Publication Number:
500-02-FEEDGUIDE-UK-2013

Aviagen™ Turkeys

Aviagen Turkeys Limited
Chowley Five, Chowley Oak Business Park,
Tattenhall, Cheshire CH3 9GA
Tel: +44 (0)1829 772020
Fax: +44 (0)1829 772059
Email: turkeysltd@aviagen.com

www.aviagenturkeys.com

The premier supplier of
turkey breeding stock worldwide

B.U.T. Nicholas

Feeding Guidelines

For Medium and Heavy Breeding Stock

The premier supplier of
turkey breeding stock worldwide

Aviagen™ Turkeys

Feeding Guidelines

For Medium and Heavy Breeding Stock

The guidelines for feeding breeders address the needs of the latest Aviagen Turkeys' products. Attention has been paid to assessing the schedule of feeding for the medium and the heavy lines separately, whilst using the same nutritional guidelines (Table 1).

Adequate control of the bodyweight development of females can be achieved through qualitative feed management, as long as the process is established at an early stage and a pattern of weighing and adjustment of the feed programme started within the first few weeks. Quantitative feed management of females is not recommended.

Males need to be fed and reared independently of females as their protein needs are greater – and it is important for their development that they receive the correct inputs to achieve full productive capability.

Quantitative feed management of males has shown to have considerable benefits in terms of health and liveability and, as long as management practices and equipment are adequate, this practice is encouraged.

Nutrition guidelines for the rearing and laying stages are shown in Tables 1 and 2. These are laid out in a format based on advised energy levels, amino acids as total or digestible values and mineral levels. Suggested vitamin and trace mineral additions are shown in Table 3.

Aviagen Turkeys' nutritionists will be happy to advise on feeding programmes if these guidelines are considered to be unsuitable due to local conditions and ingredient availability.

Contents

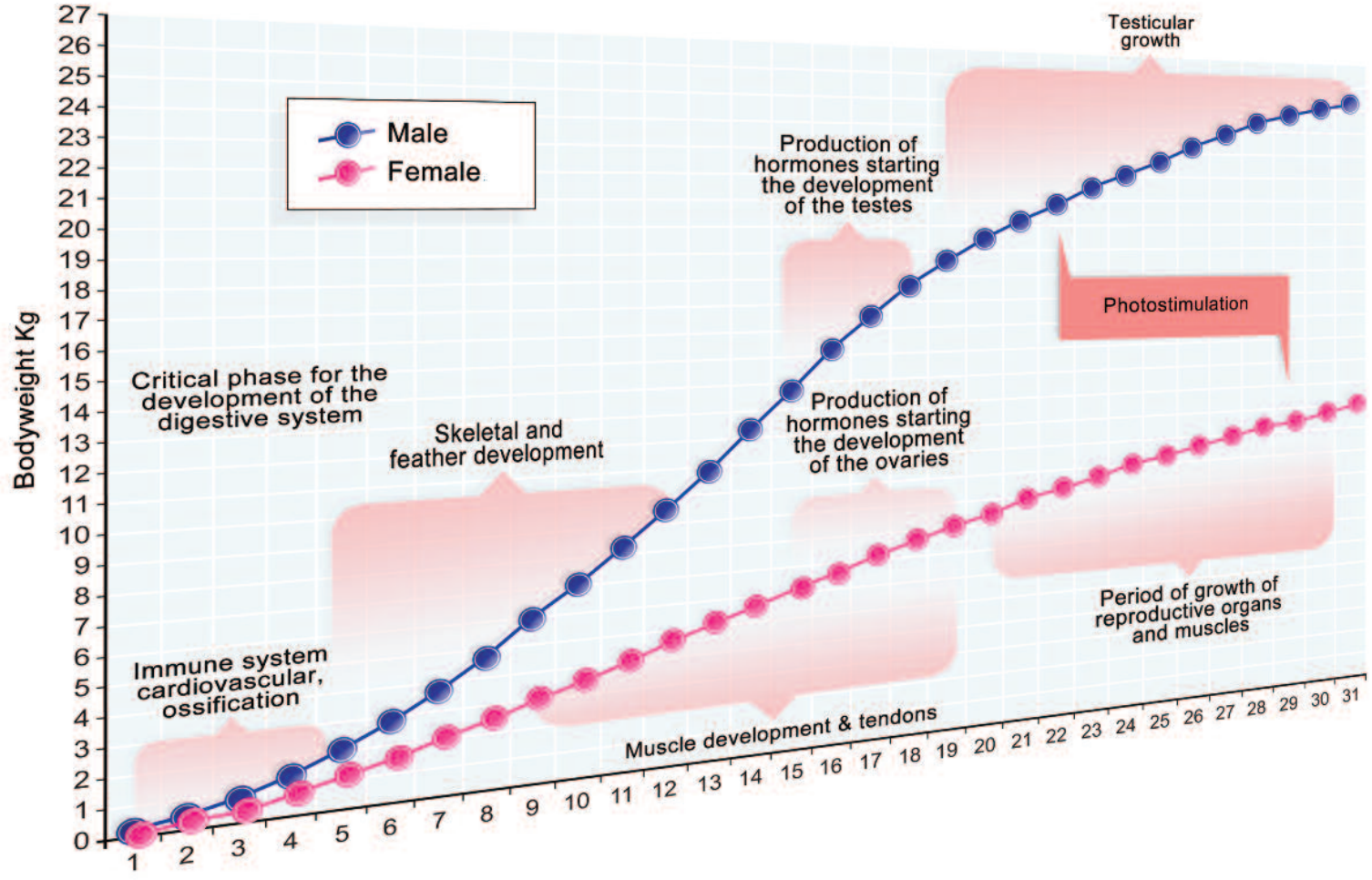
Bodyweight Management of Breeding Stock

Feeding Females

The management of the female development during the rearing stages is important in achieving the best level of egg production. Peak egg production and persistency of lay are affected by the way the female grows during the last 5-10 weeks of the rearing period. They need to be in a positive physiological state when the day-length is increased, so that they can respond correctly to that stimulus and increase their bodyweight as the reproductive tract expands. During the early part of the laying period, the female's natural body rhythm leads to a drop in feed consumption and this, combined with high levels of egg production, leads to a drop in weight. This relates to a pattern of clutch length and broody period relating back to the turkey's wild ancestry. To assist the female through this period, there needs to be sufficient body reserves to support full egg production. These can only be ensured if there is sufficient increase in bodyweight following light stimulation.

A dynamic system of monitoring and reaction to the bodyweight during the rearing period is crucial to achieve the best from today's genetic package. The following of a regimented week-by-week feeding schedule based on qualitative feed management will not necessarily control bodyweight, but active adjustment of the programme based on each flock's performance will achieve this aim. Quantitative feed management of breeder females is not necessary and is never recommended. If the flock is monitored and the feed programme adjusted from an early age, qualitative feed management will be successful.

Figure 1 shows the phases of development of major organs and tissues as the bird ages. Management of breeder nutrition is designed to satisfy the needs of the bird through these phases, in order to achieve optimal breeder performance.



Weights shown are for illustration, consult latest Breeder Performance Goals for actual weights.

Figure 1: *Physiological Development of Breeding Stock*

< *Physiological development of breeding stock*

- **During the first 6 weeks of life, the fundamental development of the skeleton, immune system, and cardiovascular system takes place.**
  - It is essential to feed good quality breeder rations that provide the correct balance of nutrients at the right time.
  - Rations must be nutritionally optimal and presented in a form that encourages the birds to develop their appetite.
  - Feeding commercial high-density starter diets is not recommended as they can result in early weights ahead of target and overweight flocks.
- **Providing a range of diets that reduce protein levels in small steps are key tools in managing the growth pattern.** Managing growth by transition through the range of diets ensures the birds do not receive metabolic shocks which can occur if the steps in protein reduction are large.
- **The females should hit target weights at 6, 16 and 22 weeks of age.** These are key ages and weights that have been identified in the ideal growth profile.
- **It is essential to start weighing a good sample of birds every week from 1 week of age** so as to ensure that birds are on track to meet the target weight at 6 weeks.
- **From 6 weeks through to 22 weeks, the growth profile needs to be monitored closely.** The birds continue to develop their skeletal structure and, at the same time, feather cover and muscular development are taking place. Weekly weighing of birds and plotting of actual results against targets allows an early response to growth trends that move away from the target profile.

- **Adjustment of the feeding programme must become an active process based on the growth trend.**
  - Heavy flocks should move on to the next ration sooner.
  - Light flocks should be held on the higher protein ration longer.
  - In periods of high ambient temperature, if weight gain stalls the females must be changed back to higher-protein rations to maintain the desired growth.
- **At 20 weeks, if the birds are heavier than the target, it is essential not to force these flocks back to the target line by more severe nutritional management.** A new target line should be redrawn that runs parallel to the original line. If the female is in a positive growth status at lighting, even if the flock is slightly overweight, the response of the bird to the light stimulus allows good production.
- **Changing feed form during this period is not recommended as a means of managing bodyweight.** The use of crumble or mash feed in this period can result in reduced evenness of the flock and more variability in egg production.
- **From 22 weeks to lighting is a key period in the development of the female.** The objective is to keep the bird growing at a steady rate through this period so that, when light stimulus is given at 29/30 weeks, the metabolism of the bird is able to respond immediately and meet the rapid changes in the reproductive system. The birds need to gain 0.3 kg for Medium lines or 0.35 kgs for Heavy lines every week in this period.
- **Normal flocks will increase in weight by (0.5 – 1 kg for Medium lines and 0.8-1.2 kg for Heavy lines) from lighting to first egg.** Flocks that plateau in weight prior to light stimulation do not respond as positively. When weight gain is insufficient, peak egg production is lower and spread over a longer period.

- **There should be a continuous improvement in uniformity over the life of the flock.** It can either be measured as "evenness" (number of birds +/- 10% of mean) or as "coefficient of variation". These numbers express the variability of weights within the sample of birds weighed. If the flock is becoming less uniform, factors such as bird health, feed access, feed quality and water availability should be checked. At point-of-lay, a flock should have an "evenness" greater than 90% or a CV of less than 10%.

Weighing and Decisions on Feed Programme Changes

Frequent weight sampling, followed by a quick management decision, is key to the success of qualitative feed management of the breeder flock during the rearing phase. To achieve this, the information from the weight sampling must be representative of the average weight of the whole flock. (See Aviagen Turkeys' Technical Advice Sheet on Flock Sample Weighing – Theory and Practice).

A short summary of this methodology is as follows:

- Weighing should start from poult arrival and be repeated each week.
- The weight should always be compared to the age that matches the flock, as found on the breed standard provided by Aviagen Turkeys'. These standards are based on weekly ages and any weighings made at an age that is not a weekly multiple needs to be adjusted to take account of this.
- Use a small catching pen to collect a sample of the flock.
- Weigh all the turkeys in the pen (exclude sexing errors and sick animals), using a mechanical or electronic scale with an accuracy of 0.1 kg.
- Repeat the process in at least 2 other places within the shed, aiming to weigh at least 1% of the flock or a minimum of 50 birds. (See the Aviagen Turkeys Website for a Sample Size Calculator spreadsheet).

Record the data on a histogram and, from this, calculate the sample average and standard deviation (available on most scientific calculators). The average sample weight should then be compared to the target bodyweight at the specific age of the flock – and for ease of decision-making, this should be calculated to be a % of the target. If the weight is:

- Between +5% and -5% of the target, then the feeding programme should follow the normal age-related change pattern.
- Greater than +/-5% from the target but less than +/- 7.5%, then the feed programme will probably need to be modified if the flock follows a trend of increased deviation from target. At this point, let feed stocks run low and then, following the next week's weighing, it will be possible to implement a feed change quickly if necessary.
- Greater than 7.5% above target, the feeding schedule should be accelerated to move to the next feed more quickly. But if the flock is more than 7.5% below the target, the feed changes should be delayed to allow some weight gain to be made up. Flocks dropping to more than 10% below target may need to step back onto a higher-protein feed until recovery takes place.
- **A spreadsheet that guides the user through this feed decision process is available on the Aviagen Turkeys' Website. www.aviagenturkeys.com**

The next step with the data is to consider the evenness of the flock by calculating the Coefficient of Variation (CV).

$$CV\% = \frac{\text{Standard Deviation}}{\text{Average Weight}} \times 100$$

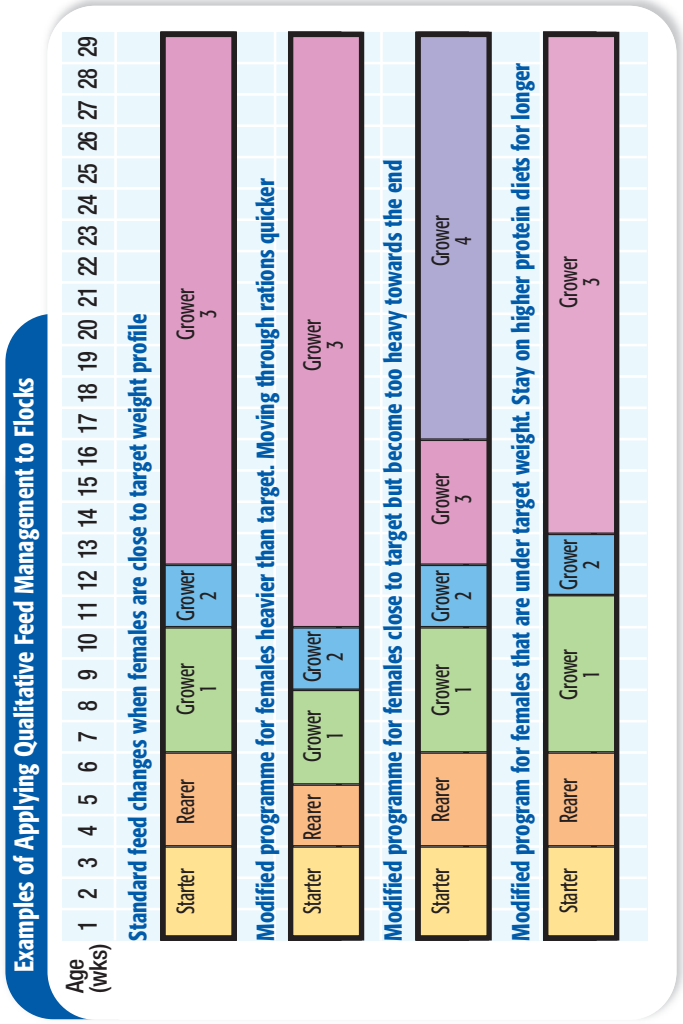
This value tells you how the evenness of the flock is changing over time. A normal flock will start with a CV of 10% to 12% and then, as the flock ages, this should decrease to around 6% to 8%. If the weekly pattern changes and the flock becomes less even (a higher CV), then this may be an indication of a problem and investigations of stocking density, feeder space, lighting patterns and temperature, etc, may suggest adjustments are necessary.

CV can also change in relation to management practices – and it is possible to see a worsening in evenness following vaccination and reduction in daylength. This change should be temporary, and subsequent data collection should show a recovering trend. If no such trend is observed, investigation should be carried out.

The objective of all this work is to achieve a flock that has followed the target bodyweight line with as little variation of bodyweight within the flock as possible, so that following light stimulation, the flock will respond in a uniform way and achieve coordinated peak production and persistency.

Techniques to Manage Bodyweight

Qualitative Feed Management – adjust the feeding programme depending on the actual weight of the females versus the target, move through the diets quicker than the feeding programme if the weights are above target – and make slower changes if the weights are lighter.



Feeding Males

Rearing males in with females becomes more difficult when the females are managed according to the strategy described above, as the requirement of males for protein at an early stage is much higher.

- See Aviagen Turkeys' Technical Advice Sheet – Bodyweight Management of Breeder Males.
- Males must follow a feeding schedule that nutritionally matches their needs, and must not be compromised by following the female regime. **Males must be fed for at least the first 4 weeks on the starter ration.**
- Male weight should be managed in the same way as described for females, with regular monitoring of the weight against target and adjustment of the feeding schedule when the birds begin to move away from the line.
- Following the final selection, males should be fed diets which enable them to make positive weight gains week-on-week without becoming overly fat, whether they are fed ad-lib or adapted amounts.
- **During the productive period, males should receive the same vitamin and trace mineral supplementation as the laying female.**

Table 1: Nutrition Guidelines for Aviagen Turkeys Parent Stock. Rearing Diets

Male Feeding

		Starter		Rearer		Grower 1		Grower 2		Grower 3		Grower 4		Quality Managed Male Feed		Quantity Managed Male Feed		High Energy Male****	
Medium Females	kg feed/ turkey	1.0 kg*		4.0 kg* adjust based on actual flock weight		Adjust feed amount based on actual flock weight		Adjust feed amount based on actual flock weight		Adjust feed amount based on actual flock weight		As needed							
	Days	0-21*		22-42*		43-70*		71-84*		85-203*		As needed							
Heavy Females	kg feed/ turkey	0.8 kg*		3.0 kg* adjust based on actual flock weight		Adjust feed amount based on actual flock weight		Adjust feed amount based on actual flock weight		Adjust feed amount based on actual flock weight		As needed							
	Days	0-14*		15-35*		35-63*		64-84*		85-203**		As needed							
Males	kg feed/ turkey	2.0 kg*		6.0 kg* adjust based on actual flock weight		Adjust feed amount based on actual flock weight		Adjust feed amount based on actual flock weight		Adjust feed amount based on actual flock weight		As needed		Ad-lib		Measured quantity per day		Ad-lib	
	Days	0-28*		29-42*		43-70*		71-112*		113-selection***									
Protein	%	25-26		21-23		16-18		12-14		10-12		9-11		9-12		14-15		9-11	
Energy	Cals/lb	1270		1270		1270		1270		1270		1270		1270		1300		1455	
	Kcal/kg	2800		2800		2800		2800		2800		2800		2800		2866		3200	
	Mj/Kg	11.6		11.6		11.6		11.6		11.6		11.6		11.6		12.0		13.3	
AMINO ACIDS		Total	Digestible	Total	Digestible	Total	Digestible	Total	Digestible	Total	Digestible	Total	Digestible	Total	Digestible	Total	Digestible	Total	Digestible
Lysine	%	1.55	1.40	1.15	1.04	0.90	0.81	0.65	0.58	0.45	0.40	0.30	0.25	0.45	0.40	0.65	0.58	0.31	0.26
Methionine	%	0.56	0.50	0.45	0.41	0.38	0.34	0.29	0.26	0.25	0.22	0.19	0.16	0.25	0.22	0.29	0.26	0.14	0.12
M+C	%	1.01	0.91	0.78	0.71	0.65	0.59	0.50	0.45	0.42	0.39	0.33	0.27	0.42	0.38	0.52	0.47	0.31	0.26
Tryptophan	%	0.25	0.22	0.20	0.18	0.17	0.15	0.15	0.13	0.15	0.13	0.13	0.11	0.15	0.13	0.16	0.14	0.12	0.10
Threonine	%	0.94	0.85	0.74	0.67	0.61	0.55	0.42	0.38	0.29	0.26	0.22	0.18	0.29	0.26	0.42	0.38	0.22	0.18
Arginine	%	1.58	1.43	1.20	1.08	0.95	0.86	0.69	0.62	0.48	0.43	0.32	0.27	0.49	0.43	0.70	0.63	0.32	0.27
MINERALS																			
Calcium (minimum)	%	1.45		1.35		1.25		1.10		1.00		1.00		1.00		1.00		1.00	
Available Phosphorus (min)	%	0.73		0.68		0.62		0.55		0.50		0.50		0.50		0.55		0.50	
Sodium (min)	%	0.17		0.16		0.16		0.16		0.16		0.16		0.16		0.16		0.16	
Chloride (min)	%	0.20		0.20		0.18		0.18		0.18		0.18		0.18		0.18		0.18	
Linoleic Acid (18:2) (min)	%	1.25		1.20		1.10		1.00		1.00		0.90		1.00		1.00		1.00	

* The ages and quantities shown are a guide only and should be adjusted based on local conditions and the nutritional profiles of the diets used. ** If hen weights rise above the target line after 12 weeks of age then the Grower 4 ration should be used. *** Males being fed by quantitative feed management should be fed Grower 2 or the Quantity Managed Male diet. Calcium and available phosphorus levels do not assume any use of phytase enzyme. Metabolisable energy and digestible amino acids are based on adult chicken values. Males should receive the same vitamin and trace mineral supplementation as laying breeders.
**** To be used under guidance from ATL Technical staff.

Table 2: Nutrition Guidelines for Aviagen Turkeys Parent Stock. Laying Diets

		Standard Breeder		Cold Weather Breeder		Hot Weather Breeder	
Degrees C, (Fahrenheit)		21 - 32, (71 - 90)		7 - 21, (45 - 70)		32 +, (91 +)	
Protein	%	16.5-18.5		15.0-16.5		18.5-20	
Energy	Cals/lb	1280		1270		1316	
	Kcal/kg	2820		2800		2900	
	Mj/Kg	11.8		11.7		12.2	
AMINO ACIDS		Total	Digestible	Total	Digestible	Total	Digestible
Lysine	%	0.80	0.74	0.75	0.70	0.90	0.84
Methionine	%	0.40	0.37	0.37	0.34	0.45	0.42
M+C	%	0.66	0.61	0.62	0.58	0.72	0.67
Tryptophan	%	0.17	0.16	0.16	0.15	0.18	0.17
Threonine	%	0.57	0.53	0.53	0.49	0.61	0.57
Arginine	%	0.83	0.77	0.78	0.73	0.94	0.87
MINERALS							
Calcium (minimum)	%	2.80		2.70		2.90	
Available Phosphorus (min)	%	0.38		0.35		0.41	
Sodium (min)	%	0.18		0.17		0.20	
Potassium (guide)	%	0.85		0.85		0.85	
Chloride (min)	%	0.21		0.20		0.22	
Linoleic Acid (18:2) (min)	%	1.55		1.50		1.60	

The rations should contain a minimum of 6% total fat of which at least 3% is added oil. In hot weather added fat should be increased to 5%.

1. The energy levels shown are examples for each diet. The actual energy content may vary by 50 kcal/kg upwards or downwards dependant upon ingredients used.
2. Under hot conditions, aim to provide up to 20 per cent of the energy from fat, providing pellet quality can be maintained. A typical inclusion rate for added fat would be 5%.
3. Crude protein levels will vary according to the ingredients used. The levels shown are for minimums for guidance only.
4. The specifications above assume pellet quality will not limit feed intake. If pellet quality is poor, the nutrient: energy ratios should be increased to maintain nutrient intake.
5. Calcium and available phosphorus levels do not assume any use of phytase enzyme.
6. Energy and digestible amino acids are based on adult chicken values.
7. Use of phytase enzyme in laying diets should be approached with caution. Base calcium and phosphorus adjustments on adult chicken egg layer values.

Feeding Guidance

Standard Breeder
Temperature Guide: 20-32 C (70-90 F)
Use in areas with temperate summers, and in cooler periods in mediterranean climates.

Cool Weather Breeder
Temperature Guide: 7-21 C (45-70 F)
For use in cool annual climates and winter months when the mean 24 hour temperature is below 10 C.

Hot Weather Breeder
Temperature Guide: > 32 C (> 90 F)
Use in areas with very hot summers with consistently high temperatures during day and night.

Table 3: Nutrition Guidelines Vitamin and Minerals Supplement Specifications

		Starting 0-6 weeks		Growing 7-29 weeks		Laying 29+ weeks	
ADDED VITAMINS PER KG		Wheat Based	Maize Based	Wheat Based	Maize Based	Wheat Based	Maize Based
Vitamin A	iu	12000	11000	8000	6000	12000	11000
Vitamin D3	iu	5000	5000	4000	4000	5000	5000
Vitamin E	iu	100	100	50	50	120	120
Vitamin K	mg	4	4	2	2	5	5
Thiamin (B1)	mg	4	4	1	1	4	4
Riboflavin (B2)	mg	15	15	5	5	20	20
Nicotinic Acid	mg	100	110	50	55	80	90
Pantothenic Acid	mg	28	30	15	16	28	30
Pyridoxine	mg	7	6	5	4	7	6
Biotin	mg	0.4	0.3	0.3	0.2	0.45	0.3
Folic Acid	mg	4	4	2	2	6	6
Vitamin B12	mg	0.04	0.04	0.02	0.02	0.04	0.04
Choline	mg	1000	1200	600	800	800	1000
ADDED TRACE MINERALS PER KG							
Copper	mg	15		15		15	
Iron	mg	45		40		45	
Manganese	mg	120		110		120	
Selenium*	mg	0.4		0.3		0.4	
Zinc	mg	110		80		110	
Iodine	mg	3		2		3	

* 50% of the selenium should be in the organic form.

Some milling processes will destroy vitamin activity, in such circumstances, vitamin addition must be increased to cover these losses.

Productive males should receive the same vitamin and trace mineral supplementation as layers.

Antioxidant should be added to protect vitamins.

The premix may contain synthetic amino acids, antioxidants, and other feed additives depending on requirements and local circumstances.

Table 4: Ingredient Constraints

Age of Turkeys	0-6 weeks		7-29 weeks		29+ weeks	
	Min	Max	Min	Max	Min	Max
Cereals	%	%	%	%	%	%
Maize	0	100	0	100	0	100
Wheat[1]	20	100	20	100	20	100
Barley[1]	0	10	0	15	0	25
Triticale	0	10	0	10	0	10
Sorghum[2]	0	10	0	20	0	20
Oats	0	10	0	20	0	20
Vegetable Proteins:						
Soya 48-50%	0	50	0	40	0	30
Full Fat soya	0	10	0	10	0	10
Combined Constraint Total Soya Products	0	50	0	40	0	25
Extracted Rapeseed	0	2	0	3	0	0
Whole Rapeseed	0	2	0	5	0	0
Combined Constraint Total Rape Products	0	3	0	5	0	0
Extracted Sunflower 33-38% protein	0	5	0	10	0	7.5
Extracted Sunflower 27-30% protein	0	3	0	7.5	0	5
Combined Constraint Total Sunflower Products	0	5	0	10	0	7.5
Peas	0	5	0	5	0	5
Field Beans	0	2.5	0	5	0	5
Combined Constraint Total Pulses	0	5	0	10	0	5

Table 4: Ingredient Constraints

Age of Turkeys	0-6 weeks		7-29 weeks		29+ weeks	
	Min	Max	Min	Max	Min	Max
Animal Proteins:[3]						
Fish meal	2.5*	7	0	5	0	5
Meat+bone meal	0	3	0	5	0	0
Poultry Meal	0	5	0	5	0	0
Cereal By-products:						
Wheat Bran	0	5	0	15	0	15
Maize Gluten Meal	0	5	0	5	0	5
Middlings	0	20	0	25	0	20
Distillers Dark Grains + solubles	0	2	0	3	0	3
Added Fats and Oils:						
Soyabean or Sunflower Oil	1	5	2	5	3	10
Palm Oil	0	0	0	1	0	2
Rape Oil	0	0	0	1	0	5
Fat Blend - veg oils, low FFA, C18.2 >25%	0	2	0	3	3	10
Fat Blend - general purpose, FFA >10% C18.2 <20%	0	0	0	1	3	5
Tallow and Lard	0	2	0	3	3	5
Animal/ Veg blend FFA <15% C18.2 >15%	0	0	0	1	0	0
Poultry Fat	0	2	0	3	0	0
Added Fat Limits	1	4	1	5	3	7

[1] Assumes use of NSP enzyme

[2] Low tannin varieties

[3] The use of fish meal and other animal proteins may be controlled by local regulations. These should be checked before use.

* Minimum in starter diets to reduce soya levels if no other animal protein used.

Feed Presentation and Composition

For turkeys, the presentation of the feed can be as important as the nutrient content. To stimulate and drive growth, the turkeys need to be able to consume large quantities of feed on a regular basis. Any factors that delay or discourage the poults from eating will result in slower development than the target.

Feed Structure

In the first 24 -72 hours it is very important to get the poults to consume as much food as possible. Early management in terms of feed presentation, lighting and temperature must encourage the poults to eat.

In order to start the poults, the diet needs to have enough structure to enable the young birds to pick up particles. If it is too fine and dusty, then the poults may not be able to select enough particles, so they may not consume sufficient nutrients. However if the particles are too large, then the poults will not be able to swallow them and so will not eat enough food to get them off to a good start.

The starter feed should be presented as a coarsely ground meal or a sieved crumble made from hard pellets of a maximum diameter of 3.5 mm. Small diameter pellets 1.5-2.0 mm can be used, but the pellets should not be longer than the diameter.

Some guidelines on crumble consistency are shown in Table 5.

As the poults get older, the grist or crumble size can be coarser, and small-diameter pellets (3.5 mm) can be introduced after 21 days.

To manufacture good pellets and crumbles, many feedmills will grind the ingredients to a fine powder to improve the cohesion when it is conditioned and pelleted. When the turkey consumes these pellets or crumbles, the processed feed will dissolve into a fine slurry in the crop when mixed with water; this then passes into the gizzard. The gizzard should act to further process the feed by grinding it down, but without any coarse structure the gizzard muscles do not develop and the enzyme production is low. Using coarsely ground cereals or adding whole or cracked grains of cereals or insoluble grit to the diet will stimulate the gizzard to develop naturally. This will increase enzyme production, improve food utilisation, improve litter conditions and help to reduce enteric problems.

Feed Composition

The ingredients that are used in the diets need to be highly digestible and of the best available quality. Attention should be paid to the quality of high-protein materials. The inclusion of fishmeal in diets for young turkeys, where permitted, helps to improve the amino-acid balance and reduces the risks from over-reliance on soya meal as the only protein source. The use of ingredients with protein of low digestibility should be restricted. Undigested protein can accumulate in the caecae of the turkey and stimulate proteolytic bacterial development, resulting in digestive upsets and wet droppings – and this can lead to increased condemnations.

Fats are an important energy source in turkey diets but young turkeys have a limited capacity to digest some of the fatty acids. In general, the use of pure vegetable oils like soya bean or sunflower oil is recommended for starter diets. The proportion of lower quality fats or blends with higher levels of free fatty acids or high in palmitic or stearic acid should be restricted until the turkeys get older.

Feed enzymes should be used to improve the availability of nutrients in feed ingredients wherever possible. Xylanase and Beta Glucanase should be used to treat cereals with high NSP (non-starch polysaccharide), and Phytase enzymes can be used to release the phosphorus which is bound as phytate in vegetable ingredients.

The balance of ingredients across the range of turkey diets is important to ensure that the transition from one diet to the next does not cause a change in gut integrity. The digestive system of a turkey is a dynamic environment relying on regular inputs of feed. Within this environment, the balance of nutrients and electrolytes can be affected by the diet composition and the microflora of the gut.

Changes in the rate of feed consumption or the mixture of ingredients within the diets can alter the balance. Within small tolerances, the gut will control the natural equilibrium. However, larger changes can trigger shifts in the bacterial population and may lead to digestive upsets and enteritis. We advise that the rate of change of ingredients across the range of diets needs to be managed to minimise these potential shifts in the gut microflora. This can best be done by limiting the change in inclusion to a maximum of 25% of the inclusion level from one diet to the next. For instance, if wheat middlings are included at 10% in a Grower 1 diet, then the Grower 2 diet should have no more than 12.5% or no less than 7.5%.

An effect on intake can also be caused by changes in colour and appearance of the pellets. High levels of sunflower or rapeseed can result in black particles from the seed coat being visible in the pellets. This has been shown to lead to feed rejection. In addition, changing from a diet with no fat coating to one with dark fat coating can slow down feed consumption for a period. All such changes should be made on a small and gradual basis.

Table 4 shows guidelines for the inclusion of some feed ingredients.

Feed Management

On the farm, the presentation of the feed needs to be suitable to encourage maximum consumption by the turkeys. The feed should meet the standards shown in Table 5 to ensure the crumbles or pellets actually arriving at the feeder are suitable for the turkeys to readily consume.

The feeders should be kept clean and free from contamination and the level of fines should not be allowed to build up. As a management tool, it can be useful to turn off the feeders for a short period each day to encourage the turkeys to clean down the pans and to stimulate appetite. The turkeys should never be left without any feed available for longer than 1 hour.

To reduce nutritional stress to the bird due to any change in the feed (raw material profile, presentation), a gradual transition between two sequential diets can be achieved by mixing the two rations together for 1-2 days, if the farm has the correct equipment (2 silos). Aviagen Turkeys' Management Specialists can provide more information on these techniques.

It is also very important to check that the equipment (feeders and drinkers) provided during the brooding phase is sufficient to ensure all the poults have free and easy access to food and water. More information is given in Aviagen Turkeys' Management guides.

Table 5: Guidelines for Crumble and Pellet Manufacture

Ground Meal Profile – pre pelleting

	Fines	>0.2 mm	>0.5 mm	>1 mm	>2 mm	>3.1 mm
Crumble	0 - 5%	10 - 15%	50 - 60%	20 - 25%	0 - 5%	0 - 5%
Pellets	0 - 2%	0 - 10%	20 - 30%	30 - 40%	15 - 25%	2 - 5%

Crumble Profile – in front of the poults

	Fines	>0.2 mm	>0.5 mm	>1 mm	>2 mm	>3.1 mm
1st Crumble 1-14 days	0 - 2%	5 - 10%	20 - 25%	45 - 55%	15 - 20%	0 - 3%
2nd Crumble 15-28 days	0 - 2%	0 - 3%	0 - 5%	10 - 15%	55 - 65%	20 - 25%

First Pellet – to be fed after 28 days. This should have a Holmen of 88 - 92% maximum and pellets should be a maximum of 3 - 4 mm in length

Pellet Hardness – after delivery to farm

Pellet before Crumbling – 88 - 92% Holmen (30 sec)
Pellets – 90 – 95% Holmen (30 sec) Maximum Fines content 10%

Pellet Size – Guide Only

Age Weeks	0-2	2-4	4-8	8-12	12+
Diameter in mm	Crumble made from 3mm pellet	2 - 3mm	3 - 3.5mm	3 - 3.5mm	3 - 4.5mm

Water Quality

Water is an essential ingredient for life, a clean supply of which should be readily available from placement throughout production. Any restriction in water intake or contamination of water will ultimately affect the growth rate and overall performance of the turkey. There are many factors that can affect water intake including age, sex, environmental temperature, water temperature and the drinker system type. The bacterial and physical quality of water should be monitored regularly and, where required, corrective action taken to ensure that bird performance is not compromised. Depending on the source, the water supplied to the birds may contain excessive amounts of various minerals or be contaminated with bacteria. Acceptable levels of minerals and organic matter in the water supply can be found in the Aviagen Turkeys Technical Advice Sheet – Water Quality Management.

This technical sheet also contains information about recommendations on water line sanitisation, pH adjustment and ORP guidelines.

Feed Processing and Hygiene

In order to maintain a zero Salmonella status in a breeder flock, it is important to source feed from a feed company that is capable of ensuring the microbiological status of the feed matches the requirements of the customer. Such a feed company should have procedures in place to monitor ingredients on a regular basis, kill Salmonellae during processing and prevent recontamination afterwards. A control system based on HACCP principles should be in place with outcomes in line with the customer's needs.

Salmonella is an ubiquitous organism and can occur in feed ingredients following contamination in growing, storage or processing. Some ingredients have a higher risk potential than others.

Sampling frequency should be based on the measured risk and control of ingredient sourcing directed to lower-risk suppliers. As testing for Salmonellae is currently historical, (results usually being received after ingredients have been processed into feed) it is important to develop controls within the supply chain to ensure a minimisation of risk.

The heat treatment process within the feed mill should be adequate to kill Salmonellae and reduce total microbiological content to a minimum level. Machinery should have the capability of heating feed to a specified temperature for a minimum period of time. Feed not receiving this treatment should be discarded. Frequent testing of feed samples that have been through the process are necessary to verify the process.

Following heat treatment, the feed should be pelleted and then cooled and stored in such a manner as to not increase the microbiological load of the material.

In situations where heat treatment is not adequate, or where there is a risk of recontamination after heat treatment, then anti-Salmonellae additives can be added to the feed. Products based on formaldehyde or an aggressive mixture of organic acid should be used.

It is usually a sensible approach to visit the feed supplier on a regular basis to check that all the necessary checks and treatments are meeting the standards agreed upon.

Mycotoxin Risk in Turkey Feeds

Mycotoxins are metabolic products produced by fungi which can be toxic to humans and animals. Mycotoxin-producing fungi damage crops either in the field or during storage, causing economic loss due to spoilage. Moreover, many of the mycotoxins impair health, cause diseases and can result in death in the humans or animals consuming food or feed products which contain the damaged crops.

Currently, there are more than 400 known mycotoxins, but knowledge is limited by analytical technology – and there could be many more of which we are currently aware. Those of most concern can be divided into 6 major categories: aflatoxins, tricothecenes, fumonisins, zearalenone, ochratoxins and ergot alkaloids.

The fungi can be divided into:

a) Field fungi which produce mycotoxins in crops before harvest, and

b) Storage fungi which produce mycotoxins mainly after harvest. Fusarium fungi are considered to be field fungi whilst aspergillus and penicillium fungi are classified as storage types.

Mycotoxins may be present in feedstuffs despite a negative analytical result. Mycotoxins are not homogenously dispersed in feedstuffs but usually occur in hot-spots. This makes sampling difficult and the mycotoxins may stay undetected despite adequate sampling.

Different species of animals show varying susceptibility to mycotoxins: poultry are highly susceptible to T-2 Toxins and moderately sensitive to aflatoxins and ochratoxins. However, within poultry species, chickens are less sensitive to aflatoxins than turkeys and geese, but in most cases, the younger the birds, the more susceptible they are.

Once a mycotoxin is present in a feedstuff, it cannot be easily removed. Apart from high-temperature ammoniating, there are few chemical treatments that can destroy a mycotoxin. So the approach used to minimise the effects of mycotoxins is to try and mop up the mycotoxin by binding it to an inert substrate or to try and deactivate it.

Several mycotoxin binders are available to be added to poultry feeds with varying claims of efficacy, but to gain the most cost-effective response, it is necessary to understand the challenge in the feed by analysing the mycotoxin levels in the feedstuffs. Then the correct binder should be selected; this should possess those activities that will act against the challenge that has been identified.

Table 6: Trouble-shooting Nutritional Deficiencies

Possible Cause	Problem							
	Egg Production	Fertility	Hatchability	Resistance to Disease	Feathering	Bone Deformities	Weakness	Thin Shell Eggs
Vitamin A	X		X	X	X		X	
Vitamin D3	X		X			X		X
Vitamin E	X	X	X	X				
Vitamin B12	X		X					
Riboflavin			X	X			X	
Niacin					X	X		
Pantothenic Acid			X	X	X			
Choline	X					X		
Vitamin K								
Folic Acid	X		X		X	X		
Thiamin								
Pyridoxine	X		X					
Biotin	X	X	X		X	X	X	
Amino Acids		X	X	X	X			
Calcium/Phosphorus						X	X	
Energy	X	X		X				