INTRODUCTION

This manual has been developed as a study guide for the Florida State Fair Skillathon which is part of the Champion Youth Program. The topic for this year's Skillathon is **nutrition and feeding management**.

The Florida State Fair recognizes that agricultural education instructors, 4H agents, parents, and leaders provide the traditional and logical instructional link between youth, their livestock projects and current trends in the animal agriculture industry. **PLEASE NOTE:** This manual is provided as a ***study guide*** for the skillathon competition and should be used as an additional aid to ongoing educational programs.

Sections are labeled **Junior, Intermediate, and Senior; Intermediate & Senior; or Senior** to help exhibitors and educators identify which materials are required for each age level.

****** Additional information is noted in the study manual for preparing for the Champion of Champions competition.

Juniors (age 8-10 as of September 1, 2018)
Digestive tract parts identification
Feed classification & identification

Intermediates (age 11-13 as of September 1, 2018)
Digestive tract functions
Feed tag analysis

Seniors (age 14 and over as of September 1, 2018)
all of the above plus....
Evaluating Feed efficiency
Evaluating and selecting feedstuffs

GOOD LUCK

Poultry Nutrition

What a chicken eats, how it is digested, absorbed, utilized and what is excreted are the essence of *nutrition*. Good nutrition is basic to good health and production. Proper feeding management requires knowledge of nutrients in feedstuffs available to the producer and the nutrient needs of their animals. It also includes an understanding of animal behavior and a management strategy that allows the animals to consume all that is required without causing digestive upset. Though general rules of thumb are helpful, each situation may require adjustments in order to optimize growth and production.

Nutrients are substances in the diet that support normal body functions. Some nutrients can be manufactured in the animal's body and are classified as *dietary non-essential*. *Dietary essential* nutrients must be provided in the ration. Nutrients can be classified into six groups: *water, carbohydrates, fats (lipids), proteins, vitamins and minerals.*

Water is the most essential nutrient and is involved in all body functions. It is the most abundant and therefore the cheapest nutrient. Animals receive water from drinking as well as from feeds that contain water. An animal that is not receiving enough water will not eat well. Factors which affect an animal's water consumption are the animal's size, level of production, activity level, feed intake, environmental temperature, humidity, and water quality.

Proteins function as the basic structural unit of the animal body and in metabolism. Protein is the main component of the organs and soft structures of the animal body with the exception of water. The dietary requirement for protein is highest in young, growing animals. All proteins are composed of simple units called amino acids. The particular amino acids in a protein determine the quality of that protein. Protein is one of the most expensive portions of the diet.

Carbohydrates are organic compounds formed in plants by the process of photosynthesis. They make up about 75% of the dry weight of plants and grain. Carbohydrates serve as a source of energy in the body. A surplus of carbohydrates is transformed into fat and stored.

Fats function much like carbohydrates in that they serve as a source of energy. Fats produce 2 ¼ times more energy than carbohydrates when digested; therefore a smaller amount is required to serve the same function. Some fats are essential for proper metabolism in the animal.

Vitamins are essential for the development of normal tissue and necessary for metabolic activity. They are effective in the animal body in small amounts. When not eaten correctly and in the right amounts, a specific deficiency disease can result or toxicity may result if eaten in extremely high amounts. Vitamins are classified as being either fat soluble (A, D, E, K) or water soluble (B complex & C).

Minerals are inorganic, solid, crystalline chemical elements. They are classified as being either macro (Ca, P, Na, Cl, K, Mg & S) meaning required in high concentrations or micro (Cr, Co, Cu, F, Fe, I, Mn, Mo, Ni, Se, Si, & Zn) meaning required in trace amounts. Calcium makes up nearly 50% of the total body mineral, phosphorus composes 25%, and other minerals make up the remaining 25%. Minerals function in protein synthesis, oxygen transport, and in skeletal formation and maintenance.

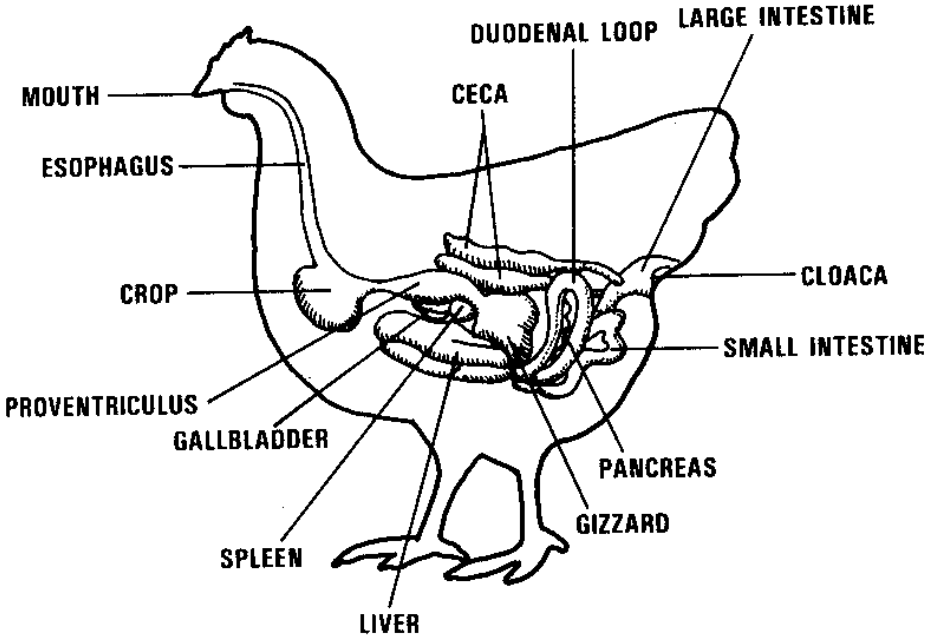
Specific nutrient requirements vary between species but also between individuals. Factors such as weight, environmental temperature, and level of production must be considered when determining optimum nutrient levels in a ration. Though it is tempting to provide more than enough as insurance, some nutrients cause problems (toxicity) if fed in excess. Also, feed expenses account for 60-75% of the cost for bird growth from the hatching egg to the processing plant (slaughtering) and for egg production from hens. Too much of a good thing is not good.

Digestive Anatomy

Juniors, Intermediates, and Seniors

You are what you eat sounds silly but is somewhat true. Farm animals are grouped by what they eat, which is based on the type of digestive system they possess. *Herbivores* are vegetarians (cattle, sheep, goats, rabbits). *Carnivores* are flesh eaters (dogs). *Omnivores* eat both flesh and plants (pigs, chickens, humans). Based on the digestive system, animals are grouped as *monogastric* or *simple stomach* (pig), *polygastric* or *ruminant* (cattle, sheep, goats), *avian* (chickens), or *pseudo-ruminants* with a functional cecum (rabbits). Understanding the digestive system is fundamental to selecting the proper feeds and feeding system for your animal.

After studying this manual, you should be able to identify the parts of the digestive tract of a chicken and know the function of each part.



Feed Classification and Identification

The “stuff” fed to animals in order to meet their nutritional needs are called feeds. The National Research Council (NRC) produces many publications on nutrient requirements of animals and nutrient content of most feedstuffs. Most youth purchase “complete rations”, however, it is helpful to know what may go into those rations. Go to the web site: http://www.ca.uky.edu/agripedia/AGMANIA/FEEDID/INDEX.asp and study feed ingredients so that you can visually identify those typically used in livestock feeds.

Though we generally group feeds into roughages (high fiber, >18% crude fiber, less digestible) and concentrates (low fiber, <18% crude fiber, more readily digestible). There are 8 international feed classes that are based on content and use.

1. Dry forages and roughages – cut and cured products with >18% CF like hay, straw, corn cobs, shells and hulls, paper, wood by-products and stover.

2. Pasture, range plants and forages fed fresh – all forages not cut or cut and fed fresh.

3. Silages and haylages – plant material preserved through the ensiling process, forages like corn, alfalfa and grass.

4. Energy feeds – products with <20% CP, <18% CF and > 70% TDN, like cereal grains (corn, oats, wheat), mill byproducts, beet and citrus pulp, molasses, animal, marine and vegetable fats, nuts, roots and tubers. Energy content of a feedstuff is expressed as percent total digestible nutrients (TDN) because it is strongly correlated with digestible energy.

5. Protein supplements – products with >20% CP or more protein from animal origin as well as oil meals like gluten, legume seeds, milling by-products of grains, brewery and distillery by-products, yeast, non-protein nitrogen.

6. Mineral supplements

7. Vitamin supplements

8. Non-nutritive additives – supplements such as antimicrobials, antifungals, antibiotics, antioxidants, probiotics, buffers, coloring material, flavors, hormones and medicines.

Digestive Function

Intermediates and Seniors

The physical and chemical changes of feed within the gastrointestinal tract that allow nutrients to be released and absorbed into the body are called digestion. There are significant differences in the digestive processes between species. The type of digestive system an animal has determines what the animal can successfully use as feed. Complicated feed (forage) requires a complicated digestive tract (ruminant). The steps in digestion include: prehension (gathering), mastication (chewing), salivation, deglutition (swallowing), microbial, enzymatic and chemical breakdown, absorption of nutrients, defecation, and micturition (urination). For a review of the avian digestive system visit: http://www.poultryhub.org/physiology/body-systems/digestive-system/

Mouth/Beak- Rapidly picks up feed without the aid of teeth.

Esophagus- Hollow muscular tube with enlarged area called the crop. The function is to transport ingesta from the mouth to the proventriculus. Some of the ingesta may be stored in the crop for a few minutes to a few hours before it is moved on to the proventriculus. The ingesta is moistened as it is moved through the esophagus. (14 inches long, crop 2 inches)

Proventriculus- Also called the glandular stomach because it secretes gastric juices. Ingesta passes through rapidly. (3 inches long)

Gizzard- Also called the muscular stomach. Thick, muscular wall area acting to physically reduce particle size of ingesta and mix it with the gastric juices. (2 inches long)

Small Intestine- Digestion and absorption of nutrients similar to mammals (pancreas & liver) (55 inches long). The first portion is the duodenal loop.

Large Intestine- Two *ceca* and short large intestine (4 inches) reabsorb water and the fecal material is voided through the *cloaca* and out the *vent*.

Liver- Bile formation to digest fats, stores glycogen and fat, and detoxifies.

Gall bladder- Stores bile.

Pancreas- Digestive enzymes and hormones insulin and glucagon.

Feed Tag Analysis

Intermediates and Seniors

It is required by law that all commercial feed products carry a proper label. In order to know what you are getting for your money, you should be able to read and understand the information on a feed tag. Some of the information included will be: net weight in pounds, company brand name (trade name), product name (class or use), product type (textured, pelleted, extruded, etc.) purpose statement, warning or cautions, active drug ingredient (when applicable), guaranteed analysis (protein, fat, fiber, etc.), feed ingredients in order of content, company name and address, detailed use directions, other feeds (suggestions for other feeds in the total program). Go to the feed store and look at the tags on several types of feeds and determine which feeds are best suited to your program and which are the best value in terms of nutrients per dollar. Be prepared to interpret the information on a feed tag.

Guaranteed Analysis:

Crude Protein: not less than _%.
This number represents nitrogen content of feed and does not give a clear picture of protein quality, (e.g. amino acid profile). If all of the protein is not from “natural” ingredients (e.g. contains urea or a similar product) the following statement must be added, “this includes not more than __% equivalent protein from non-protein nitrogen.”

Crude Fat: not less than _%, typically 1 to 3%.
At equal volumes fat contributes 2.25 times the energy as carbohydrates. Increased crude fat levels can decrease digestion of forages (e.g., hays and grasses). Fat can be added to the diet in hot weather to maintain energy level when intake decreases.

Crude Fiber: not more than _%.
The higher the crude fiber, the lower the digestible energy of the feed. The price should reflect this lesser energy, but frequently does not.

Some manufacturers also show minimum/maximum quantities of calcium and phosphorus and other macro and micro minerals. Units of vitamins A and D may also be shown.

Ingredients: listing on the tag does not necessarily identify individual feedstuffs. Instead, it uses *categories* of feedstuffs, e.g., *grain products* (such as corn, oats, barley, wheat), *processed grain by-products* (bran, brewers grain, hominy), *plant protein products* (soybean meal, cottonseed meal, etc.), *molasses products* (cane or beet molasses, dehydrated molasses, wood molasses), and *forage products* (alfalfa meal or leaf meal). The phrase, *roughage products*, identifies the presence of cottonseed hulls or other types of hulls or ground hays. This total must be shown as a percentage of the feed. Their presence will cause the crude fiber guarantee to be abnormally high (16-26% or more) and, as indicated above, lowers the digestible energy content.

The tag will also list sources of minerals, any preservatives used, and any vitamin supplements present or used. In the case of a medicated feed, the tag will also include the medication dosage provided and the prescribed use.

The following fictitious tag is included to encourage you to think about what information is actually available on the feed tag and to consider what it means to you in your feeding program.

Laying Pellets

GUARANTEED ANALYSIS

Crude Protein, not less than 18.0%
Crude Fat, not less than..... 3.0%
Crude Fiber, not more than..... 9.0%
Calcium (Ca), not more than..... 3.8%
Calcium (Ca), not less than..... 2.4%
Phosphorus (P), not less than..... 1.2%
Iodine (I), not less than..... 0.00015%
Salt (NaCl), not less than..... 1.0%
Salt (NaCl), not more than..... 2.0%

INGREDIENTS

Ground Newspapers, Ground Uncooked Turkey Feathers, Ammonium Nitrate, Super Phosphate, Tincture of Iodine, Used Crankcase Oil, Hardwood Sawdust, Ground Marble Chips, Vitamin A & D Oil, Ground Shoes (without Rubber Soles), Barber Shop Sweepings, Salt.

Manufactured By: LEAST IN THE EAST

Selling Directions: For price conscious feeders who are not interested in results.

Feed Additives

Seniors

Poultry feeds often contain substances not directly concerned with meeting nutrient requirements. An antioxidant, for example, may be included to prevent rancidity of the fat in the diet, or to protect nutrients from loss by oxidation. Pellet binders may be used to improve the texture and firmness of pelleted feeds. Mold inhibitors allow for longer shelf life and higher quality feed. Copper sulfate and sodium bicarbonate give performance benefits. Coccidiostats are routinely used in broiler feeds and also in diets for rearing replacement pullets to prevent coccidiosis and to stimulate growth rates and improve feed efficiency. If coccidiostats and/or antibiotics are in your feed, careful attention should be paid to feeding directions on the tag, and withdrawal times should be strictly followed. Hormones are not added to any poultry feeds.

Evaluating and Selecting Feeds

Seniors

It is easy to look at the price of feed per bag and assume that lower cost is the same as higher value. Spend time thinking about your feeding management situation and the types of feeds you have available. Be prepared to judge the relative value of feeds for various scenarios. Are you feeding for production of meat or eggs? What type, breed and age of poultry do you have? There are several methods to assess the value of a feed.

1. Physical evaluation of feedstuff: Does it look good and smell good? Is it free of dust and mold? Is it fresh? Can you see indicators of quality?

2. Determine the cost per unit of nutrients: This requires some analysis and calculations but it is not difficult. The poultry industry has made tremendous progress in least-cost feed formulation and getting the most meat and egg product for the lowest feed expense.

   Example:

Product	**Soy Bean Meal**	**Linseed Meal**
Crude Protein	44%	35%
Cost	$9.40 per 100 Pounds	$5.50 per 100 pounds

   To solve this problem you must determine the value of each feedstuff for protein:
   Do this by dividing the cost by the percentage of protein

   Soy bean Meal: $9.40⁄44 = 21 cents per pound of Crude Protein
   Linseed Meal: $5.50/35 = 15 cents per pound of Crude Protein
   Therefore linseed meal is cheaper.

   Another way is to look at productivity. If you must give your animal twice as many pounds of a low cost, but low protein feed to achieve the desired gain, it may be more cost effective to pay for a higher priced, higher protein feed but provide your animal a smaller amount.

   Example:
   Let's look at the feed stuffs from above but add in rate of gain expected for each feed.

Product	**Soy Bean Meal**	**Linseed Meal**
Crude Protein	44%	35%
Cost	$9.40 per 100 Pounds	$5.50 per 100 pounds
Rate of Gain	1 pound of gain per 2 pounds of feed	1 pound of gain per 4 pounds of feed

   Solve for cost per pound of gain.
   - First, determine cost per pound of feed
     Soy Bean Meal $9.40/100 pounds = $0.094/pound
     Linseed Meal $5.50/100pounds = $0.055/pound
   - Next, determine cost per pound of gain
     Soy Bean Meal: $0.094/pound X 2 pounds feed/pound gain = $0.188/pound of gain
     Linseed Meal: $0.055/pound X 4 pounds feed/pound gain = $0.220/pound of gain
   - On a cost of gain basis, using Soy Bean Meal would result in a lower cost.

3. There are a number of chemical analyses that are carried out on feeds by the companies that produce them. This information is useful in evaluating quality.

4. One of the most often used methods is to do your own feeding trials. You probably already do this without thinking about it. If you run into problems one year, you make adjustments the next year. With limited numbers of animals, this is a slow, often costly process.

Evaluating Feed Efficiency

Seniors

Performance in poultry is evaluated by examining growth rate or egg production rate, feed conversion and livability. Feeding management strategies should strive to optimize growth to reach the desired end point in an appropriate time frame. For example; if the desired 4 week weight is 1.5 pounds, your birds must gain 0.05 pounds per day. If the birds eat 3.0 pounds of feed during the 28 days to gain 1.5 pounds, feed efficiency for that period of time is 2 pounds of feed per pound of gain. The cost of gain is determined by multiplying the cost per pound of feed by the pounds of feed per pound of gain. Therefore, in this scenario, $8.00 per 100# feed with 2:1 feed efficiency comes out to $0.16 per pound of gain.

In regards to feed efficiency for egg production, if each hen eats 0.25 pounds of feed per day and lays one egg per day, then in 12 days each hen would eat 3 pounds of feed and lay one dozen eggs. This would result in 3 pounds of feed per dozen eggs produced. If feed costs $8.00 per 100# with a 3:1 feed efficiency ratio, then the cost of feed per dozen eggs would be $0.24.

As you plan your feed management program, you should develop some performance goals. Phase feeding is a common practice in the poultry industry. Age, stage of production, season, and type or strain of bird, will impact the nutrient requirements. Avoid feeding more than a bird needs to increase feed efficiency.

Poultry feeds are commonly classified as a starter, grower, finisher or layer, depending upon the type and age of bird they are designed to feed. The feed's brand name and/or feeding directions should indicate whether the product was designed for your flock. If the store doesn't have the proper feed for your species, type, or age of bird, ask about initiating a special order or shop at another store.
Visit:
http://extension.arizona.edu/4h/sites/extension.arizona.edu.4h/files/resourcefile/resource/icoussens/Poultry-Nutrition.pdf to learn more about Poultry nutrition.

Feed Safety & Veterinary Feed Directive

Seniors

For decades, antimicrobials and antibiotics have been used in animal feeds at “sub therapeutic” levels to improve growth and feed efficiency. To fight diseases in humans and livestock, antimicrobials are used at therapeutic levels to fight a variety of microorganisms (bacteria, viruses, fungi, parasites) while antibiotics specifically fight bacteria. Microbial resistance is a phenomenon that can develop in humans and animals. The Food and Drug Administration is working with the livestock and feed manufacturing industries to develop strategies to limit the potential for development of resistant microbes. Drugs that are important for treating human disease cannot be used for production purposes. Drugs use to fight animal disease now require veterinary supervision, no more over the counter antimicrobials. Please read about Antibiotics in Livestock & Poultry Production so that you can sort fact from fiction.
https://www.meatinstitute.org/index.php?ht=d/sp/i/102248/pid/102248

Processing Feeds

Seniors

Because feed constitutes a major portion of the cost of intensive animal production, it is very important that a diet have the right nutrient content and be in a form that will encourage consumption without excessive feed waste. Feeds are often processed by mechanical, chemical or thermal methods in order to alter the physical form or particle size to prevent spoilage, isolate certain parts of the seed or plant, to improve palatability and digestibility, or sometimes to inactivate toxins. Occasionally feed is processed to improve handling, like chopped hay. Some methods include: roller mill cracking, grinding, steam-rolled and steam-flaked, pelleting, extruding, popping, drying and cubing. Obviously there are costs associated with processing so the improvements in productivity must offset price increases.

Toxic Plant Substances

Seniors

Certain chemicals in plants are very toxic to poultry such as alkaloids, resinoids, phytotoxins, and oxalic acid. Some substances in plants become toxic after digestion such as glucoside and amygdalin. A list of plants toxic to poultry can be found at:
http://ufdcimages.uflib.ufl.edu/IR/00/00/30/36/00001/PS05200.pdf

Common Nutritional Disorders**

Disorder	**Chief Cause**
Ketosis	Sudden need for extra energy
Goiter	Iodine deficiency
Rickets	Ca, P, or vitamin D deficiency (young animals)
Anemia	Fe, Cu, vitamin B12, or folic acid deficiency
Perosis or slipped tendon	Mn deficiency
Gossypol toxicity	Toxic level of gossypol from cottonseeds
Photosensitization	Some feeds or forages or accumulation of metabolites
Encephalomalacia (crazy chick disease)	Vitamin E deficiency