Feeding the broiler chicken

Part 3 - The ingredients used to achieve the nutrients requirements

To reach the genetic potential of today's broiler chicken - 2.5 kg liveweight with feed conversion of 1.72 at 42 days of age, and this potential increases by around 50 grams growth each year - they must be fed close to their nutritional requirements. In this third instalment of a five-part series DAVID CRESWELL* discusses the ingredients used to achieve the nutrient requirements of the birds.

Ingredient specifications

Chemical composition and nutritional values are provided for a range of commonly used ingredients in the following tables. Care should be taken in using these, as ingredient composition can vary widely. Chemical and biological assays and prior knowledge should be used to characterize any ingredient.

Notes below the tables provide some guidance for usage of these ingredients in broiler diets.

Part 4 of this series, in the next issue of *Asian Poultry Magazine*, will show some demonstration formulations. ■

Table 1: Chemical and nutrient composition of grains.

Ingredient	Corn 1	Corn 2	Broken rice	Sorghum 9	Wheat 11
ME, kcal/kg	3350	3350	3450	3275	3066
Protein, %	8.3	7.5	7.5	9	11
Lysine, %	0.26	0.24	0.27	0.22	0.33
Methionine, %	0.18	0.16	0.19	0.15	0.19
M+C, %	0.36	0.32	0.35	0.30	0.44
Tryptophan, %	0.07	0.05	0.08	0.10	0.15
Threonine, %	0.30	0.26	0.24	0.30	0.33
Arginine, %	0.42	0.36	0.56	0.30	0.52
Isoleucine, %	0.30	0.26	0.31	0.44	0.45
Valine, %	0.42	0.38	0.58	0.46	0.46
Linoleic acid, %	1.90	1.90	0.4	1.1	0.9
Fat, %	3.8	3.8	0.8	3	1.7
Crude Fibre, %	2.5	2.5	0.2	2.2	2.4
Ash, %	1.1	1.1	0.5	1.7	2
Calcium, %	0.02	0.02	0.5	0.03	0.05
Total Phosphorus, %	0.26	0.26	0.1	0.27	0.30
Avail. Phosphorus, %	0.068	0.068	0.03	0.07	0.16
Sodium, %	0.03	0.03	0.05	0.01	0.04
Dry Matter, %	87	87	88	88	89
Chloride, %	0.04	0.04	0.05	0.08	0.06
Xanthophyll, ppm	18	18	0	0	2
Choline, ppm	660	660	1000	678	770
Digest. Lysine, %	0.211	0.194	0.220	0.167	0.251
Digest. Methionine, %	0.162	0.144	0.175	0.128	0.160
Digest. M+C, %	0.310	0.275	0.308	0.234	0.840
Digest. Tryptophan, %	0.060	0.043	0.070	0.086	0.132
Digest. Threonine, %	0.207	0.179	0.173	0.204	0.228
Digest. Arginine, %	0.365	0.313	0.498	0.246	0.400
Digest. Isoleucine, %	0.252	0.218	0.267	0.365	0.365
Digest. Valine, %	0.44	0.12	0.487	0.368	0.359

Corn 1 and 2 represent corn with different protein levels.
Broken rice Check for purity/adulteration.
Sorghum Check for protein content which can vary widely, from 7-12%. Use only low tannin varieties.
Wheat Check for protein content, which can vary widely, from 8-14%. Use a xylanase enzyme with inclusion levels over 10%, and adjust energy and digestible amino acids of the wheat accordingly.

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Table 2: Chemical and nutrient composition of grain by-products.

	Rice bran	Extracted rice bran	Wheat pollard	Wheat bran	DDGS
ME, kcal/kg	2650	1800	2200	1800	2800
Protein, %	12	15	15.5	15	27
Lysine, %	0.60	0.72	0.65	0.67	0.74
Methionine, %	0.26	0.30	0.21	0.21	0.49
M+C, %	0.52	0.62	0.45	0.45	1.01
Tryptophan, %	0.10	0.12	0.14	0.14	0.22
Threonine, %	0.48	0.52	0.51	0.48	0.98
Arginine, %	1.05	1.05	1.00	1.07	1.08
Isoleucine, %	0.45	0.54	0.47	0.47	0.96
Valine, %	0.67	0.85	0.72	0.75	1.32
Linoleic acid, %	6	0.90	1.9	1.9	5
Fat, %	16	2.5	4	4	10
Crude Fibre, %	7.5	9	8.5	11	7.8
Ash, %	8	11	5.5	5.5	5
Calcium, %	0.1	0.2	0.1	0.1	0.05
Total Phosphorus, %	1.50	2	1	1	0.79
Avail. Phosphorus, %	0.25	0.3	0.45	0.45	0.50
Sodium, %	0.05	0.05	0.06	0.06	0.1
Dry Matter, %	88	90	88	88	88
Chloride, %	0.06	0.06	0.06	0.06	0.06
Xanthophyll, ppm	0	0	0	0	0
Choline, ppm	1390	1450	1100	1100	1100
Digest. Lysine, %	0.390	0.468	0.475	0.489	0.53
Digest. Methionine, %	0.166	0.192	0.170	0.170	0.43
Digest. M+C, %	0.328	0.391	0.329	0.329	0.80
Digest. Tryptophan, %	0.087	0.104	0.112	0.112	0.18
Digest. Threonine, %	0.250	0.270	0.332	0.312	0.74
Digest. Arginine, %	0.798	0.798	0.740	0.792	0.93
Digest. Isoleucine, %	0.261	0.313	0.353	0.353	0.82
Digest. Valine, %	0.389	0.493	0.518	0.540	1.12

Rice bran/extracted rice bran Check for composition (proximates) which can vary widely. Use at low levels of not over 15% in broiler diets. When used in starter phase, suggest adjust ME level downwards by 300 kcal/kg

Wheat pollard/bran Composition of wheat by-products can vary widely. Use at low inclusions only

DDGS Distillers Dried Grains & Solubles. Check composition. Use at levels up to 10-15% only in broiler diets.

Five part series

To achieve the maximum potential performance, broiler chickens must be fed close to their nutritional requirements. These requirements are discussed in part one of this series.

In many situations a decision is made not to feed to nutritional requirements, and rather, to feed lower density diets. In part two of this series, the best way to feed broilers in these situations is discussed.

Part three will provide information on ingredients, ingredient composition, and how to use ingredients to meet the birds' nutrient requirements. And finally parts four and five will provide formulation examples using these ingredients with current availability and prices.

In this series, we will examine the following aspects of broiler feeding:

- What are the nutritional requirements of today's broiler?
- How to feed lower energy diets
- Ingredient specifications
- Formulation examples, high energy diets
- Formulation examples, diets of differing energy

Table 3a: Chemical and nutrient composition of animal protein meals.

	Fish meal 60	Meat & bone meal
ME, kcal/kg	3050	2650
Protein, %	60	50
Lysine, %	4.40	2.80
Methionine, %	1.78	0.58
M+C, %	2.25	1.10
Tryptophan, %	0.70	0.29
Threonine, %	2.50	2.00
Arginine, %	3.73	3.35
Isoleucine, %	2.50	1.40
Valine, %	3.14	2.35
Linoleic acid, %	0.3	0.6
Fat, %	10	12
Crude Fibre, %	1	2.5
Ash, %	18	30
Calcium, %	6	10
Total Phosphorus, %	3	5
Avail. Phosphorus, %	3	4.5
Sodium, %	0.5	0.5
Dry Matter, %	90	93
Chloride, %	1	0.8
Xanthophyll, ppm	0	0
Choline, ppm	2860	2000
Digest. Lysine, %	3.652	2.128
Digest. Methionine, %	1.495	0.458
Digest. M+C, %	1.840	0.704
Digest. Tryptophan, %	0.609	0.209
Digest. Threonine, %	1.852	1.360
Digest. Arginine, %	2.984	2.546
Digest. Isoleucine, %	2.050	1.050
Digest. Valine, %	2.481	1.716

All animal protein meals can vary widely in composition, and should be checked. **Blood meal** should be spray/ring dried. **Poultry meal** specifications are for pet food grade.

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Table 3b: Chemical and nutrient composition of animal protein meals (continued).

	Blood meal	Feather meal	Poultry meal
ME, kcal/kg	3000	3200	3300
Protein, %	80	85	65
Lysine, %	8.30	2.10	2.70
Methionine, %	1.00	0.55	0.89
M+C, %	2.2	3.55	2.50
Tryptophan, %	1.00	0.40	0.5
Threonine, %	4.1	2.80	2.30
Arginine, %	2.35	3.92	3.60
Isoleucine, %	2	2.66	2.20
Valine, %	5.6	6.41	2.67
Linoleic acid, %	0.1	0.5	4
Fat, %	1	6	15
Crude Fibre, %	1	1.5	2.1
Ash, %	4.5	2	14
Calcium, %	0.28	0.2	3
Total Phosphorus, %	0.40	0.7	1.70
Avail. Phosphorus, %	0.40	0.6	1.50
Sodium, %	0.15	0.7	0.36
Dry Matter, %	92	90	92
Chloride, %	0.18	0.4	0.60
Xanthophyll, ppm	0	0	0
Choline, ppm	990	880	5980
Digest. Lysine, %	7.31	1.134	1.998
Digest. Methionine, %	0.85	0.336	0.712
Digest. M+C, %	1.738	2.024	1.625
Digest. Tryptophan, %	0.84	0.184	0.365
Digest. Threonine, %	3.403	1.400	1.702
Digest. Arginine, %	1.951	2.626	3.024
Digest. Isoleucine, %	1.2	1.889	1.760
Digest. Valine, %	4.816	4.167	2.109

All animal protein meals can vary widely in composition, and should be checked. **Blood meal** should be spray/ring dried. **Poultry meal** specifications are for pet food grade.

Table 4: Chemical and nutrient composition of vegetable protein meals.

	Sbm 44	Sbm 46-47	Sbm 48	Full fat soy	Canola meal
ME, kcal/kg	2325	2500	2500	3400	2000
Protein, %	43.5	46.5	47	37	35
Lysine, %	2.84	2.890	3.01	2.40	2.20
Methionine, %	0.62	0.643	0.67	0.51	0.70
M+C, %	1.32	1.354	1.41	1.05	1.35
Tryptophan, %	0.62	0.653	0.68	0.55	0.50
Threonine, %	1.75	1.786	1.86	1.50	1.70
Arginine, %	3.40	3.456	3.60	2.80	2.20
Isoleucine, %	2.07	2.150	2.24	1.90	1.40
Valine, %	2.17	2.314	2.41	2.10	2.00
Linoleic acid, %	0.5	1	0.5	9	0.50
Fat, %	1	2	1.4	18	1.8
Crude Fibre, %	6.3	3	3.2	7	12
Ash, %	7	6.4	6	5	7.2
Calcium, %	0.3	0.3	0.3	0.25	0.67
Total Phosphorus, %	0.69	0.69	0.69	0.58	1.00
Avail. Phosphorus, %	0.20	0.20	0.2	0.17	0.40
Sodium, %	0.02	0.02	0.02	0.02	0.09
Dry Matter, %	89	89	89	88	89
Chloride, %	0.05	0.05	0.05	0.04	0.05
Xanthophyll, ppm	0	0	0	0	0
Choline, ppm	2860	2860	2860	2600	3500
Digest. Lysine, %	2.414	2.456	2.559	2.112	1.672
Digest. Methionine, %	0.558	0.5789	0.603	0.439	0.630
Digest. M+C, %	1.162	1.191	1.241	0.861	13.134
Digest. Tryptophan, %	0.558	0.579	0.603	0.462	0.405
Digest. Threonine, %	1.488	1.517	1.581	1.27	1.105
Digest. Arginine, %	2.992	2.948	3.071	2.52	1.804
Digest. Isoleucine, %	1.697	1.764	1.837	1.653	1.036
Digest. Valine, %	1.758	1.874	1.952	1.806	1.440

All soybean meals should be checked for being de-hulled or non-dehulled, and for processing adequacy. **Note that Indian sbm** (46% protein) should be given similar energy and amino acid specs as for a 44 % protein sbm. **Canola meal** should be from low glucosinolate varieties of rape

Table 5a: Chemical and nutrient composition of vegetable protein meals (continued).

	Corn gluten meal
ME, kcal/kg	3750
Protein, %	60
Lysine, %	1.10
Methionine, %	1.60
M+C, %	2.75
Tryptophan, %	0.40
Threonine, %	2.00
Arginine, %	1.90
Isoleucine, %	2.50
Valine, %	2.93
Linoleic acid, %	3
Fat, %	7
Crude Fibre, %	2.5
Ash, %	1.8
Calcium, %	0.02
Total Phosphorus, %	0.50
Avail. Phosphorus, %	0.15
Sodium, %	0.03
Dry Matter, %	90
Chloride, %	0.05
Xanthophyll, ppm	180
Choline, ppm	2200
Digest. Lysine, %	0.979
Digest. Methionine, %	1.504
Digest. M+C, %	2.53
Digest. Tryptophan, %	0.364
Digest. Threonine, %	1.860
Digest. Arginine, %	1.805
Digest. Isoleucine, %	2.375
Digest. Valine, %	2.784

Table 5b: Chemical and nutrient composition of vegetable protein meals (continued).

	Cotton seed meal	Copra meal	Palm kernel meal	Lupins
ME, kcal/kg	2030	1800	1500	2240
Protein, %	38	21	16	32
Lysine, %	1.60	0.52	0.57	1.50
Methionine, %	0.55	0.24	0.26	0.23
M+C, %	1.32	0.51	0.57	0.704
Tryptophan, %	0.50	0.15	0.11	0.339
Threonine, %	1.32	0.54	0.50	1.07
Arginine, %	4.50	2.20	2.20	3.84
Isoleucine, %	1.34	0.7	0.58	1.27
Valine, %	1.70	1.02	0.83	1.251
Linoleic acid, %	0.85	1	0.30	2.5
Fat, %	1.7	8	1.50	5.5
Crude Fibre, %	1.0	10	15	14
Ash, %	6.5	6	4	3.8
Calcium, %	0.19	0.1	0.28	0.22

	Cotton seed meal	Copra meal	Palm kernel meal	Lupins
Total Phosphorus, %	1.2	0.8	0.60	0.30
Avail. Phosphorus, %	0.25	0.2	0.09	0.1
Sodium, %	0.04	0.05	0.02	0.02
Dry Matter, %	88	90	88	91
Chloride, %	0.04	0.1	0.17	0.05
Xanthophyll, ppm	0	0	0	0
Choline, ppm	3000	1100	1100	3100
Digest. Lysine, %	0.88	0.26	0.342	1.26
Digest. Methionine, %	0.424	0.194	0.208	0.186
Digest. M+C, %	0.911	0.281	0.342	0.598
Digest. Tryptophan, %	0.360	0.120	0.083	0.305
Digest. Threonine, %	0.805	0.324	0.300	0.824
Digest. Arginine, %	3.87	1.884	1.826	3.379
Digest. Isoleucine, %	0.911	0.420	0.418	1.016
Digest. Valine, %	1.19	0.795	0.623	0.988

Table 6a: Chemical and nutrient composition of vegetable protein meals (continued).

	Peas	Sunflower meal
ME, kcal/kg	2750	1700
Protein, %	22	32
Lysine, %	1.60	1.20
Methionine, %	0.22	0.70
M+C, %	0.57	1.20
Tryptophan, %	0.19	0.33
Threonine, %	0.90	1.20
Arginine, %	2.10	2.80
Isoleucine, %	0.81	1.23
Valine, %	1.1	1.61
Linoleic acid, %	0.6	1
Fat, %	1.2	2.5
Crude Fibre, %	7.5	25
Ash, %	2.8	7
Calcium, %	0.1	0.37

	Peas	Sunflower meal
Total Phosphorus, %	0.41	0.82
Avail. Phosphorus, %	0.17	0.25
Sodium, %	0.08	0.01
Dry Matter, %	88	90
Chloride, %	0.06	0.1
Xanthophyll, ppm	0	0
Choline, ppm	650	1900
Digest. Lysine, %	1.312	0.972
Digest. Methionine, %	0.156	0.644
Digest. M+C, %	0.410	1.008
Digest. Tryptophan, %	0.156	0.290
Digest. Threonine, %	0.612	0.864
Digest. Arginine, %	1.764	2.492
Digest. Isoleucine, %	0.567	0.996
Digest. Valine, %	0.759	1.288

Table 6b: Chemical and nutrient composition of vegetable protein meals (continued).

	Sesame meal	Cassava	Molasses
ME, kcal/kg	2500	2950	2000
Protein, %	36	2.5	
Lysine, %	0.90	0.08	
Methionine, %	1.1	0.04	
M+C, %	1.9	0.07	
Tryptophan, %	0.55	0.02	
Threonine, %	1.3	0.08	
Arginine, %	4.3	0.12	
Isoleucine, %	1.2	0.08	
Valine, %	2.07	0.09	
Linoleic acid, %	0.8	0.5	
Fat, %	1.3	0.5	
Crude Fibre, %	7	4	
Ash, %	12	6	
Calcium, %	2	0.2	0.08

	Sesame meal	Cassava	Molasses
Total Phosphorus, %	1.3	0.1	0.08
Avail. Phosphorus, %	0.39	0.03	0.04
Sodium, %	0.04	0.04	0.15
Dry Matter, %	90	88	75
Chloride, %	0.04	0.09	0.65
Xanthophyll, ppm	0	0	
Choline, ppm	1690	0	660
Digest. Lysine, %	0.81	0.04	
Digest. Methionine, %	1.034	0.02	
Digest. M+C, %	1.748	0.04	
Digest. Tryptophan, %	0.413	0.015	
Digest. Threonine, %	1.17	0.05	
Digest. Arginine, %	4.09	0.09	
Digest. Isoleucine, %	1.104	0.05	
Digest. Valine, %	1.842	0.06	

Table 7: Chemical and nutrient composition of oils.

	Vegetable oils	Palm oil	Coconut oil	Tallow	Yellow grease
ME, kcal/kg	9000	8000	8400	8400	8600
Linoleic acid, %	50-70	9	4	2.5	23-35
Fat, %	99	98	99	99	98
Dry Matter, %	99	99	99	99	98

Vegetable oils would include soy oil, sunflower oil, canola oil, groundnut oil, safflower oil. **Palm oil, coconut oil and tallow** have lower digestibility for young broiler chickens (starter stage). Suggest a lower ME value (750-1000 kcal/kg lower) be assigned to them for usage during this stage.

Table 8: Chemical and nutrient composition of Calcium and Phosphorus sources.

	Dicalcium phosphate	MDCP	Bone meal	Limestone
ME, kcal/kg			1600	
Protein, %			20	
Lysine, %			1	
Methionine, %			0.22	
M+C, %			0.45	
Tryptophan, %			0.1	
Threonine, %			0.8	
Fat, %			1	
Calcium, %	24	18	22	36-38
Total Phosphorus, %	18	21	9	
Avail. Phosphorus, %	16.5	21	8	
Dry Matter, %	97	97	95	97

All inorganic phosphates should be checked for Calcium and Phosphorus levels, which can vary. MDCP regarded as having higher P digestibility than DCP for broiler chickens. **Bone meal** composition can vary widely.

Table 9: Chemical and nutrient composition of synthetic amino acids.

	Dl methionine	Hydroxy methionine	L lysine HCL	Biolys	L threonine
ME, kcal/kg	5020	3700	3625	3740	5373
Protein value, %	99	88	94.4	75	73.5
Lysine, %			78.5	51	
Methionine, %	99	88		0.2	
M+C, %	99	88		0.3	
Tryptophan, %				0.15	
Threonine, %				0.5	98.5
Arginine, %				1	
Isoleucine, %				0.5	
Valine, %				1.2	
Total Phosphorus, %				0.2	
Avail. Phosphorus, %				0.07	
Dry Matter, %	99	88	98.5	95	99
Chloride, %			20		
Digest. Lysine, %			78.5	51	
Digest. Methionine, %	99	88		0.17	
Digest. M+C, %	99	88		0.255	
Digest. Tryptophan, %				0.1275	
Digest. Threonine, %				0.425	98.5
Digest. Arginine, %				0.85	
Digest. Isoleucine, %				0.425	
Digest. Valine, %				1.02	

Table 10a: Chemical and nutrient composition of other ingredients.

Item	L Tryptophan
Protein, %	99
Tryptophan, %	99
Sodium, %	
Dry Matter, %	99
Chloride, %	
Choline, ppm	
Digest. Tryptophan, %	99

Table 10b: Chemical and nutrient composition of other ingredients.

Item	Choline Chloride 60
Protein, %	
Tryptophan, %	
Sodium, %	
Dry Matter, %	98
Chloride, %	15
Choline, ppm	450000
Digest. Tryptophan, %	

Table 10c: Chemical and nutrient composition of other ingredients.

Item	Salt
Protein, %	
Tryptophan, %	
Sodium, %	39
Dry Matter, %	98
Chloride, %	60
Choline, ppm	
Digest. Tryptophan, %	

Table 10d: Chemical and nutrient composition of other ingredients.

Item	Sodium Biocarbonate
Protein, %	
Tryptophan, %	
Sodium, %	27
Dry Matter, %	99
Chloride, %	
Choline, ppm	
Digest. Tryptophan, %	