

Poultry Feed Nutrition and Applied Technology

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What are the needs of the birds?

Major nutrient classes:

- Energy
- Protein
- Fat
- Vitamins
- Minerals
- Water





Part 1. Common feed materials



Energy feed (Grain feed)



Oat

Grain Feed Characteristics:

- Higher dry matter digestibility, reach about 70% ~ 90%.
- Lower crude fiber, about 3% ~ 8%,
- Crude fat content about $2\% \sim 5\%$,
- Crude ash content about $2\% \sim 4\%$.
- Protein, essential amino acid lysine, methionine and tryptophan is low.
- Calcium content is less than 0.1%.
- Rich in B vitamins and VE.



Corn is the most common grain feed material in poultry, and the additive proportion is usually about 50% to 70%.

Advantage:

a good energy feed with strong palatability with easy digestion



Need attention:

i) the essential amino acids: <u>tryptophan</u>, <u>lysine</u>, <u>methionine</u> is low, so it is necessary to supplement amino acids to meet the nutritional requirement.

ii) the moisture of newly harvested corn should be paid attention.

iii) mycotoxin pollution problems.



Also considered as energy feed Instead of $15\% \sim 50\%$ corn



Broilers: <15% wheat $15\% \sim 20\%$ wheat + Enzyme preparation

Laying hens: 20% corn +40% wheat Wheat should be increased gradually for 10 days

Protein Feed

i) Plant-derived protein







Soybean



Cottonseed cake

Soybean protein content 40%~ 48%. Rapeseed cake is about 33% ~ 39%. Cottonseed cake dosage is usually low, but it can effectively reduce the economic cost of feed.

Soybean is the most common protein feed material in poultry.

The ratio of soybean could reach to 52% in poultry feed.







Examples:

- Corn, which is low in lysine
- Soybean meal, which is low in methionine
- By themselves neither corn nor soybean meal can provide enough essential amino acids to maximize performance.
- But when the two are combined, they provide adequate amounts of the essential amino acids and are said to complement each other.

Soybean price > Cottonseed cake price > Rapeseed cake price

Cottonseed cake and Rapeseed cake can replace part of soybean, respectively.

Need attention:

Cottonseed cake and Rapeseed cake contains antinutritional factors, both of them need to be detoxicated.







After Detoxification



Cottonseed cake

The proportion in the feed is generally not more than 10%, it should be used more carefully in egg production peak for laying hens.

Rapeseed cake: For broilers, the maximum amount is 20%, for laying or breeding chickens, about 10%.

ii) Animal derived protein

Fish meal Meat and bone meal Blood meal Feather meal Image: Descent rest in the second rest i

Fish meal is rich in protein, essential amino acid and balanced in composition.
Meat and bone meal: crude protein content 45% ~ 60%, water content 5% ~ 10%, crude fat content 3% ~ 10%.

Fish meal is the most common protein feed material in poultry, especially for young poultry, and the additive proportion is usually about 5% to 12%.

Fish meal has a special smell, can increase the chicken's appetite.

The quality varies according to the origin.

The price is also more expensive.

Crude Fiber Feed

wheat bran



Higher in crude fiber. Crude protein content reach about 12%~19%. Rich in lysine, but low in methionine.



It has good palatability for broilers, but large proportion of additives can easily lead to water absorption, causing. Rice bran has higher crude protein content than

corn (about 13%), rice and wheat.

Mineral Feed

Calcium

- Shell, limestone and eggshell are the main sources, among which shell is the best, which contains more calcium and is easily absorbed by chickens.
- The dosage of mineral feed, chicks accounted for about 1% of the diet, laying hens accounted for 5%~8% of the diet.







Mineral Feed

• Phosphorus

- bone meal, calcium phosphate and calcium hydrogen phosphate are high quality phosphorus and calcium supplementary feed.
- The amount of bone meal in general diet is 1%~2.5%, and phosphate is 1%~1.5%.



Calcium phosphate



Calcium hydrogen phosphate



- Salt
- Salt is the source of sodium and chlorine, and the dosage of chicken diet is 0.25%-0.3%, adult chicken diet is 0.3%-0.4%.







Vitamin

- The essential vitamin requirement of broilers is very small but indispensable, and deficiency can cause many diseases.
- Due to the influence of various factors in the process of breeding, vitamin deficiency is easy to be VA, VD, VC, VE, and B vitamins (mainly VB1, VB2, VB12), followed by folic, niacin, pantothenic acid , *etc*.
- Lack of certain vitamins can cause growth restriction in chickens and easily induce other diseases.

Vitamin

- *Poultry cannot use just any form of D, must be D3, cholcalciferol!
- Choline**
- Niacin ****** very high requirement by poultry, Very little is synthesized by the chickens.

Others

- medical stone 2.5%~5%
- zeolite 5%
- bentonite 1.5%~3%.
- They have strong adsorption, such as zeolite and bentonite can reduce the concentration of ammonia in the digestive tract









Water

- Water occupies a large proportion in the chicken body, and the water content in the chicken body can be as high as 70%, especially in chickens less than 1 week old, the water content in the body is 85%
- When the temperature is higher than 20 °C, drinking water began to increase,
- The temperature increased from 20 °C to 35 °C ,the amount of water consumed increased 1.5 times.

Part 2. Broilers Feeding and Applied Technology



Broilers feeding stage



Starter period

- $0 \sim 14$ days :
- The objective of period is to establish good appetite and achieve maximum early growth.
- The target is to achieve a seven-day body weight of 170 g or above.

Body weight is important!!!



Broiler Starter Feed requirements:

- 1) The Starter represents a small proportion of the total feed cost and decisions on Starter formulation should be based on performance and profitability rather than cost.
- 2) The digestible amino acid levels are important aspects and must be considered when purchasing feed.
- 3) In wheat-feeding areas the use of some maize may be beneficial.
- 4) Total fat levels should be kept low (<5%) and saturated fats should be avoided, especially in combination with wheat.

Grower period

- $15 \sim 35$ days :
- Adapted to the new environment.
- The target is to improve the quality of the chicken population, promote the formation of the chicken physique, so that the late grow fast, less disease.

Grower period Feeds

- Appropriately increase the feed volume, reduce the concentration of energy and protein, about reduce 10%.
- but all of vitamin, microelement and mineral should meet or exceed the requirement.
- Feeding method: regular feeding 3 times a day, pay more attention to exercise, so as to improve the activity of broilers and reduce disease occurrence.



Finisher period

- 36 days \sim slaughter :
- The growth rate is the fastest.
- The target is to promote digestion and absorption of the chickens, reduce movement, reduce energy consumption, make the feed conversion rate to achieve the maximum.

Finisher Feeds

- 36 days \sim slaughter :
- Provide highe quality feed.
- Compound feed should pay attention to:
- i) the diversification of raw materials and low fibrosis,
- ii) Adding 3% ~ 5% animal and vegetable fats,
- iii) Pellets should be used as far as possible.
- Feeding times increased to 5 times, or free feeding.
- In terms of management, exercise should be reduced, and low light should be used.

Water is also important for broilers

- Ensure clean drinking water: maintain growth speed and production performance, improve feed utilization rate.
- In general, the water supply of chickens is related to feed, the water supply of chickens should be 2 to 2.5 times the quality of dry feed.

Energy feed increased

Table 2, Examples of Broiler Diets.

	Starte	er	Gr	ower	Fi	nisher prot	ein decreased
Corn	563	268	582	605	652	506	
Wheat	-	200	-	-	-	270	
Barley	-	200	-	-	-	-	
Soybean meal (48%)	336	270	305	307	238	170	
Meat Meal (50%)	20	-	30	-	20	-	
Fat	35	17	46	45	47	10	1
Ground limestone	17	16	13	15	15	15	
Calcium phosphate (20% P)	15	15	10	15	15	15	
Salt	3	3	3	3	3	3	
Vitamin:Mineral premix ¹	10	10	10	10	10	10	
Methionine	1.2	1.0	0.8	0.6	0.6	1.0	
Calculated analysis							
Crude protein (%)	22.0	22.0	21.8	20.0	18.0	16.1	
Digestible Protein (%)	17.7	17.7	17.7	16.2	14.2	12.9	
Crude Fat (%)	5.9	5.9	7.0	7.0	7.3	3.4	
Metabolizable Energy (kcal/kg)	3060	3060	3145	3146	3200	3050	
Calcium (%)	1.00	1.00	0.98	0.95	0.94	0.96	
Av. Phosphorus (%)	0.42	0.42	0.42	0.42	0.41	0.41	
Sodium (%)	0.17	0.17	0.18	0.17	0.17	0.18	
Methionine (%)	0.48	0.48	0.46	0.40	0.37	0.37	
Methionine & cystine (%)	0.82	0.82	0.80	0.71	0.64	0.61	
Tryptophan (%)	0.31	0.31	0.30	0.28	0.25	0.22	
Lysine (%)	1.25	1.25	1.27	1.10	0.96	0.78	
Threonine (%)	0.94	0.94	0.94	0.86	0.78	0.65	

¹Use additional choline chloride if vitamin premix does not contain this vitamin

Part 3. Laying hens Feeding and Applied Technology





Brooding period

- $0 \sim 6$ weeks of age:
- grows fast in the early stage.
- the digestive system of chickens is not perfect, and the constitution is relatively weak.





Nutrition requirements:

- adjust the free feeding system
- provide digestible feed.
- ensure sufficient energy feed.
- maintain the nutrition balance, to ensure the growth, it is necessary to strengthen the nutrient supply.
- generally growing rapidly, the trace elements, amino acids, vitamin content requirements relatively high.

Growing period

- 7 weeks \sim laying stage:
- Body organs is relatively mature.
- strong ability to adapt to the living environment.
- rapid growth of skeletal and muscle.
- the appetite is also gradually increased.
- at the same time, farmers should also pay attention to the problem of fat deposition, to avoid the symptoms of serious obesity caused by excessive fat accumulation in chickens.

Nutrition requirements:

- Protein feed decreased compared with the brood period.
- timely supplement vitamins.
- according to the actual situation, the free feed intake of chickens can be controlled scientifically, the feed intake should be controlled at 70% ~ 80% as far as possible, feed with a higher crude fiber feed, so as not to affect the later laying rate, this method could reduce feed consumption.

Laying period

- Laying period of laying hens mainly includes three stages:
- early laying stage
- peak laying stage
- end laying stage.



Early laying stage:

- Early egg production should be supplemented with vitamins, calcium, trace elements and other nutrients. appropriately reduce the amount of protein powder;
- the calcium should choose the more bigger pellet, such as shell powder and the coarse stone powder.

Peak laying stage:

- Reduce the protein content of feed gradually.
- In the peak period of laying eggs, we also should observe the changes of temperature and environment.
- replenish water in time to ensure adequate drinking water for laying hens.

End laying stage

- at the end of laying, laying rate is generally decreased, and nutrient absorption and digestion ability of laying hens are decreased.
- it is necessary to strengthen nutritional regulation, increase mineral content, reduce the crude protein proportion.

Generally,

• Adding oil such as flaxseed oil and rapeseed oil can improve the disease resistance of laying hens and promote the deposition of polyunsaturated fatty acids in egg yolk.



Effects of different feed forms on laying performance in laying stage

Item	Weight/g		21 weeks eggs	Laying rate %		
	14 weeks	21 weeks	weight/g	19 weeks	20 weeks	21 weeks
Powder	1184	1798	46.3	5.9	27.7	55.2
Pellet feed	1249	1860	47.0	15.4	40.8	74.3

Proportion of protein regulation during laying period

Period	weeks	protein level (%)
Early laying stage	20~42	18.0
Peak laying stage	43~62	16.5~17.0
End laying stage	63~	15.0~16.0

Water adjustment and management

- Drinking water is very important for the growth and development of laying hens.
- it is necessary to provide clean and adequate drinking water for laying hens.

Water adjustment and management

- Generally, drinking water is 2 to 3 times of intake.
- When the egg production rate rises by 10%, the drinking water of each chicken should increase by 12 ml.
- When the weather is hot, increase the amount of water to drink, and when the weather is cold, keep the water temperature above 10 °C

Example of laying hens dies (early laying stage)

1. corn: 62%, wheat bran:3.2%, soybean:31%, calcium hydrophosphate:1.3%, mountain flour:1.2%, saly: 0.3%, feed additive: 1%.

Red: energy feedBlue: fiber feedGreen: protein feedPurple: mineral feed



Example of laying hens dies (early laying stage)

2. corn: 61.7%, wheat bran:4.5%, soybean:24%, fish meal: 2%, rapeseed cake:4%, calcium hydrophosphate:1.3%, mountain flour:1.2%, saly: 0.3%, feed additive: 1%.

Red: energy feedBlue: fiber feedGreen: protein feedPurple: mineral feed

Protein feed changes

Example of laying hens dies (early laying stage)

3. corn: 62.7%, wheat bran:4%, soybean:25%, fish meal: 1.5%, rapeseed cake:3%, calcium hydrophosphate:1.3%, mountain flour:1.2%, saly: 0.3%, feed additive: 1%.

Red: energy feed Blue: fiber feed Green: protein feed Purple: mineral feed

Protein feed increased rapeseed cake

Example of laying hens dies (peak laying stage)

1. corn: 61.4%, wheat bran:14%, soybean:21%, calcium hydrophosphate:1.2%, mountain flour:1.1%, saly: 0.3%, feed additive: 1%.

Red: energy feedBlue: fiber feedGreen: protein feedPurple: mineral feed



Example of laying hens dies (peak laying stage)

2. corn: 60.4%, wheat bran:14.5%, soybean:17%, fish meal: 1%, rapeseed cake:4%, calcium hydrophosphate:1.2%, mountain flour:11%, saly: 0.3%, feed additive: 1%.

Red: energy feedBlue: fiber feedGreen: protein feedPurple: mineral feed

Protein feed increases fish meal and rapeseed cake

Example of laying hens dies (peak laying stage)

 3. corn: 61.9%, wheat bran:12%, soybean:15.5%, fish meal: 1%, rapeseed cake:4%, cottonseed cake:2%, calcium hydrophosphate:1.2%, mountain flour:1.1%, saly: 0.3%, feed additive: 1%.

Red: energy feed Blue: fiber feed Green: protein feed Purple: mineral feed



Example of laying hens dies (end laying stage)

1. corn: 58.4%, wheat bran:3%, soybean:28%, calcium hydrophosphate:1.3%, mountain flour:8%, saly: 0.3%, feed additive: 1%.

Red: energy feedBlue: fiber feedGreen: protein feedPurple: mineral feed



Example of laying hens dies (end laying stage)

2. corn: 57.9%, wheat bran:4%, soybean:21.5%, fish meal: 2%, rapeseed cake:4%, calcium hydrophosphate:1.3%, mountain flour:8%, saly:
0.3%, feed additive: 1%.

Red: energy feedBlue: fiber feedGreen: protein feedPurple: mineral feed

Protein feed increases fish meal and rapeseed cake

Example of laying hens dies (end laying stage)

3. corn: 57.4%, wheat bran:3%, soybean:20%, fish meal: 2%, rapeseed cake:4%, cottonseed cake:3%, calcium hydrophosphate:1.3%, mountain flour:8%, saly: 0.3%, feed additive: 1%.

Red: energy feedBlue: fiber feedGreen: protein feedPurple: mineral feed



Part 4. Poultry Feed Additives



The target of additive for broilers and laying hens

- **Broilers:** in order to promote the normal growth, prevent disease, improve the yield and economic benefit.
- Laying hens: in order to promote the health of laying hens, improve the laying rate and improve the egg quality, improve the yield and economic benefit.

Probiotics

• Probiotics could produce organic acids, polysaccharides and other active components, which regulate the animal intestinal tract.

Mode of Action:

- Promote the absorption of nutrients in feed.
- Improve the performance of broilers
- Protective effect on broilers infected with *Salmonella enteritidis*.
- Promote the absorption of nutrients in feed.

Common Species of probiotics:

- Lactobacillus
- Bacillus
- Saccharomycetes

Need attention:

viable count , process, transportation, storage. So, we should consider dosage form, feeding time and feeding dose of probiotics.







Lactobacillus

• *Lactobacillus* is the normal intestinal microbiota of chicken, it can produce organic acids, polysaccharides and other active substances to promote health.

• Studies have showed that *Lactobacillus* could promote the growth, improve antioxidant capacity, anti-inflammatory and other effects.

Bacillus

- <u>Characteristic</u> : have rapid growth, easy survival, easy reproduction, and can secrete a variety of enzymes.
- It could improve the activities of intestinal lipase and protease, regulate the stability and diversity of microbiota, and improve the feed digestibility.

Plant extracts

• substances extracted from the plant (all or part of a plant) as a material, mainly include polysaccharides, polyphenols, saponins, flavonoids, essential oils and amino acids.

In China, plant resources are abundant and plant extracts are widely used.



Mode of Action:

- Plant extracts could significantly increase the production efficiency of broilers, reduce the feed to gain ratio.
- The daily gain and feed return of broilers were significantly .
- The rate and death rate have been significantly reduced
- Improve egg production rate, reduce the ratio of feed to egg, yolk color is also raised.

• Plant extracts: Improve laying performance and reduce oxidative stress, and improve the color of egg yolk.



Plant essential oils

• Plant essential oils are extracted from plant tissues and organs aromatic oily liquid.

• It has good antibacterial effect and promotes the growth of broilers.



Enzyme preparation

• can improve the digestion of poultry and increase the digestibility of feed.

Classification

PHYTASE: the most widely used and successful enzyme. Non-starch polysaccharide enzyme: widely used in production, can reduce the viscosity of feed materials (such as barley, wheat) viscosity, so as to improve the efficiency of the use of feed. Protease, amylase, lipase : to supplement the animal's own endogenous digestive enzymes Enzyme preparation

Need attention:

The source of the enzyme and its characteristics: including the optimal temperature, pH value.





Mineral additive

• Supplement the deficiency of nutrients in general feed, it could decrease disease rate, promote growth performance and improve feed utilization.





Other additives

• Acidifiers can significantly improve the growth performance of poultry, strong immunity and antioxidant capacity, and improve the structure of intestinal microbiota.











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