because females are usually marketed after 20 weeks

4.3 Energy requirement

Metabolisable energy (ME) is the measure of feed energy used when comparing poultry diets. Birds excrete both faeces and urine via the cloaca, making it difficult to measure digestibility. ME is the gross energy of the feed minus the gross energy contained in the faeces, urine and gaseous products of digesta. Gaseous products are generally negligible in poultry. A correction for nitrogen retained in the body is frequently applied to yield an ME_n value, which is the most common measure of available energy in poultry nutrition.

Poultry tend to eat to satisfy their energy requirements if fed ad libitum. An absolute requirement for energy in terms of kilojoules per kilogram of diet cannot be stated because poultry adjust their intake to obtain their necessary daily requirements. Poultry will increase intakes of diets with a lower energy content and therefore consume more nutrients, unless lesser concentrations of nutrients (e.g. protein, amino acids, etc) are used. Similarly, if diets contain a higher energy content, the concentrations of other nutrients should also be increased to compensate for the decline in intake. Higher energy diets are generally more efficient in terms of weight gain per unit intake. The bulk density of a diet (volume per unit weight) may limit the quantity of nutrients that can be ingested. Pelleting a bulky diet increases the bulk density and enables consumption of more nutrients. Adding fat will increase the energy concentration of the diet.

Temperature affects energy requirement, and since birds eat to meet their energy requirement, feed intake is also affected by temperature (Payne's hypothesis – interaction between environment and nutrition cited by Gordon and Charles, 2002). Protein, vitamin and mineral requirements are not affected by temperature, therefore when formulating the composition of a diet, the feed intake of the birds should be known, and a diet with the optimum energy: protein ratio selected (so that if temperature is altered, the correct balance of protein and energy intake can be maintained). In times of heat stress, increasing the nutrient concentrations in the diet can compensate for reductions in feed intake. Increased fat and reduced carbohydrate levels stimulate appetite in warm weather. High quality materials should be used to maximise digestibility and availability of amino acids. Bicarbonate may be used in the drinking water to reduce alkalosis.

4.4 Protein requirement

Protein requirement has two components: (1) the essential amino acids needed by the bird (for maintenance, growth, egg production and immunocompetence) because it cannot synthesise them, or cannot synthesise them in sufficient quantities and (2) sufficient protein to supply either the nonessential amino acids themselves or to supply amino nitrogen for their synthesis. The biggest problem when formulating diets for organic production is in meeting the essential amino acid requirements of the birds while keeping dietary protein at a low level. Synthetic or crystalline amino acids are not permitted in organic poultry diets. The crystalline amino acids, which are widely used in the feed industry (non-organic feeds), are L-lysine hydrochloride, DL-methionine, L-threonine and L-tryptophan. Others are available but not economical to use.

Chicks need a dietary supply of lysine, methionine, arginine, tryptophan, threonine, isoleucine, leucine, glycine, histidine, phenylalanine and valine. Essential amino acids can influence the feed intake either through their concentrations in blood reaching the brain, where they influence other brain receptors, or by influencing the metabolism of amino acids in the liver. Deficiencies or excesses of certain essential amino acids cause feed intake to decline by influencing the areas of the brain controlling feed intake.

The amino acid of most concern in poultry diets is methionine. The amino acids methionine and cystine are referred to as the sulphur amino acids (SAA) since they are high in sulphur and are required especially for feather production. While methionine is essential for birds, the requirement for cystine can be met by either cystine or an adequate supply of methionine. It is normal therefore to specify a requirement for a certain minimum amount of methionine (depending on type of stock) and for a certain minimum amount of methionine plus cystine (usually twice the methionine requirement).

Layers are generally fed ad libitum during the growing and laying periods. Broilers are also fed ad libitum to ensure rapid development to market size. Broiler-breeders, however, are maintained for hatching egg production. Since they can become obese, feed intake is usually restricted. However, some organic regulations require that a slow-growing strain must be one where parent lines are not feed restricted (Food Animal Initiative, 2004).

Layer hens can consume excess feed during the latter phases of egg production with resultant obesity and reduced feed efficiency. Limiting feed intake to 90 to 95 percent of full feed consumption is desirable when over-consumption of energy is a problem. Laying hens can be phase fed to adjust nutrient intake in accordance with their changing nutritional needs as the rate of egg production declines during the laying year. After 8-12 months of egg production, some flocks of hens are moulted as a means of recycling hens for another period of reproduction. A combination of feed and light restriction is used to stop egg production and induce moult. The hens are then 'rested' for up to 4 to 6 weeks. Upon refeeding, and increasing the hours of light, the birds are stimulated to resume egg production. In organic production, poultry are only kept for one laying season. They are not moulted and do not resume egg production.

The requirements for amino acids differ for maintenance and growth functions. The optimum balance of dietary amino acids will depend on the proportions used for maintenance and production (Table 18). Therefore high-producing birds will differ from low producing birds. The amino acid content of the carcass and feathers of growing chickens is shown in Table 19.

The nutrient requirements of high producing layers, broilers and turkeys, at different ages, as reported by various authorities, are shown in Tables 20, 21, 22, 23 and 24.

Table 18. Estimates of essential amino acid requirements for growing chickens

Amino acid	Maintenance (mg/d per kg liveweight)	Growth (g/100 g liveweight gain)
Lysine	82	1.49
Sulphur amino acids	60	1.16
Tryptophan	10	0.27
Threonine	86	0.75
Leucine	93	1.21
Isoleucine	58	0.77
Valine	70	0.95
Histadine	63	0.37
Arginine	50	1.40
Phenylalanine + tyrosine	370	1.20

Source: Larbier and Leclercq, (1994): p196 of Gordon and Charles, (2002)

Table 19. Amino acid content of the carcass and feathers of growing chickens (g/100 g protein)

Amino acid	Carcass (g/100 g protein)	Feathers (g/100 g protein)
Protein percentage[1]	38-40	18-20
Lysine	6.5	1.6
Sulphur amino acids	4.0	7.9
Tryptophan	0.9	0.7
Threonine	4.2	4.6
Leucine	7.2	8.5
Isoleucine	4.3	6.4
Valine	4.7	8.9
Histadine	3.5	0.7
Arginine	6.8	7.3
Phenylalanine + tyrosine	7.0	7.4

Source: Larbier and Leclercq, (1994): p195 of Gordon and Charles, (2002)

[1](from www.sac.ac.uk/animal/External/ABDWeb/Avian/TechNotes/note6.htm). This percentage can vary according to breed of bird

Table 20. Nutrient requirements of immature layer-type hens and broilers

	Brown-egg-laying strains			
	0–6 wks	6–12 wks	12–18 wks	18 wks to 1[st] egg
	500g[a]	1100g[a]	1500g[a]	1600g[a]
%	11.7 [b]	11.7 [b]	11.9 [b]	11.9 [b]
Crude protein	17.0	15.0	14.0	16.0
Lysine	0.80	0.46	0.42	0.49
Sulphur AA	0.59	0.49	0.39	0.44
Methionine	0.28	0.23	0.19	0.21
Threonine	0.64	0.53	0.35	0.44
Tryptophan	0.16	0.13	0.10	0.11
Linoleic acid	1.00	1.00	1.00	1.00

	Broilers (90 % dry matter diet)		
	0-3 wks	3-6 wks	6-8 wks
%	13.4	13.4	13.4
Crude protein	23.0	20.0	18.0
Lysine	1.10	1.00	0.85
Sulphur AA	0.90	0.72	0.60
Methionine	0.50	0.38	0.32
Threonine	0.80	0.74	0.68
Tryptophan	0.20	0.18	0.16
Linoleic acid	1.00	1.00	1.00

Source: Nutrient Requirements of Poultry 9th Edition

[a] final body weight

[b] typical dietary energy concentrations for diets based mainly on corn and soyabean meal expressed in MJ ME_n / kg diet

Table 21. Nutrient requirements of layers

	Laying + breeding hens > 18 weeks	@ 90 g feed/hen per day	@ 100 g feed/hen per day	@ 110 g feed/hen per day
ME MJ/kg		12.1	12.0	11.9
Crude Protein %		16.5	16.3	16.0
Lysine %	0.88	0.98	0.88	0.80
Sulphur AA %	0.78	0.87	0.78	0.71
Methionine %	0.42	0.47	0.42	0.38
Threonine %	0.58	0.64	0.57	0.52
Tryptophan %	0.16	0.18	0.16	0.15

Source: Degussa (2001)

Table 22. Nutrient requirements of broilers

	Starter	Grower	Finisher
ME MJ/kg	13.2	13.4	13.6
Crude Protein %	21.0	20.0	18.0
Lysine %	1.28	1.22	1.05
Sulphur AA %	0.96	0.92	0.81
Methionine %	0.56	0.52	0.44
Threonine %	084	0.80	0.72
Tryptophan %	0.21	0.20	0.18

Source: Degussa (2001)

Table 23. Nutrient requirements of turkeys (90 % dry matter)

	Growing turkeys – males and females					
	0-4 wks	4-8 wks	8-12 wks	12-16 wks	16-20 wks	20-24 wks
	11.7[a]	12.1[a]	12.6[a]	13.0[a]	13.4[a]	13.8[a]
Crude protein	28.0	26.0	22.0	19.0	16.5	14.0
Lysine	1.60	1.50	1.30	1.00	0.80	0.65
Sulphur AA	1.05	0.95	0.80	0.65	0.55	0.45
Methionine	0.55	0.45	0.40	0.35	0.25	0.25
Threonine	1.00	0.95	0.80	0.75	0.60	0.50
Tryptophan	0.26	0.24	0.20	0.18	0.15	0.13
Linoleic acid	1.00	1.00	0.80	0.80	0.80	0.80

Source: Nutrient Requirements of Poultry 9th Edition

[a] approximate ME values provided with typical corn-soyabean feeds (MJ ME/kg)

Table 24. Nutrient requirements for turkeys

	Wk 1-4	Wk 5-8	Wk 9-12	Wk 13-16	Wk 17-20	> 20 Wks
ME MJ/kg	11.7	12.1	12.6	13.0	13.4	13.4
Crude Protein %	28.0	25.0	22.0	19.0	16.0	14.0
Lysine %	1.80	1.60	1.40	1.20	1.10	1.00
Sulphur AA %	1.15	1.04	0.92	0.80	0.75	0.69
Methionine %	0.66	0.59	0.53	0.46	0.43	0.39
Threonine %	1.06	0.95	0.84	0.73	0.67	0.61
Tryptophan %	0.31	0.27	0.24	0.20	0.19	0.17

Source: Degussa (2001)

Most plant protein sources are deficient in lysine and /or methionine. For example, a diet based on wheat and peas would not support egg production, because of methionine deficiency and would have health and welfare implications (Gordon and Charles, 2002). Feeds high in crude protein but low in methionine and lysine are associated with low egg outputs, according to response to the first limiting amino acid (McDonald and Morris, (1985); Mellows Agricultural College).

These nutrient requirements (NRC, Degussa, etc) refer to fast growing strains for use in intensive production systems. There is little information on the optimum amino acid levels for organic production but the available data suggests lower levels (Gordon and Charles, 2002) and this is seen also in the amino acid content of the available compound feeds for organic poultry.

Tables 25, 26 and 27 show sample ration formulations and nutrient contents formulated by Gordon and Charles (2002) for organic birds.

Table 25. Sample ration formulation for organic laying hens

Ingredient	Quantity (kg/t)
Wheat	704.6
Corn gluten meal	68.4
Full fat soya	98.0
Grassmeal	10.0
Minerals, vitamins and amino acids	119.0

Source: Gordon and Charles, (2002)

Table 26. Sample ration formulation for organic table chickens

	Quantity (kg/t)		
Ingredient	Starter	Grower	Finisher
Wheat	550	700	710
Wheatfeed	105	50	50
Full fat soya	260	198	192
Peas	50	20	17
Starter supplement	35	-	-
Grower supplement	-	32	-
Finisher supplement	-	-	30

Source: Gordon and Charles, (2002)

Table 27. Nutrient specification of table bird rations (as fed basis)

Content (g/kg)	Starter	Grower	Finisher
Dry matter	873	871	870
Crude protein	182	161	159
Nitrogen	29.1	25.8	25.4
Total phosphorus	7.3	6.5	6.5
Potassium	8.0	6.7	6.6

Source: Gordon and Charles, (2002)

Amino acid or protein deficiency results in:

- reduced feed intake
- growth depression
- abnormal feather development
- tongue deformity in growing birds with leucine, isoleucine and phenylalanine deficiency
- lack of melanin pigment in black- or reddish-coloured feathers with lysine deficiency
- decline in egg production (hatchability unaffected)
- reduction in egg size
- reabsorption of ova in severe deficiency
- body weight loss in severe deficiency

A closed system where all the inputs can be supplied on-farm is currently not achievable (Gordon and Charles, 2002).

4.5 Methionine

Methionine is the first limiting amino acid in poultry diets i.e. the methionine content of the protein in common ingredients is below the optimum for poultry. This means that regardless of the content of other amino acids in the diet - lysine, tryptophan etc., the birds will only perform to the level allowed by the content of methionine, in effect, other amino acids can be excess of requirement. Methionine is first limiting because it is used not only for growth and egg production but it is also metabolised into feather proteins that are needed to maintain and replace the feathers (see Table 19). Birds can replace their feathers 3 to 4 times during the growth phase. When hens commence lay they are still growing, while replacing feathers and producing eggs all at the same time. This is a critical time for the requirement for methionine.

Since there are few organic certified feedstuffs that contain enough methionine to meet the birds requirements, formulating diets without additional crystalline amino acids will result in significant increases in the protein content. When protein intake increases, very little of the excess nitrogen is utilised and so it must be excreted. To rid itself of the excess protein and nitrogen, the bird will consume more water. Nitrogen is excreted by poultry as uric acid or urea, which are further broken down into water and ammonia. Overall, the water excretion of the birds is increased, resulting in ideal conditions on the floor of hen houses for damp litter where bacteria and protozoan disease organisms can reside.

Addition of supplemental methionine allows for a better balance of protein in the diet. DL-methionine has been used in animal diets for over 50 years. It is a safe product and Dr. Owen Keene (Heritage Poultry Management Services Inc.) recommends that it is necessary in organic poultry feeds in order to maintain the best nutrition and health of all the avian species.

4.6 Betaine

Dietary betaine is an osmolyte (i.e. it acts to maintain water balance in cells of the body) that can reduce the energy demand for maintaining cellular walls and ion balance. Betaine is also a methyl donor. Methyl groups are continually required for essential metabolic processes (e.g. DNA, RNA and protein synthesis) and can be obtained from dietary sources such as choline, methionine or betaine. Betaine is the most efficient donor of the three. Betaine is a metabolite of choline and is a substrate in one of the two recycling pathways that convert homocysteine to L-methionine. All supplemental choline and some of the dietary methionine can be replaced by betaine. Betaine, the common term for trimethylglycine, is found widely throughout the animal and plant kingdoms. In animals it is found mainly in the liver. When all three methyl groups have been transferred, betaine becomes the amino acid glycine and is metabolised as normal. By producing methionine in the liver, betaine can allow some dietary methionine to be spared, saving feeding costs (Virtanen, 1999).

Betaine occurs in sugar beet. It is a tertiary amine which is formed by the oxidation of choline. In the animal body betaine may be transformed into trimethylamine. Choline is a B vitamin. It is not a metabolic catalyst but it forms an essential structural component of body tissues. It plays an important role in lipid metabolism in the liver by preventing the accumulation of fat in the organ. It is a donor of methyl groups in transmethylation reactions. Choline can be synthesised in the liver from methionine. Deficiency symptoms include slow growth and fatty infiltration of the liver in chicks.

4.7 Vitamins

Requirements for fat-soluble vitamins (A, D, E, K) are considered to be proportional to body weight (at least in older animals). Requirements for the B-vitamins (water-soluble) which are concerned with metabolism vary with feed or nutrient intake and may also vary according to the extent to which they are synthesised in the alimentary tract. Considerable synthesis takes place in the lower gut of poultry but these vitamins may fail to be absorbed.

In laying hens, the minimum amounts of vitamins required to ensure maximum egg production might be insufficient to provide for normal growth of the chick, both before and after hatching. For most of the B-vitamins the quantities needed for maximum hatchability are appreciably greater than those for egg production alone.

This is not the case for vitamins A and D. The value of β-carotene as a source of vitamin A for poultry has, on a weight basis, only 33 per cent of the value of vitamin A. Poultry fed a diet deficient in vitamin A can exhibit symptoms such as retarded growth, weakness, ruffled plumage and a staggering gait. In mature birds, egg production and hatchability are affected.

In poultry, a deficiency of vitamin D causes the bones to break and become soft and rubbery, growth becomes retarded and legs become weak. Egg production is reduced and eggshell quality deteriorates. If reared indoors, poultry are generally supplied with synthetic vitamins, since most feeds for poultry contain little or no vitamin D. The problem is lessened when poultry roam and range outside since sunlight can convert the provitamins to the vitamins.

Vitamin D_3 (cholecalciferol) is about 10 times as potent for poultry as D_2 (ergocalciferol) (McDonald et al., 1995).

Vitamins C and E should be provided at recommended levels. Generally, farm animals can synthesise vitamin C. However, under certain conditions, such as climatic stress, the demand for vitamin C becomes greater than can be provided by normal tissue and may have to be supplemented. Nutritional encephalomalacia or 'crazy chick disease' arises through a deficiency in vitamin E. The chick is unable to walk or stand and it is accompanied by haemorrhages and necrosis of the brain cells.

5. Potential feed ingredients for organic production

5.1 Cereals

The crude fibre content of harvested grain is highest in those such as oats and rice which contain a husk or hull formed from the fused glumes (palea and lemma), and is lowest in the naked grains, wheat and maize. Barley and oats can be used to replace half the wheat included in poultry diets. Oats and barley are lower in energy and crude protein and higher in fibre than wheat but are still acceptable ingredients. Unless an enzyme is added to the diet to aid in the digestion of the "sticky starches" (indigestible carbohydrates or beta glucans) found in barley and oats, young birds may have temporary diarrhoea when these ingredients are first fed. Enzyme addition to barley-containing poultry diets for non-organic birds is routine. Low bushel weight cereal grains, especially oats with a high proportion of hulls should be avoided.

5.1.1 Wheat

Wheat is one of the best cereal grains for feeding to poultry. It is a good source of starch and energy and a moderate source of protein. Any variety of wheat can be fed to birds, although some are slightly more digestible than others. The presence of shrunken or sprouted kernels can downgrade wheat for use in human foods but in many cases the feeding value of the wheat for poultry will remain acceptable. The crude protein content of wheat is generally between 80 and 140 g/kg DM. The mixture of proteins present in the endosperm of wheat is often referred to as 'gluten' (gliadin and glutenin). The amino acid content of these two proteins differs, glutenin containing about three times as much lysine as that present in gliadin. All glutens possess the property of elasticity. This is why finely ground wheat is unpalatable when given in any quantity to animals. Wheat, especially if finely milled, forms a pasty mass in the mouth and rumen which can lead to digestive upsets. Poultry are less susceptible, although wheat with a high gluten content should not be given since a doughy mass can accumulate in the crop. ME available from wheat to poultry is about 15.3 MJ/kg (McDonald et al., 1995). Table 28 shows the recommended maximum inclusion level of wheat in poultry diets.

Table 28. Maximum wheat inclusion levels %

Chick	Broiler	Breeder	Layer
50	60	65	60

Source: Ewing 1997

5.1.2 Barley

In most varieties of barley the kernel is surrounded by a hull which forms about 10-14 per cent of the weight of the grain. ME available to poultry from barley is about 13.3 MJ/kg (McDonald et al., 1995). The crude protein content of barley grain ranges from about 60 to 160 g/kg DM with an average value of about 120 g/kg DM. However, the protein quality is low, being particularly deficient in lysine. The lipid or fat content of barley grain is low, usually less than 25 g/kg DM. Barley should always have the awns removed before it is offered to poultry, otherwise digestive upsets may occur. Table 29 shows the maximum recommended inclusion levels of barley in poultry diets.

Table 29. Maximum barley inclusion levels %

Chick	Broiler	Breeder	Layer
25	70	55	55

Source: Ewing 1997

5.1.3 Oats

Oats are common in ruminant and horse diets but they are less favourable in pig and poultry diets because of the comparatively high fibre content and low energy value. The nutritive value of oats depends to a large extent on the proportion of kernel to hull, which depends on the variety and season, and the hull content can vary from 23 to 35 per cent. A higher proportion of hull means a higher fibre content and a lower energy value. The crude protein content of oats ranges from 70 to 150 g/kg DM. Sulphur amino acid content as a proportion of crude protein content is marginally higher than other cereal grains, although the protein content is low. The oil content of oats is higher than other cereals and about 60 per cent is in the endosperm. This oil is rich in unsaturated fatty acids and has a softening effect on the body fat. Table 30 shows the maximum recommended inclusion levels of oats in poultry diets.

Table 30. Maximum oats inclusion levels %

Chick	Broiler	Breeder	Layer
0	0	15	15

Source: Ewing 1997

5.1.4 Maize (corn)

Maize grains can be yellow, red or white, depending on variety. Yellow maize contains a pigment, cryptoxanthin, which is a precursor of vitamin A. This is useful in the diet of laying hens to produce an orange colouration in the egg yolk. Maize is low in protein content, which is also of poor quality although relatively rich in SAA (Baker, 2000). Maize contains about 730 g starch/kg DM, is low in fibre and has a high ME value. The available ME content of maize for poultry is about 16.2 MJ/kg (McDonald et al., 1995). The oil content in maize varies from 40 to 60 g/kg DM and is high in linoleic acid, which is important in controlling the size of hen eggs. However, maize oil can produce a soft body fat. The crude protein content of maize ranges from about 90 to 140 g/kg DM. The maize kernel contains two main types of protein. Zein, occurring in the endosperm, is qualitatively more important but is deficient in tryptophan and lysine. The other protein, maize glutelin, occurs in a lesser amount and also in the germ, is a better source of these two amino acids. Varieties are being developed with increased lysine or methionine content. Table 31 shows the maximum recommended inclusion levels of maize in poultry diets.

Table 31. Maximum maize (corn) inclusion levels %

Chick	Broiler	Breeder	Layer
30	50	50	50

Source: Ewing 1997

5.1.5 Triticale

Triticale is a hybrid cereal derived from crossing wheat with rye. The objective in crossing two cereals was to combine the desirable characteristics of wheat such as grain quality, productivity and disease resistance with the vigour and hardiness of rye. The crude protein content can range from 110 to 185 g/kg DM. Recent strains of triticale are at least equal in protein content to wheat and the quality of the protein in the hybrid is better than in wheat because of its higher proportion of lysine and SAA (methionine and cystine). However, it is deficient in tryptophan. Triticale contains trypsin inhibitors and alkyl resorcinols. Both of these have been implicated in problems of poor palatability and performance in pigs. Triticale should not make up more than 50 per cent of the grain in the diet of farm animals. Table 32 shows the maximum recommended inclusion levels of triticale in poultry diets.

Table 32. Maximum triticale inclusion levels %

Chick	Broiler	Breeder	Layer
10	20	30	35

Source: Ewing 1997

5.1.6 Soyabean meal

Soyabean meal is the best protein source for chickens and turkeys. However, organic soyabean meal is very expensive because the seed must be grown organically and processed organically. Oil must be removed from the seeds mechanically because solvent extraction is not permitted in organically produced feed. Typically, poultry feed in Ireland (which accounts for up to 70 % of production costs) was based on cereals and soyabean (for energy and protein), with added vitamins and minerals. Soyabean meal is a good source of protein and fat and is well balanced except that the protein is relatively poor in SAA for broilers (Baker, 2000).

Soyabean meal must be heat treated due to the presence of anti-nutritional factors (ANFs) including trypsin inhibitors (reduce trypsin activity, increase secretion of pancreatic enzymes), lectins (cause gut wall damage, immune response, increased loss of endogenous protein), antigenic proteins (cause interference with gut wall integrity, immune response) and alkaloids (cause neural disturbances and reduced palatability). Trypsin inhibitors and other ANFs present in unheated soya can depress poultry performance (Liener, 2000). Cold pressing will not destroy or remove these compounds.

SBM has about 20% less ME for poultry than for pigs due to the reduced digestibility of oligosaccharides or non-starch polysaccharides (Baker, 2000, Liener, 2000). These and the high level of potassium (K) in soyabean meal can result in increased litter wetness when used at high levels in the diet (Cooke and Raine, 1986). Despite the cost (often up to four times that of regular soyabean meal), it is still an attractive product to feed to organic turkeys that need high levels of protein in their diets. Table 33 shows the maximum recommended inclusion levels for soyabean meal in poultry diets.

Table 33. Maximum soyabean meal inclusion levels %

Chick	Broiler	Breeder	Layer
25	30	35	35

Source: Ewing 1997

5.1.7 Roasted soyabean seed (Full-fat)

Roasted soyabean seed is a good source of protein and fat for poultry. Soyabean seed contains a trypsin inhibitor that can severely interfere with digestion in the bird's gut and the seed must be heat treated to inactivate this compound. The processing cost to produce roasted soybean seed is lower than for soyabean meal. Roasted soyabean seed is sometimes referred to as being 'full-fat' because the oil has not been extracted. Because of the high unsaturated fat content of the seed, feeding 20 % or more soyabean seed may produce a slight fishy taste in the poultry meat or eggs. Table 34 shows the maximum recommended inclusion levels of full-fat soyabean in poultry diets.

Table 34. Maximum roasted soyabean (full-fat) inclusion levels %

Chick	Broiler	Breeder	Layer
20	25	20	20

Source: Ewing 1997

5.1.8 Rapeseed

Rapeseed meal is a high protein, good energy feed used to partially replace soyabean meal, although the protein is less digestible. ANF's include erucic acid, glucosinolates, tannins and sinapine. Erucic acid and glucosinolates can be unpalatable and even lead to death in poultry. Low glucosinolate and low erucic acid varieties of rapeseed (known as 'double zero', OO) can only be included in poultry diets at no more than 100 g/kg for laying hens and 50 g/kg in broiler starter diets, and maybe up to 80 g/kg in broiler finisher diets because of possible egg taint problems and ANFs. Table 35 shows the recommended maximum inclusion levels of rapeseed meal in poultry diets.

Table 35. Maximum rapeseed meal inclusion levels %

Chick	Broiler	Breeder	Layer
0	2.5	0	5.0

Source: Ewing 1997

5.2 Alternatives

Peas, beans, lupins, linseed, rapeseed and naked oats have been suggested as alternative protein sources. All these alternative protein sources have lower lysine concentrations than full fat soyabean. Rapeseed meal and sunflower meal have higher concentrations of SAA than full fat soya, although their inclusion rates are limited due to the presence of anti-nutritional factors, and because of low metabolisable energy value. Any oil seed by-products that may be used would have to be produced by extrusion since solvent extraction is not permitted. Fishmeal has a high protein content and high essential amino acid content compared to full fat soya, although use of fishmeal where there are herbivores present is not permitted (generally not allowed). Gordon and Charles (2002) formulated an organic pullet feed without fishmeal or synthetic lysine and methionine, using wheat, full fat soya, sunflower, potato protein, wheatfeed, vitamins and minerals. Dietary methionine content of 6 g/kg was achieved (similar to conventional chick ration), although the crude protein and available lysine contents were much higher.

5.2.1 Maize (corn) gluten feed

Three maize by-products – germ, bran and gluten, are frequently mixed together and sold as maize gluten feed. This has a variable protein content, normally in the range of 200-250 g/kg DM. Maize gluten feed has a crude fibre content of about 80 g/kg DM, and ME value of about 9 MJ/kg for poultry. In the US this is a mixture of pellets and meal (although it can be bought screened). It can vary considerably from golden yellow to dark brown. Dark brown material indicates heat damage, which will decrease the digestibility of the protein. It is a by-product of wet milling of maize or increasingly of ethanol / alcohol production. It has a good level of digestible fibre with reasonable protein and energy contents. Corn gluten feed is available in the UK as either golden meal or mid-brown pellet. It is wet milled in the UK from GM free French maize. It is much more consistent in appearance than the US material whilst possessing all the same nutritional qualities, e.g. DM 890 g/kg, ME 12.5 MJ/kg, CP 220 g/kg, CF 80 g/kg, Oil 40 g/kg, starch and sugar 255 g/kg (Anon 2004b). Table 36 shows the maximum recommended inclusion levels of maize gluten feed in poultry diets.

Table 36. Maximum maize (corn) gluten feed inclusion levels %

Chick	Broiler	Breeder	Layer
0	12.5	0	12.5

Source: Ewing 1997

5.2.2 Maize (corn) gluten meal (Prairie meal)

Maize gluten meal must not be confused with the previous ingredient **maize gluten feed** which is much lower in protein. This is a by-product of the manufacture of maize starch. It consists principally of gluten obtained during the separation of the starch. Prairie meal is a palatable high protein concentrate, which is the by-product of wet milling of maize. It produces a deep yellow / orange fine meal which was traditionally used as a natural yolk colour enhancer. It is widely viewed as an organic alternative to fishmeal and can be fed to all classes of stock. It is also a reasonable source of starch and sugars however, excessive levels can cause soft carcass fat or discolouration. Typical composition is DM 900 g/kg, CP 680 g/kg, DCP 680 g/kg, ME 14.5 MJ, CF 15 g/kg, Oil 45 g/kg, Ash 20 g/kg, Starch 160 g/kg in DM (Anon 2004c and 2004d). Maize gluten meal has a very high protein content (up to about 700 g/kg DM) and is a good source of SAA. It is high in pigments, so is valuable in poultry diets.

Table 37 shows the maximum recommended inclusion levels of maize gluten meal in poultry diets.

Table 37. Maximum maize gluten meal (Prairie meal) inclusion levels %

Chick	Broiler	Breeder	Layer
0	5	0	7.5

Source: Ewing 1997

5.2.3 Wheatfeed (pollard)

In the production of white flour, the extraction rate varies in different countries but in the UK it is about 74 %. The remaining 26 % constitutes the residues or 'offals'. In modern roller milling, the offals may be sold complete as straight-run wheatfeed or as three separate products – germ, fine wheat feed (shorts, pollard) and coarse wheat feed (bran). The germ is rich in protein (approx. 250 g/kg DM), low in fibre and an excellent source of thiamin and vitamin E. Fine wheat feed varies considerably in composition. Crude protein content is generally in the region of 160-210 g/kg DM and the crude fibre content is about 40-100 g/kg DM. Fine wheat feed can be used safely for all classes of farm animals. Coarse wheat feed, or bran, contains more fibre and less protein than fine wheat feed. It is not considered suitable for feeding to pigs or poultry because of the high fibre content (McDonald et al., 1995). Table 38 shows the maximum recommended inclusion levels of wheatfeed in poultry diets.

Table 38. Maximum wheatfeed (pollard) inclusion levels %

Chick	Broiler	Breeder	Layer
0	5	15	15

Source: Ewing 1997

5.2.4 Peas

Peas provide moderate levels of protein and starch for poultry. The protein level is much lower and the quality more variable than soyabean meal or roasted soyabean seed. Peas are particularly low in methionine and should not be used as the sole protein source for young birds. Peas can probably be incorporated into broiler diets up to 250 to 300 g/kg and into layer diets up to 150 to 200 g/kg (Gordon and Charles, 2002). White flowering peas do not contain tannins and early sown spring varieties have relatively low quantities of trypsin inhibitor. The lysine: crude protein ratio in peas is high but the lysine and crude protein contents are lower than those of soya bean meal but higher than that of cereals, and the energy content (12.1 MJ/kg DM) is compatible with the majority of diets used in the poultry industry. The energy content can rise to 13 MJ/kg DM after pelleting because of the effect of the steam. Peas are low in SAA and tryptophan compared to soya bean meal, however, Grosjean (1985) considered peas in poultry diets to be satisfactory, provided that crystalline methionine was added. Protein content of peas is about 241 ± 12 g/kg DM, but can be variable depending on variety, environment etc. Micronisation has been shown to reduce the lysine content of peas by 2.7 % (Igbasan and Guenther, 1996). Peas should not be considered as the sole protein source for young birds. Table 39 shows the maximum recommended inclusion levels of peas in poultry diets.

Table 39. Maximum peas (dried) inclusion levels %

Chick	Broiler	Breeder	Layer
0	0	7.5	7.5

Source: Ewing 1997

5.2.5 Beans

Beans have a good level of energy from starch. They are high in lysine but have a low content of SAA and fibre. Spring beans are higher in protein than winter varieties. They can often be interchanged with peas in a diet, although the presence of anti-nutritional factors means they are second best to peas. They can be unpalatable but this can be overcome in a mixture. ANF's include tannins (mainly in the hulls) and trypsin inhibitors. Urease, phytates, haemagglutinins and glucosides are regularly present, meaning heat treatment is often necessary. Table 40 shows the maximum recommended inclusion level of beans in poultry diets.

Table 40. Maximum bean inclusion levels %

Chick	Broiler	Breeder	Layer
0	5	5	5

Source: Ewing 1997

5.2.6 Lupins

It has been suggested that up to 200 g/kg of sweet lupins could be used to replace soya, however, consistency is variable. Sweet lupin seeds lack trypsin inhibitors and can make a valuable contribution to dairy, beef, swine, sheep, and poultry rations at the farm since high temperature cooking to eliminate anti-nutritional factors is not needed. Lupin seeds contain approximately 30 g/kg ash, 370 g/kg protein, 50 g/kg oil, and 70 g/kg sugar (Anon 2004e). Potential problems pointed out by van Kempen and Jansman (1994) include oligosaccharides of the raffinose family, α-galactosides, high levels of manganese in *Lupinus albus* and pectins and alkaloids including lupanine, spartine, lupinine, and angustifline. Olver and Jonker (1997) found that sweet lupins were acceptable up to 400 g/kg inclusion rate in the diet of broilers. Van Kempen and Jansman (1994) suggest satisfactory performance of layers could be obtained using up to 300 g/kg, and of broilers up to 400 g/kg of sweet lupins, though Naveed et al., (1998) found that 400 g/kg of *L. albus* depressed broiler growth rate. Addition of an enzyme such as xylanase or cellulase can help prevent some of broiler weight gain depression that may occur. Ferraz de Oliveira and Acamovic (1999) found that when feeding 400 g/kg of *L. angustifolius*, enzyme treatment reduced the amount of endogenous amino acid secretions. Castanon and Perez-Lanzac (1990) concluded, based on their own work and work carried out previously in Spain, that only peas and lupins are able to compete with soya bean meal as protein sources in poultry feeds. However, there is a degree of uncertainty in terms of performance when feeding lupins to poultry. Table 41 shows the maximum recommended inclusion levels of lupins in poultry diets.

Table 41. Maximum lupin inclusion levels %

Chick	Broiler	Breeder	Layer
0	5	7.5	7.5

Source: Ewing 1997

5.2.7 Sunflower meal

Sunflower meal is produced when the oil is removed from the seed by hydraulic pressure or by solvent extraction. The hulls are usually partially, rather than completely, removed but the resulting high fibre meals (up to 420 g/kg DM) are readily acceptable to older animals provided they are finely ground. Sunflower seeds are low in trypsin inhibitors and low to medium in phenolic compounds. Sunflower meal is a good source of protein, and SAA, although it is deficient in lysine. ANFs are not a problem in broiler diets, however the energy content is moderate. But this could be useful in organic production, where slower growing birds are required. Sunflower meal can be included in poultry diets at up to 100 g/kg but is not recommended for young birds. Table 42 shows the maximum recommended inclusion levels of sunflower meal in poultry diets.

Table 42. Maximum sunflower meal inclusion levels %

Chick	Broiler	Breeder	Layer
0	5	10	10

Source: Ewing 1997

5.2.8 Potato protein

Potato protein concentrate is a high grade protein. At present is it mostly used in the dairy industry. The crude protein content can range from 750-800 g/kg with a well balanced amino acid profile. In potato starch manufacture an aqueous by-product remains that is called potato fruit juice (PFJ). On a dry matter basis PFJ contains about 200-250 g/kg protein and amino acids, 150 g/kg sugars, 200 g/kg minerals, 140g/kg organic acids and other components, such as phenolic compounds. Potato protein has a relatively high nutritional quality, comparable to that of whole egg. Protein recovery from industrial PFJ is presently achieved through heat coagulation by steam injection after pH adjustment. This method is very efficient in removing protein from solution (van Koningsveld 2001).

5.2.9 Lucerne meal

Lucerne meal is obtained by drying lucerne, which is a perennial legume. Composition varies with stage of maturity at harvesting. Crude protein content is about 180 g/kg. Because of the high fibre content inclusion levels should be low and in conventional poultry production the product is used only in layer diets. Table 43 shows the maximum recommended inclusion levels of Lucerne in poultry diets.

Table 43. Maximum dried lucerne inclusion levels %

Chick	Broiler	Breeder	Layer
0	0	0	2.5

Source: Ewing 1997

5.2.10 Grassmeal or fresh grass

Dried grass meal is usually manufactured from Italian or perennial ryegrass. As with lucerne meal, stage of maturity at harvesting affects the composition. For conventional poultry diets inclusion levels are low on account of the high fibre content. Table 44 shows the maximum recommended inclusion levels of grassmeal in poultry diets.

Table 44. Maximum grassmeal inclusion levels %

Chick	Broiler	Breeder	Layer
0	0	5	2.5

Source: Ewing 1997

5.2.11 Fishmeal

Fishmeal is produced from whole or parts of fish from which the oil has been removed. It comes in two main types, namely herringmeal (from oily fish) and white fishmeal from non-oily species and has been used for a long time as a protein source in poultry feeds where it also supplies omega-3 fatty acids and minerals. While, in theory, fishmeal is still permitted to be used the limitations and restrictions associated with its use make it impractical in most organic units. The prohibition on fishmeal usage is due to possible contamination or adulteration with meat and bone meal. Table 45 shows the maximum recommended inclusion levels of fishmeal in poultry diets.

Use of fishmeal would allow for some reduction in crude protein content of the diet since fishmeal protein is relatively rich in methionine and total sulphur amino acids compared with the protein in soyabean meal. Fishmeal protein is richer in methionine than any of the other protein sources listed in figure 1. Use of fishmeal would also decrease reliance on soyabean meal, which in some circumstances can contribute to litter problems.

Table 45. Maximum fishmeal inclusion levels %

Chick	Broiler	Breeder	Layer
5	5	5	2.5

Source: Ewing 1997

5.3 Ranking possible feed ingredients

Potential ingredients for use in organic diets can be assessed based on the content of the principal amino acids (methionine plus cystine and lysine) in the crude protein. Table 46 shows the crude protein and amino acid composition (as a percentage of crude protein content) of some possible ingredients for organic diets. It is important when ranking ingredients in this way that the crude protein content of the ingredient is also clearly stated. For example, from the table and graphs it is clear that oats contain a relatively higher proportion of SAA in their crude protein, however, they contain relatively little crude protein. This has the effect of diluting the SAA content. In other words, the birds would have to consume a lot of oats in order to ingest sufficient quantities of SAA. This is not feasible, due to the presence of anti-nutritional factors and the fibre content, so it is also important not to include ingredients in poultry diets above their recommended maximum inclusion levels. The quality of the protein is more important than the protein content per se.

Figure 1 shows the potential ingredients for organic poultry diets ranked in order of SAA of crude protein. It can be seen at a glance which ingredients are potentially good sources of SAA and those that are poorer sources. Figure 1 should be seen in conjunction with Figure 2, which shows the crude protein content of the same ingredients. Figure 2 shows how variable the crude protein content is between ingredients, and those that had the highest proportion of SAA in the crude protein are not necessarily the best ingredients for the poultry. Figure 3 shows the lysine content of the same potential ingredients.

Table 46. Crude protein and principal amino acid content of potential ingredients for organic poultry diets

		As % of CP				
	C. Protein %	Lysine	SAA	Methionine	Threonine	Tryptophan
Wheat	12.96	2.68	3.79	1.54	2.81	1.18
Barley	11.35	3.44	3.83	1.64	3.32	1.23
Oats	10.30	4.01	4.55	1.63	3.36	1.36
Maize	8.16	2.96	4.42	2.17	3.58	0.81
Triticale	11.66	3.28	3.93	1.63	3.06	1.03
Soyabean meal	47.03	6.00	2.87	1.36	3.87	1.33
Roasted soyabean	35.89	6.08	2.95	1.38	3.92	1.33
Rapeseed meal	35.77	5.32	4.41	1.99	4.27	1.32
Maize gluten feed	20.07	2.97	3.81	1.65	3.55	0.62
Maize gluten meal	61.53	1.60	4.14	2.36	3.31	0.53
Wheat feed*	17.5	2.86	4.00	2.29	4.00	1.43
Peas	20.66	7.18	2.43	0.96	3.72	0.92
Beans	25.86	6.24	1.97	0.71	3.46	0.87
Lupine seed	32.36	4.63	2.03	0.62	3.37	0.80
Sunflower meal	34.21	3.39	3.94	2.24	3.62	1.21
Potato Protein	74.45	7.64	3.66	2.20	5.60	1.40
Fishmeal	63.68	7.33	3.63	2.73	4.08	1.06
Linseed	30.58	3.84	3.64	1.84	3.72	1.53

Source: Degussa (2001) * calculated from Ewing 1997

The figures below show the potential feed ingredients (1) ranked by the SAA content of the crude protein, (2) the crude protein content of those ingredients, and (3) the lysine content of feed ingredients as a percentage of crude protein content. O: oats, MA: maize, RSM: rapeseed meal, MGM: maize gluten meal (prairie meal), WF: wheat feed (pollard), SFM: sunflower meal, TR: triticale, B: barley, MGF: maize gluten feed, W: wheat, PP: potato protein, LS: linseed, FM: fishmeal, SFF: roasted soyabean meal (full-fat), SBM: soyabean meal, PE: peas, LU: lupins, BE: beans

Figure 1. Potential ingredients for organic diets ranked by the SAA content of the crude protein

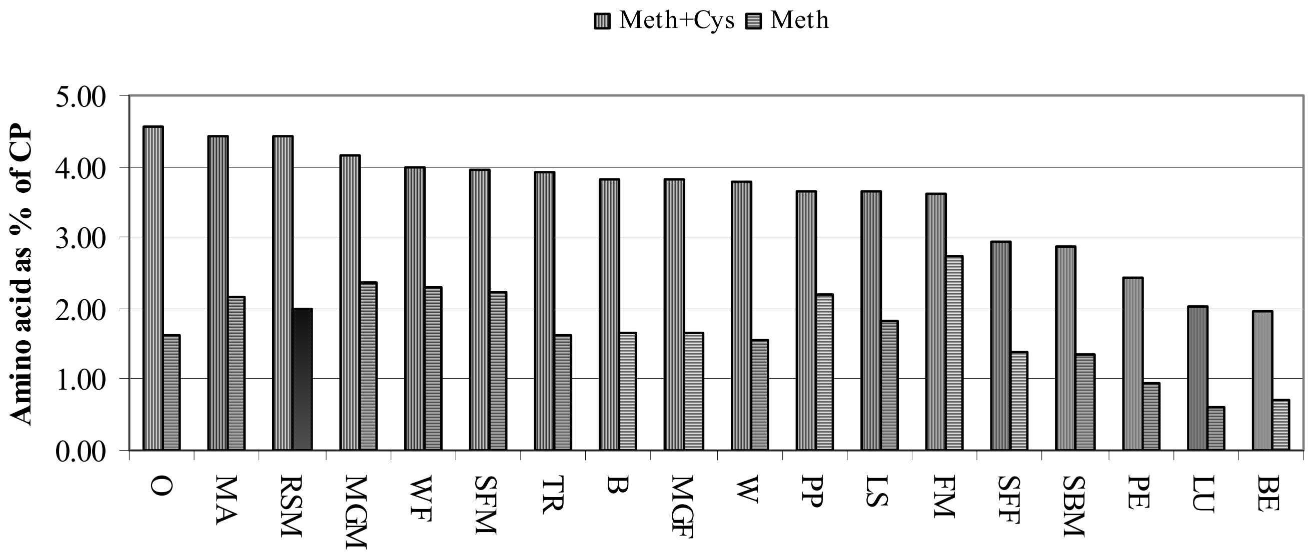


Figure 2. Crude protein content of the potential feed ingredients

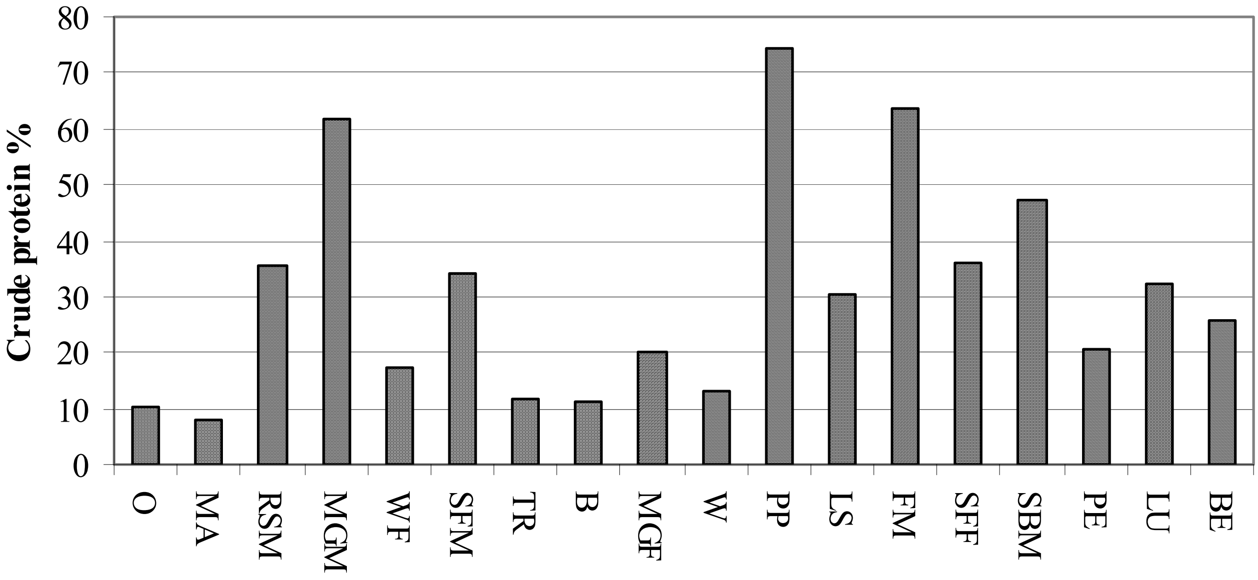
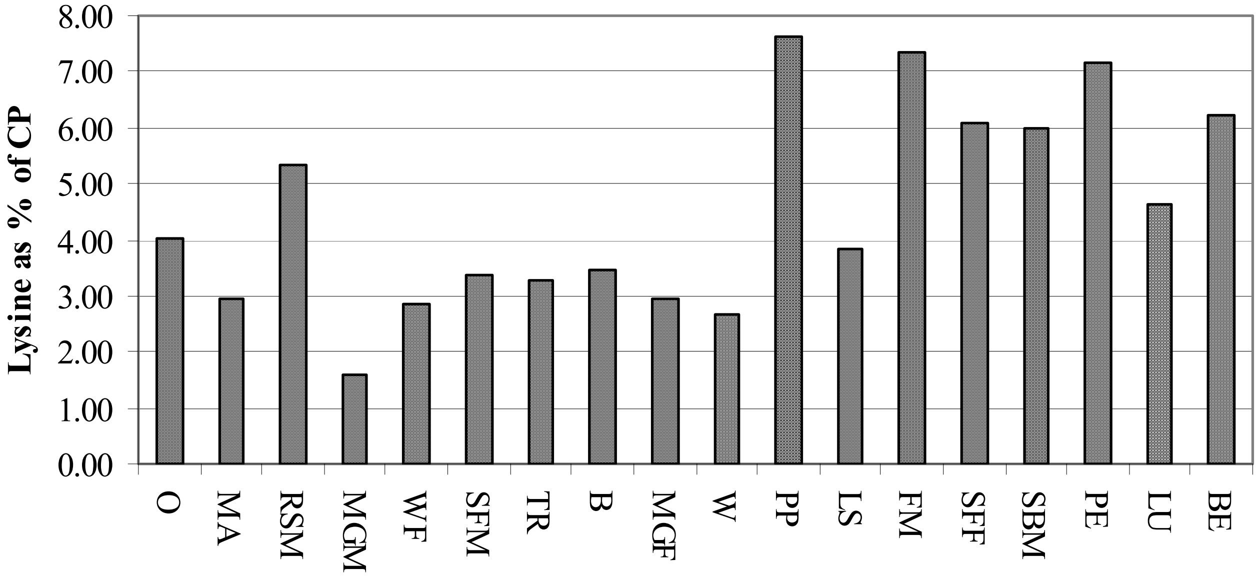


Figure 3. Lysine content of diet ingredients



Conventional maize gluten, potato protein and brewer's grains currently make it possible to meet the protein needs of the animals. But this will become more difficult and expensive after 2005, when conventional raw materials will not be allowed in organic rations.

6. Organic feed industry

Due to the small size of the market for organic animal feeds it is inevitable that there are few manufacturers and distribution costs are high. Most organic producers require their feed supply to be bagged which further increases manufacturing costs (sacks, bagging, storage and handling).

There is a shortage of organic feed ingredients in Europe and Europe is seen abroad as a potentially lucrative market for feed grain from Canada (Thompson, 2001), Australia (Cross, 2000) and Argentina (Balbi and Shull, 2002).

In a study commissioned by DEFRA in 2003 (ADAS, 2004) in the UK all certified organic feed producers in the UK (n=40) were asked to take part in a survey. Thirty-one mills took full part and two others gave partial information. Twenty-seven of the thirty-one organic feed manufacturers also produced non-organic feed, and only one had a dedicated production line for organic feed. Of the thirty-one organic producers, seventeen were producing fully organic feed (2 produced full organic feeds only) and ten were supplying only approved non-organic ingredients to the organic market. The mean delivery distance for organic feed was 50 miles more than that for conventional feed at 208 miles.

Mills were asked about their response to new regulations requiring separate production lines for organic feed. Twenty-two of the feed mills indicated that they could not justify separate organic lines and would discontinue production, while four of the six organic ingredient manufacturers surveyed (producing wheatfeed, oilseed and fishmeal) stated that they would discontinue production. None of the conventional feed compounders (n=23) saw an opportunity to move into the organic market. There were no commercial mills manufacturing feed for the non-ruminant organic sector in Scotland. Following implementation of the requirement for line separation under Regulation 223/2003 Scotland and Northern Ireland will both be without organic mills, with a few suppliers in the North of England. The remaining mills would be concentrated in the south and west of England, with additional implications for distribution costs. There is a danger that this could lead to a monopoly situation.

ADAS (2004) estimated that organic feed prices would rise by £20 per tonne or 10 % as a result of the impact of separate organic lines and on average this would be as high as £50 per tonne in more remote regions. The current output of feed for the organic livestock industry in the UK is approx. 170,000 tonnes (2 % of overall market), and an increase of 10 % on this would translate into £3.4 million, which would be concentrated in the pig, poultry and dairy sectors.

7. Breed of bird

7.1 Available breeds

Most organic producers raising chickens for organic production choose standard breed broilers as their stock (e.g. *Ross* and *Cobb* types). These birds, bred specifically for intensive production systems, perform well in the systems for which they were designed. On average, days to slaughter (at 2.5 kg) can be as low as 35. Within this time there is rapid weight gain, and a low feed usage per unit weight gain, producing the round chubby birds sold in supermarkets. Bassler and Ciszuk (2002) compared conventional *Ross* birds with *Derco* birds and found that the *Ross* birds were 3.64 kg when slaughtered at nine weeks of age and the *Derco* birds were 1.82 kg when slaughtered at twelve weeks. *ISA* (organic strains) can have a liveweight of 2.4 kg after 12 weeks (Fisker 1999).

The conformation of slow growing birds is different with a more elongated carcass, a higher proportion of leg and a lower proportion of breast. Since consumers prefer breast meat, this is to the disadvantage of organic production.

Conventional birds, although used in organic production systems, are less than satisfactory. The Regulations state that '*the choice of breeds or varieties must reflect the capacity of the animals to adjust to local conditions and their vigour and resistance to disease'*. However, through selection for body weight in broilers, a reduction in locomotive activity is perceived and there is a reduction in fear and hence the animals' reactivity to external events, which jeopardises adaptation to the environment. Perch use is also reduced and therefore behaviour is altered. There is less use of sand baths, which impairs defensive capacity against external parasites, compared to birds from 1976 (Italian Ministry, 2004).

Organic regulations require that birds are not slaughtered before 81 days (unless a slow-growing strain is used). Genetic improvements over the last forty to fifty years in broiler growth rates mean that the broiler hybrids today have too fast a growth rate for achieving typical market liveweights of between 2.0 and 2.5 kg at day 81 (Gordon and Charles, 2002). They become too large and show typical health problems related to rapid growth (Bassler and Ciszuk 2002). Secondly, standard breeds can be prone to heart attacks, the incidence of which increases as bird weight increases. Thirdly, these breeds are also prone to leg problems, which become more acute as body weight increases beyond the 41-day life span for which they were bred. Therefore, slow-growing strains are more suited to organic poultry meat production than conventional birds.

However, there is no clear definition of what exactly a slow-growing strain is. Some producers in the UK determine that their birds are slow growing in order to slaughter them at an earlier age. The Food Animal Initiative (FAI, 2004) suggests that welfare science indicates that a slow-growing bird must be one where parent lines have not been subjected to restricted feeding. Others have suggested that a slow growing breed is one that grows at less than 45 g per day. The FAI have a small flock of 250 *JA 57* females from Hubbard that are commonly used for organic production and are slow-growing (at 60 % of the rate of commercial females) and do not have to be restrict fed to produce 240 eggs per year.

There are several suitable breeds, crosses and hybrids that perform well under organic management. Many of these are based on the *Rhode Island Red*. They have a proven track record for liveability, a range of feather colours and meat texture. On average, these broiler breeds attain the desired slaughter weight of 2.4 kg in about 77 days. At this weight the birds are healthy and can stand and run about well. Some of these breeds include *Redbro, MasterGris, JA 57, Colopak, Cu'Nu,* and *Gris Barre*. Specific characteristics to look for include – hardiness, disease resistance, docility and free-ranging nature.

Sorensen (2001) claimed that layers from the breeds used in cage systems were not suitable for organic production systems, having a tendency towards abnormal behaviour (feather-pecking, cannibalism, laying on the floor rather than in the nest boxes) when used in organic systems. Birds reared specifically for outdoor systems, and that have access to perches within the first 28 days of life, are much more likely to adapt to organic free range egg production. Chickens may be encouraged to go outdoors by brooding in a less 'controlled' environment than that used for intensive broilers, and by allowing access to pasture when young (21 days), however, mortality can be higher (Gordon and Forbes, 2004). After 31 December 2003, organically reared pullets must be used. Bassler and Ciszuk (2002) suggest that crossing *Indian Game* cocks with commercial layers would be useful in providing 'farm-own' broilers. However, a drawback of this is that purebred, heavy *Indian Game* cocks seem to have difficulty mating with the agile layers, which can result in unsatisfactory fertilisation rates (Bassler and Ciszuk, 2002).

Some smaller scale producers in the UK use specialist breeds such as *Marans*, in part because the birds and speckled eggs are attractive to consumers.

The French market for ready to cook chicken is quite different from other countries. They have 4 types of meat chicken:

1. Standard (or commercial)
2. Certified chicken
3. Label Rouge or free range chicken
4. Organic chicken

The quality of the birds can be defined according to 4 criteria – strain of chicken (usually traditional), the lifetime before slaughter, life conditions and animal feed.

The **standard** chicken is considered a heavy strain that is reared in a short period of time (35-40 days). In general they are reared in buildings of 1,000 m^2 with on average 20 chickens per m^2. They are fed a wide range of ingredients including cereals, soya, animal fats, meat and bone meal, etc. Antibiotic growth promoters and coccidiostats are permitted. The carcasses are flatter and bigger than other types of chickens. They can be sold whole or as cuts. They are considered to have poor taste, but are well adapted to people with small budgets (Anon 2004f).

Certified chickens are similar to 'label' chickens but they are reared for a minimum of 56 days. They are housed in buildings of at least 400 m^2 with 18 chickens per m^2. They are fed mostly cereals but can eat other feedstuffs. Certified chicken is less intensively reared than standard chicken, although not to the standard of Label Rouge chicken, and the quality cannot be guaranteed (Anon 2004f).

Label Rouge production uses traditional strains, the most popular one being the 'label' naked neck chicken. They must be at least 81 days old at slaughter and have spent 42 days outside. The houses can be 400 m^2 at most and are surrounded by a one hectare field, allowing 10.5 chickens per m^2. The feed used is guaranteed not to have animal fat or meat and bone meal and be without growth promoters. The meat from Label Rouge birds is generally darker (like game) and the breast more rounded. Full traceability and quality is guaranteed (Anon 2004f).

Organic chicken depends on traditional strains of birds reared for at least 13 weeks. Generally the birds are stocked at 10.5 chickens per m^2 and are fed organic cereals, no animal fat, meat and bonemeal or growth promoters. The difficulty with rearing organic chickens is that the organic feed required is difficult to source. Organic or Label Rouge type birds tend to have a greater proportion of leg meat than their conventional counterparts, due to the increased amount of exercise that they get. Often this carcass shape is not acceptable to consumers who prefer a rounder, plumper bird (Anon 2004f).

7.2 Choice of Breed

Commercial broilers are bred to grow rapidly and reach market weight at a young age. In contrast, organic broilers are expected to grow more slowly. Changes to both breed and diet over the past 40 years have had a major effect on growth rate.

Havenstein et al., (1994) compared growth rates of 1991 *Arbor Acre* broilers with a 1957 breed and fed both genotypes on 1957 and 1991 diets. The 1991 starter and grower diets had higher energy, protein, lysine and methionine than the 1957 diets (Tables 47 and 48).

Table 47. Nutrient content of 1957 and 1991 diets (g/kg).

	ME, MJ	Crude protein	Lysine	Methionine
1957	12.0	217	10.9	4.3
1991	12.9	225	12.1	5.1

Table 48. Weight of two genotypes fed 1957 and 1991 diets

	Diet		Mean of two diets
Breed	**1957**	**1991**	
56 day weight, kg			
1957	790	980	890
1991	2704	3108	2906
Mean of two breeds	**1747**	**2049**	
81 day weight, kg			
1957	1400	1681	1541
1991	4179	4498	4339
Mean of two breed	**2790**	**3090**	

The 1991 genotype was approximately three times the weight of the 1957 genotype at both 56 and 81 days. The effect of diet was much less than the effect of breed.

ADAS (cited by Gordon and Charles, 2002) carried out a similar study on several hybrid strains (commercial fast-growing, moderate-growing and slow-growing) and traditional breeds. Each genotype was fed either high-nutrient diets designed for fast growing strains or lower-nutrient Label Rouge (LR) type diets. The high-nutrient starter and grower diets had higher protein, lysine and methionine than the LR diets (Table 49).

Table 49. Nutrient content of high-nutrient and Label Rouge type starter diets (g/kg).

	Crude protein	Lysine	Methionine
High nutrient	210	13.2	6.6
Label rouge	182	10.3	3.7

At 56 days of age modern commercial hybrids (*Ross 308, 508* and *YA*PM3*) weighed 3.0 kg, fast-moderate growing hybrids (*ISA 1756, 1957, Redbro* and *Master Gris*) weighed 2.25 kg, moderate-slow growing hybrids (*ISA Gris Barre, 1457, 1657*) weighed 1.8kg and traditional breeds (*Light Sussex, White Sussex, Ixworth*) weighed 1.0kg. At 81 days, these groups weighed 4.5, 3.5, 3.0 and 1.5 kg, respectively.

For each breed, broilers fed the high nutrient diet were heavier at both day 56 and day 81 though the effect was small compared with the effect of genotype. The modern genotype used today are genetically pre-disposed to grow faster, whatever type of feed they consume.

From these trials it would appear that diet manipulation, with modern broiler genotypes, is not likely to achieve the late maturity desired in organic poultry as they will eat more of the low density diet while feed restriction is likely to lead to stress and abnormal behaviour. Feeding low protein diets in order to slow growth will result in increased carcass fat content (Larbier and Leclercq, 1992).

As shown above, feeding a low density diet to fast-growing or slow-growing genotypes will result in reduced growth rate. A consequence is deterioration in feed conversion ratio through a higher maintenance requirement over the longer growing period.

Provision of a high protein content in the diet requires a high inclusion level of protein feed of which the most commonly used is soya. Water intake of birds consuming higher protein diets is increased and consequently excreted, creating wet litter situations. A high level of soya in the diet is associated with a corresponding increase in wet litter (Cooke and Raine, 1986) and this in turn results in skin blemishes in the birds.

8. Egg production

Economic analysis of organic egg production by Lampkin (1997) assumes average yields of 270 eggs/year over a 48 week laying period for hens stocked at 1,000 birds per ha and with a mortality rate of 8 %. Economic analysis of conventional free-range eggs by Nix (1999) assumes yields of 288 eggs/year.

In principle poultry should be introduced onto an organic unit as day old chicks (< 3 days old). However, where organic poultry are not available, there is provision – by derogation – that pullets for egg production may be brought in as long as they are not more than 18 weeks old. It is however, the intention of the European Commission to phase out this derogation.

9. Turkeys

Turkeys have a very high protein requirement in the early stages of growth as shown in Table 50 (Larbier and Leclercq, 1992). The protein requirement is higher than that of broilers, which necessitates a high content of soya or other protein source. It was thought that turkeys might suffer the adverse effects of prohibition of synthetic amino acids more acutely than chickens, however, in discussion with various producers it was discovered that perhaps this was not such a problem after all. It would seem that provided the birds are outdoors foraging and are not in groups that are too large, then the problems would not arise. It was also noted that traditional turkey breeds perform best in an organic situation. Even in France, which has quite a large organic poultry industry, there is very little information available about organic turkey production. However, it is known that there are two different markets being catered for: whole female black feathered turkeys for the Christmas market (*Betina* breed) and bronze male and female turkeys for cutting (*Webster, Kelly, Goubin*) (Vaugarny, Fermiers de Loué, email communication).

Table 50. Nutrient requirement of growing turkeys (g/kg)

Week	0 to 4	5 to 8	9 to 12	12 to 16
Crude protein	270	245	200	165
Lysine	16.5	13.0	12.0	9.75
Sulphur amino acids	12.0	9.5	8.0	6.85

Source: Nutrient Requirements of Poultry 9th Edition

10. Feathers

10.1 Feather functions

Feathers have three main functions:

1. to provide insulation of the body to reduce heat loss
2. to protect the skin against scratches
3. to protect the skin against blistering.

Feather characteristics also enable sexing of birds at day-old (depending on genotype of grandparents)

Rapid growth of feathers is desirable so that birds can deal with changes in environmental temperature. Feathers reduce energy loss, which in turn should improve feed efficiency. Scratches and blisters are most common in areas where feather growth is slow and / or the density of feather follicles is low – on the breast, back and thighs. Feather growth is controlled genetically. Amino acids used for feather protein and muscle protein synthesis come from the same general ‘body pool’ and if essential amino acids are not used for feather protein then more are available for other body proteins and other important molecules. A decrease in feather cover allows a greater heat loss and reduces the amount of fat in the carcass.

Poultry with outdoor access will have increased heat loss to the environment since the thermoneutral temperature of the broiler is high and ranges from c. 30 ^{o}C after hatching to c. 24 ^{o}C at six weeks of age (Larbier and Leclercq, 1992). Therefore, feather cover is extremely important in organic production systems.

10.2 Feather-pecking

Gentle pecking of birds while dustbathing is normal behaviour. Feather-pecking is defined as '*the pecking at and pulling out of feathers of another chicken*'. Often, the feathers are also eaten. Pecking of feathers is an indicator of reduced welfare in both the victim and the performer (Bestman and Wagenaar, 2003). Actually pulling out the feathers is painful and chickens with feather damage are more susceptible to further feather pecking and injurious pecking (McAdie and Keeling, 2000). Feather pecking can also have economic implications (apart from mortality and morbidity, cannibalism). Chickens with feather damage need more feed in order to maintain their body temperature (Tauson and Svensson, 1980). Feather-pecking is considered to be an undesirable or deviant behaviour, associated with the well-being of the birds. Organic systems are thought to be more welfare-friendly than conventional systems although there is still evidence of feather-pecking in organic systems. Stress is the main factor that influences feather-pecking, but other contributing factors include, exposure to sunlight, insufficient protein in the diet, excessive egg size, large flock size and boredom. Stocking densities of more than 10 birds/m^2 have been found to increase feather-pecking (Bestman and Wagenaar, 2003), due to crowding around feeders and drinkers.

Fewer incidences of feather-pecking have been observed when hens arrive on a layer farm at a young age (Bestman and Wagenaar, 2003). This is thought to be because a change in environment at a younger age is considered to be less stressful for the bird. Also a lower stocking density and group size have been shown to reduce the incidence of feather-pecking (Huber-Eicher and Audige, 1999; Nicol et al., 1999; Savory et al., 1999). High perches, at least during the laying period, scattered grain as a pecking incentive during rearing, use of an outdoor run and feeding roughage may also reduce feather-pecking (Wechsler and Huber-Eicher, 1998; Green et al., 2000; Bestman and Wagenaar, 2003). Bestman and Wagenaar (2003) suggest that once two-thirds of hens use the outside run severe feather pecking is not observed. Providing the run is not enough, it must be used. They also suggest that the optimum flock size is below 500 birds, and that there must be vegetation cover available outside.

There is evidence that a low methionine intake may be conducive to feather-pecking. Feathers are rich in methionine (7.9 g of SAA per 100 g of crude protein in feathers, see Table 20). Simply increasing the crude protein content of a diet as a way of dealing with the withdrawal of synthetic amino acids is not satisfactory as the birds would have to consume increased volumes of water to excrete the excess nitrogen, leading to wetter droppings and poor litter conditions. Methionine is also very important in the immune responses of the birds. Tsiagbe et al., (1987) considered that extra methionine is important in the synthesis of IgG antibodies and that methionine requirement for optimum health could be above that for growth. However, it is difficult to increase the methionine concentration in vegetable diets, without including crystalline methionine.

Organic poultry producers should buy pullets at 6 weeks of age at the oldest, and rear them on the laying farm. Generally, pullets are moved from the heated brooding environment to the cold rearing stable at around this age. The pullets should be encouraged to use the outdoor run from as early an age as possible. Providing shelter in the run will encourage them to use it.

11. Economics of production

The first organically reared flock of broilers in Athenry was produced in 2002. Fifty plus five *Corrhill Red* day old chicks were purchased (€37.50). They consumed 100 kg of 'Chick starter' feed (€470/tonne) and 260 kg of 'Table finisher' feed (€440/tonne). The total feed cost was €161.40. The total cost of production (including, ESB, gas, litter, cost of chicks) was €244.40. The male birds were slaughtered at 77 days, weighing 2.67 kg liveweight (oven ready weight was 1.90 kg) and the females were slaughtered at 82 days, weighing 1.47 kg (oven ready weight was 1.04 kg). Income from the sale of fifty-four birds was €257.00, which left a profit of €12.60 for the flock or €0.23 per bird.

The second flock of organically reared birds was produced the following year. Fifty plus seven *Corrhill White* day old chicks were purchased (€37.50). They consumed 80 kg of 'Chick starter' and 200 kg of 'Table finisher' feed. The feed cost was €125.60 and the total cost of production was €207.93. Fifty-four birds were sold for €366.00, giving a flock profit of €158.07 or €2.82 per bird.

There is very little information available on bird performance on Irish organic units or on production costs. Figures for France for intensively produced and Label Rouge chickens in 2002 are shown in Table 51 (ITAVI, 2003). Costs include investment, feed, chicks, labour and other variable costs. Production costs were not reported for organic broilers.

Since 1980, feed usage per kg of bird weight has improved in the intensive systems but not in the Label Rouge.

Table 51. Flock performance and production costs for broilers in France 2002

	Intensive production	Label Rouge
Age at slaughter, d	40	88
Live weight, kg	1.9	2.2
Feed/kg gain, kg	1.86	3.17
Feed cost, €/tonne	226	202
Cost of production, €/kg	0.729	1.418
1980 figures		
Feed/kg gain, kg	2.00	3.10
Production cost, €/kg	0.670	0.972

Source: ITAVI (2003)

ITAVI (2003) carried out a similar exercise for layers and found production costs (Euro cent per egg) of 4.79 for intensive, 7.67 for Label Rouge, 6.79 for free-range and 11.8 for organic systems. Organic feed cost was €408 per tonne compared with €179 for intensive, while annual labour cost was €0.91 and €6.08 per birds for intensive and organic systems respectively.

A Dutch study quoted production costs for organic eggs in the Netherlands in 2000 at 10.6 cent per egg and 12 cent per egg in Germany in 1997/1998 (Vermeij et al., 2003). They estimated Dutch costs at 11.2 cent and 12.3 cent per egg in 2002 for two housing systems. The Dutch layer feed cost in 2002 was estimated at €325 per tonne.

Table 52 shows the differences in the cost of producing conventional, certified, Label Rouge and organic chickens in France in 2001. There is very little difference between the cost of the day old chicks in any of the systems, but they are more expensive than in Ireland. The cost of the feed is again the biggest factor to affect the cost of production. Overall, the Label Rouge chickens cost nearly twice as much and the organic chickens nearly three times as much to produce than the conventional chickens.

Table 52. Cost of production in France 2001

	Broiler	Certified	Label Rouge	Organic Chicken
Chick price €/100 p	22.72	25.92	26.68	27.45
Feed price €/T	222	216	209	431
Cost of production €/live kg	0.721	0.882	1.370	2.148
Cost index	100	122	190	298

Source: ITAVI (2001)

Organically reared turkeys were produced in Athenry for the Christmas market in 2003. Eighty birds were reared and again it is clear that the cost of the feed is a huge factor in the overall profitability. Table 53 shows a breakdown of the costs involved and the profits returned.

Table 53. Turkey costs / returns

Costs	**Euro**
Poults Bronze	200.00
Poults White	194.00
Gas	35.00 (65 L)
ESB	50.00
Litter	100.00
Feed costs	
Turkey starter 480 kg @ €538/T	258.24
Turkey grower 1755 kg @ €462/T	810.81
Barley 500 kg @ €200/T	100.00
Production Costs	**1,748.05**
Returns	
Sale of 80 birds	2,496.00
Production costs	1,748.05
Flock Gross Margin	747.95
Gross Margin / bird	9.35
Processing 2/bird	160.00
Net Flock Margin	**587.95**
Net Margin / bird €	**7.35**

12. Environmental impact of organic poultry production

Animal production generates manure as a co-product and this can generally be recycled for the fertilisation of growing crops. Manure, which is not properly utilised, has the potential to damage water quality and the two nutrients of most concern are **nitrogen (N)** and **phosphorus (P)**. The amount of nutrients excreted in manure is the difference between the amount in the feed (amounts in the newly hatched chick, in drinking water and in washing water are usually insignificant) and the amount exported off the unit in bird carcasses or in eggs. With layers the difference in nutrients in the pullet and the spent hen must be included as an export.

It is possible to estimate the amounts of manure nutrients to be managed from a knowledge of (1) the quantities of feed inputs, (2) the composition of these feeds and (3) the weight of eggs or birds exported. The chemical composition of the product (eggs, carcass) can be estimated from textbooks and will not vary greatly from these values.

Assuming no change in the amount of product (meat, eggs), then a reduction in nutrient excretion is achieved by (1) more efficient utilisation of feed or (2) lower nutrient content in the feed or (3) both. Feeding a sequence of diets (= phase feeding) each of which is closely matched to the needs of the animal is commonly used to reduce protein/nitrogen intake.

The enzyme phytase, when added to feed, improves the digestibility (bioavailability) of feed P allowing diets to be formulated with a lower total P concentration. Provided feed conversion efficiency is unchanged or improved then the amount of P excreted in manure is reduced.

In the case of nitrogen, the use of lower protein diets which supply the amino acid needs of the animals is facilitated by the use of synthetic amino acids, four of which (lysine, methionine, threonine and tryptophan) are available at competitive prices. Unfortunately, the use of synthetic amino acids is not permitted in organic production. Meeting the bird's requirements for the essential amino acids from protein feeds results in higher dietary protein levels, higher nitrogen intake and higher nitrogen excretion than if synthetic amino acids were permitted.

The amounts of nutrient excreted will determine the number of stock which may be kept in an area of land in order to stay within permitted limits e.g. licensing (organic units are not likely to reach this threshold for licensing) or Nitrates Directive.

Feed usage in an organic system to the same slaughter weight will be higher than indoors because of the use of energy for activity and increased heat loss in the colder outdoor environment. If organically reared birds have to be held until 81 days of age before slaughter, then the slower growth rate will be associated with a high maintenance feed cost and poorer feed efficiency.

Tables 54 and 55 show the estimated nitrogen and phosphorus excretion from an organic broiler system and a layer system compared with conventional indoor systems. Aubert (2001) estimated the nitrogen excretion from broilers in France at 25 to 33 g/bird from intensive systems and 56 to 70 g/bird for Label Rouge systems.

Phosphorus content of the carcass in intensively reared broilers is assumed to be 4.2 g/kg liveweight (CVB, 1997). While no figures are available for organic poultry it is likely that bone development will be greater and therefore P retention will be higher and the difference is assumed to be c. 20 % i.e. 5.1 g/kg which is the estimate of Larbier and Leclercq (1992) for the broiler at 7 weeks of age.

For layers, P output in eggs (2 mg per gram egg weight – CVB, 1997) is assumed to be similar in intensively reared and organic birds. Carcass retention is assumed to be 6 g per kg weight gain in intensive layers (CVB 1997) and is likely to be higher in organic layers (say 7 g/kg) on account of more activity or exercise. Larbier and Leclercq (1992) estimated the P content of the adult chicken at 7.2 g/kg liveweight.

Nitrogen retention is assumed to be similar in intensively reared and organic broilers and for intensively reared and organic layers. Data from Jongbloed and Lenis (1993) is used in the tables below. They assumed nitrogen gain of 27.2 g/kg liveweight in broilers and about 1.1 g per egg.

Feed usage and meat/egg output figures for intensive and organic production systems are from Lampkin (1997) and Gordon and Charles (2002). Composition data for conventional and organic feed is from Irish feed manufacturers.

Both exercises show higher nutrient excretion from the organic systems. This is due to a combination of greater feed usage per unit of product (per kg broiler or per egg) and higher crude protein content of the diets as a result of the prohibition of the use of crystalline amino acids.

Table 54. Nitrogen and phosphorus excretion from broiler production

	Conventional	**Organic**
Feed intake (kg)		
Starter	0.4	0.5
Grower	1.2	1.5
Finisher	2.1	2.8
Total	**3.8**	**4.8**
Final wt, kg	2.0	2.0
Kill out, %	70	68
Carcass, kg	1.40	1.36
FCE (live)	1.85	2.50
FCE (carcass)	2.64	3.68
Protein in diet, g/kg		
Starter	225	210
Grower	200	190
Finisher	180	170
Total N intake, g	**113.3**	**145.0**
N retained, g/kg	27.2	27.2
Total N retained, g	54.4	54.4
N excreted, g/bird	58.9	90.6
N excreted, g/kg carcass	42.1	66.6
N excreted, % of intake	**52.0**	**62.5**
P in diet, g/kg		
Starter	7.6	10.0
Grower	7.0	9.0
Finisher	6.6	8.0
Total P intake	**25.3**	**42.8**
P retained, g/kg	4.2	5.1
Total P retained, g	8.4	10.2
P excreted, g/bird	16.9	32.6
P excreted, g/kg carcass	12.1	24.0
P excreted, % of intake	**66.8**	**76.2**

Table 55. Nitrogen and phosphorus excretion from egg production (point of lay to end of laying cycle or 20 to 72 weeks of age)

	Conventional	**Organic**
Feed intake (g)		
Per day, g	115	130
Per year, kg	42.0	47.5
Protein in diet, g/kg	170	165
N in diet, g/kg	27.2	26.4
N intake, g/bird/year	**1142**	**1253**
N retained, g		
N in body, g/kg	27.2	27.2
N in eggs, g/egg	1.10	1.10
In body	14	14
In eggs	330	297
Total N retained plus egg	**344**	**311**
N excreted		
Per bird per year, g	798	942
Per egg, g	2.4	3.2
Excreted as % of intake	**70**	**75**
P in diet, g/kg	7	9
Total P intake	**294**	**427**
P retained, g		
P in body, g/kg	6	7.2
P in eggs, g/egg	0.12	0.12
In body, g	3	3.6
In eggs, g	36	32.4
Total P retained plus egg	**39**	**36**
P excreted		
Per bird per year, g	255	391
Per egg, g	0.71	1.21
P excreted, % of intake	**87**	**92**

13. Marketing

One of the problems that was brought to our attention was a consideration by producers that their birds / eggs were not being marketed to the extent that they should be. It was noted that, for instance, if a producer was selling an organic chicken, the label also had to state that the bird was reared in a free-range environment (when clearly this is a statutory condition of organic production). It was felt that the public at large did not appreciate the difference between organic, free-range, corn fed, non-GM birds, and that the difference between organically produced birds and others was not emphasised. This difference would need to be clearly communicated to the public at large in order to justify the increased cost of an organic chicken. Prices quoted included: M&S € 15 for a 1300 g and SuperValu € 16.50 for a 1660 g imported organic chicken; up to €18 for an Irish-produced organic chicken (1800 g) in the English Market in Cork; average organic egg price is up to € 2.50 per 6 eggs at farmers markets. The fact that a proportion of consumers assume that once something is produced in Ireland it already has some sort of 'green' image was felt not to help the situation regarding defining to the public the difference in organic produce. Most of the organic poultry produce sold in supermarkets does not in fact sell for premium prices as it was claimed that the produce is eventually sold at a fraction of that price as it approached its sell-by date. Concern was voiced over producers claiming to be producing 'organic produce' for sale at various outlets such as Farmer's Markets, where no proof of organic production was required or displayed.

14. Conclusions

14.1 Nutrition

Many consumers identify food safety concerns as the reason for choosing organic products. With the forthcoming prohibition of antibiotic growth promoters and possibly coccidiostats an important reason for selecting organic poultry (concern over antibiotic residues) will have disappeared. The requirement for a reduction in the permitted amount of conventional ingredients in the feed will cause further problems in sourcing and formulating feeds within the regulations.

Recommendation: It is recommended that the timescale for the reduction in permitted amounts of conventional feed be extended until 2010 and the situation be re-examined (c. 2008) in light of the prevailing supply of organic protein feeds at that time.

14.2 Source of feed ingredients

Although in Ireland it is difficult to source organic feed ingredients, it is not impossible. Organic agriculture is based on the premise that the land should sustain production and it is recommended that producers aim to grow their own feed ingredients. Where this is the case it is suggested that those producers should be encouraged to engage the services of a qualified nutritionist in feed formulation. A comprehensive list of possible feed ingredients for organic poultry diets has been drawn up, along with maximum recommended inclusion levels. Organic ingredients are produced under conditions which result in lower yield and may differ in composition (fibre, crude protein, amino acids) from conventional grains. This has some (possibly minor) implications for diet formulation. Poultry producers who choose to home-mix their feed need to be especially careful to ensure a nutritionally balanced diet.

Recommendation: Producers should ensure that only nutritionally balanced diets are fed. Care should be taken where a balanced feed is supplemented with 'scatter grain'.

14.3 Strain of bird

From the information gathered herein, it is suggested that organic poultry producers should choose 'slow growing' strains. Although at present there is no clear definition of what a slow growing strain is, it is generally recognised that conventional birds are not suitable for organic broiler production due to their fast growth rate and conformation, which result in mobility problems at heavier weights. There are numerous strains of birds used for organic broiler production in both France and the UK which are giving very satisfactory results. For laying hen situations, it is suggested that it is not the strain of bird per se, but rather the management and nutrition of the bird that has the greatest influence on the production of eggs and the welfare of the birds in general. Very little research has been conducted into organic turkey production, but producers seem to be satisfied using traditional strains.

Recommendation: Only slow growing strains should be used for meat production. For layers, strain is less critical.

14.4 Management

Organic agriculture will always require a greater input of labour than conventional agriculture. Because of the situation of synthetic amino acid prohibition, the feeds provided to the birds may not be optimal, especially having excessive protein content. It is possible to deal with one problem at a time (such as poor nutrition), however, if this is compounded with poor managerial practices (bought in birds not fully settled in at start of lay), the problems become exacerbated and increasingly difficult to deal with. Birds should be encouraged to roam as much as possible. This makes them 'hardier' or better able to deal with the elements. They forage more (getting nutrients form the earth, insects, worms etc.) and are perceived to have improved welfare. Instead of directing their pecking behaviour towards each other, they have a much wider and more varied environment to explore.

Recommendation: Producers should avail of training courses where possible and these should include flock management, animal behaviour and welfare, animal nutrition and business management.

14.5 Enterprise planning

Growth in production of organic poultry should be market-led and new entrants need to be assured of a market contract. The market for organic poultry is a niche one and because of the premium price is likely to remain a small sector of the overall meat market. The high production costs incurred in producing organic poultry means high prices are required for the retail product. Matching supply and demand is critical and an oversupply can easily result in a drop in prices and margins.

Recommendation: New producers and producers considering expanding should have a guaranteed market outlet in advance of production.

14.6 Promotion of organic poultry

From the advertising and marketing side it is suggested that information be gathered regarding the consumers perception of organic produce. Is the consumer aware of the difference between organic, free-range and conventional production systems, and if so, does it affect their attitudes towards the produce? Are they willing to spend the extra cost on purchasing organic produce? Organic poultry producers felt that not enough was being done to market organic produce.

Recommendation: Bord Bia should be asked to assist in promotion of organic produce through advertising in the media and at point of sale.

14.7 Use of crystalline amino acids

The prohibition of the use of crystalline amino acids, especially methionine, is a serious concern on the grounds of animal health and welfare, and the environmental impact as a result of formulated diets with excess protein.

Recommendation: The prohibition of the use of crystalline amino acid should be reconsidered since there are significant advantages for animal welfare, animal health and environmental impact.

14.8 How other countries are managing

The organic poultry industry in France had been managing quite well until the introduction of Regulation (EC) No 1804/1999 supplementing Regulation (EEC) No 2092/91. Since then the development of French organic poultry production stopped and the number of farm conversions became very low. The French use more traditional or 'slow-growing' strains, however, the cost of organic production is still three times that of conventional production. The 'Label Rouge' poultry product in France is thriving and is more like a 'free range' product than organic.

When formulating diets for organic poultry production, in order to achieve the required levels of amino acids, it is generally concluded that a range of ingredients be included. There is a greater range of organically produced feed ingredients available in both France and the UK which helps in formulating diets for the birds. However, it should be noted that the price received for organic produce has started to drop in the UK (eggs) and Denmark (milk), as a result of supply matching demand, which removes the production incentive.

15. Recommendations for research and development support

15.1 Training and technical support

There appears to be a low standard of management on many organic flocks. Organic producers require different technical support to commercial and even free-range producers. They need training when starting production and ongoing technical support with record keeping, breed selection, feed formulation and routine management. Because organic units are widely dispersed this information will need to be distributed by workshops, telephone and electronic media. Accurate production records are key to improving profitability in any enterprise. This does not seem to be a priority for many producers. Most organic poultry producers are small scale and will not be able to pay commercial fees for technical support services. Teagasc should continue to operate a 'state of the art' demonstration / research unit in organic poultry production. This unit could be used to demonstrate production techniques, and using best practice would benchmark production costs and returns. As a priority, guidelines for producers should be developed using published information already available from other countries.

15.2 Researchable issues

Investment in research, focussing initially on broiler production with the emphasis on feed formulation and choice of breed is essential if the sector is to progress. As an interim measure, a Walsh Fellowship should be assigned to the nutritional management of organic poultry. This might take the form of a Masters degree programme and include measurement of carcass quality and manure nutrient excretion. Organic research activity in Ireland will ensure quicker access to overseas research and technological developments. The following areas are considered priorities for research:

1. Amino acid requirements of meat birds and layers used under organic production systems
2. Effect on the environment of feeding excess protein in the diet
3. Effect on the health and welfare of the birds of feeding excess protein in the diet
4. Effect of nutrient concentration in the diet on the economics of organic production
5. Effect of climate (cool with high rainfall) on organic / free range production systems.

15.3 Nutrition of birds

The problems with nutrition of the birds generally centre on the prohibition of synthetic amino acids in the poultry diets. It has been shown here that it is possible to formulate diets for organic poultry without supplementing synthetic amino acids, however, this yields further problems associated with the increase in protein content of the diet.

For this report, it was assumed that there was little, if any difference between the birds' (conventional or organic) requirement for amino acids. Although organic birds have increased activity (requiring increased nutrient intake), they are slower growing and should have a lower amino acid requirement. There is little published information on how the nutrient requirements of organic poultry differ from conventional poultry. The requirements of the organic birds for particular amino acids at particular stages of growth (such as methionine for layers at the start of lay) should be quantified, so that more accurate formulations can be made.

Physiological studies should be carried out in vivo to study the effect of these higher protein formulations on the performance and welfare of the birds. These studies should also take into account the cost of production of the feeds (using home-grown or bought in organic ingredients), birds and eggs and the returns achieved.

The sample organic diets described in this report have increased protein, and hence N levels. The manure nutrient output as a result of feeding these diets was calculated using various assumptions, but should be verified by controlled studies, and the effect of using such higher protein diets on the environment should also be addressed.

15.4 Breed of bird

On the production side of organic poultry, it is suggested that studies be conducted into organic production comparing 'slow-growing' and conventional strains that are used at present in organic broiler production. Direct comparisons between the performance of the birds and the economics of production in an Irish situation could then be drawn. A list of breeds / strains suitable for organic production should be compiled. The suitability of the most promising strains should be demonstrated through rearing a sample of each under standard organic conditions.

15.5 Management

The management of organic poultry is considerably different to that for conventional birds. It has been noted that when producers convert from conventional to organic practices, only those that had been considered 'good' conventional producers convert successfully. The labour input into organic systems is much higher than required by conventional systems and the producer needs to be much more skilled in animal husbandry. As regards research into the management of organic poultry systems it is suggested that the time that birds start to roam should be investigated as this seems to have a substantial effect on behavioural practices such as feather-pecking.

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