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Pastured Poultry Nutrition and Forages

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This publication explores the important role that forages play in pastured poultry production for either meat or egg production. Research on the effects of raising poultry on pasture has increased greatly in recent times, with an ever-growing body of scientific work. This publication pays special attention to the nutritional benefits of poultry foraging on pasture: regarding both the birds' health and the impact that forages have on the nutritional and flavor qualities of the meat and eggs.

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Laying hens, both commercial and heritage breeds, are enthusiastic foragers on pasture. Photo: NCAT

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Introduction: Forage's Historical Role in Poultry Rations

Raising poultry on pasture is a time-established method of farming quality chickens, turkeys, waterfowl, and other poultry. Historically, before the maturation of poultry nutritional science and the widespread availability of balanced rations, forages were an important component of poultry diets. Access to vegetation was a way of providing a multitude of critical vitamins and minerals, many unknown until the middle of the 20th century, to meet a flock's nutritional needs. The importance of the vegetation that poultry consumed while on pasture can be seen in the following excerpt from a 1930 poultry-production textbook:

> "At all times of the year, an abundance of green feed is necessary. A lack of it is often a cause of ill health and low production. It acts as a tonic in functioning properly, securing for the bird a larger utilization of the feed consumed. The principal value, therefore, is in maintenance of health. The importance of abundance, as well as a variety, of green feed is seldom fully realized." (Rice and Botsford, 1930)

For hundreds of years, small farm flocks were

allowed to roam and scavenge most of their diet from a farm's pastures, barnyards, orchards, and fields, with occasional supplementation from scratch grains and table and garden scraps. The leaves and seeds the birds ingested, as well as the insects that were quickly gobbled up (often full of freshly consumed plant matter), helped balance out any of the unknown deficiencies in the feed ration. Indeed, before the middle of the 20th century, forages were the only reliable source for necessary nutrients like vitamin A, critical in preventing devastating diseases.

As poultry farms grew larger as the 20th century progressed, the ways that farmers incorporated greens into the diets of their birds were as varied as the farmers themselves. Many farmers would let their flocks freely graze around the colony houses/coops where the hens lived and laid their eggs. Where climate, space, and economics allowed, other farmers would plant grains such as barley, oats, or winter wheat for the birds to graze while the grains were young and still appetizing. This practice was especially helpful in the winter, when few other forages were present. Similarly, some farmers managed poultry-friendly pastures—filled with ryegrass, clovers, or other highly palatable forages—for laying flocks. By midsummer, when the flocks had consumed most of the available forages and the invertebrate populations become scarce, greens or fodder crops would be supplied from a truck patch or even garden pickings. On many farms, greens—primarily kale —were grown specifically to harvest as poultry food. Reviewing old poultry accounts, one variety of kale is frequently referenced: 1,000-headed kale. This kale was prized by many poultry farmers over other greens due to its prolific and hardy nature. Plants could easily approach six feet tall, and the large leaves were harvested as needed in a "cut and come again" fashion.

Lavelle Donovan, who grew up on a poultry farm in California in the 1920s, recalls:

> "Chicken greens were kale or a low vine called rape which was cut with a scythe. I can still see my father in the kale patch. He'd pick a kale leaf and tuck it under his arm until he collected a bunch. Then he'd put the bunch in a burlap bag he dragged along tied to his waist. Then he chopped up the leaves with the kale cutter in the barn." (Lowry, 1993)

The larger and more confinement-based the farm, the more greens were needed. The largest farms grew at least a couple of acres of kale and other greens, usually transplanted by hand, for their poultry rations.

Other farmers used different strategies to get greens into their flocks when forages became scarce. Supplementing rations with green additions like alfalfa or grass meal (a strategy still well-advised today) was considered essential to provide sources of unidentified nutrients (Blair, 2008). Sprouted grains such as oats or wheat (see Appendix 1 – Oat Sprouter), or vegetables like kale and cabbage, were also fed to the flock at regular intervals. Feeding rootstocks like mangels (a type of large beet for livestock) or carrots during the winter, along with winter-hardy greens, was a routine practice, providing a nutritional boost and also helping to reduce excessive pecking in flocks during the winter by keeping the hens preoccupied.

Advantages of Forage Consumption by Poultry

Feed Savings

Forages can provide a significant amount of poultry nutrition, reducing the amount of feed that a poultry farmer feeds a flock. Although poultry are NOT ruminants (they're omnivores), a good pasture is still a valuable resource for the flock. Jeff Mattocks, a livestock nutritionist with decades of experience in pasture-based and sustainable/organic farming, estimates that after "gathering data from year to year and producer to producer, I have come to the conclusion that pastured poultry eat 5-20% (of their diet) from pasture, depending on type and age of poultry, and the quality of forage growth" (2002).

In many areas, feed savings are typically greatest in the late spring and early fall, when lush pasture provides plenty of high-quality forages to offset a significant amount of the cost of feeding poultry. Additionally, insect and other invertebrate populations (poultry favorites) in the pasture are booming at the same time. The amount of plant forages consumed by the flock, or even an individual bird, depends on a variety of factors that will be further explored below.

Nutrition Source

The primary benefit of forage consumption is that plant matter is typically high in both vitamins and minerals. Besides the vitamins and minerals,

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Turkeys are excellent foragers and will eagerly hunt for insects and palatable plants to consume on pasture. Photo: NCAT

forages also contain components such as fiber, protein, energy (calories), and other compounds like carentoids and Omega-3 fatty acids that are important for metabolic functions in all animals, especially humans. The specific benefits that poultry gain from forages are explored below for each nutritional group.

Vitamins

Vitamins are complex organic compounds required by animals for normal growth. Many of the vitamins added to modern-day poultry rations can lose their potency over time because they are not as shelf-stable as other components of the poultry ration. Pasture intake by poultry acts as a form of nutritional insurance, as the living forages provide a back-up "bank" of nutrition to prevent any vitamin deficiencies of the feed from affecting the birds.

Vitamins are classified as either water soluble or fat soluble. Fat-soluble vitamins dissolve in body fat and when excess vitamins are consumed, they are able to be stored in the liver and fatty tissues. The fat-soluble vitamins are vitamins A, D, E, and K. Forages are high in all the fat-soluble vitamins except D and are an important natural source of these nutrients for poultry. In confinement production, vitamin D must be added to the poultry ration to prevent the nutritional disease rickets. For pastured poultry production, however, vitamin D deficiency is not a problem because pastured poultry are exposed to ample amounts of sunshine and readily synthesize vitamin D in their skin. With access to plenty of forage and sunlight, poultry on pasture should not have problems with fat-soluble vitamin deficiencies.

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Water-soluble vitamins are not able to be stored in the body and need to be consumed regularly. The water-soluble vitamins include several important vitamins grouped together and collectively called the vitamin B complex, as well as vitamin C. Poultry can synthesize vitamin C in their own bodies, and generally don't need to supplement with dietary intake. The B vitamins consist of vitamins like riboflavin, folic acid, and B6, which are found in ample amounts in pasture vegetation. Vitamins such as niacin, thiamine, and B12 are found in animals (think insects) that poultry eagerly hunt on pasture. Some of the water-soluble vitamins are also produced by bacteria in a healthy poultry gut. Forage consumption plays a significant role in poultry gut health, as will be discussed in the "Fiber" section on page 5.

Poultry feed can often be deficient in vitamins A, D, riboflavin, and B12 due to the perishable nature of these vitamin sources in the feed. As mentioned above, pasturing poultry and giving them access to high-quality forages will help in balancing out any deficiencies. Forages are rich in vitamin A and riboflavin; when exposed to

sunshine, a bird's body manufactures all the vitamin D the bird needs; and vitamin B12 can be supplemented by grasshoppers, crickets, worms, and other invertebrates (and the occasional vertebrate) that are commonplace in healthy pastures.

Minerals

Minerals are inorganic compounds, typically found as salts, that are critical for bone and eggshell formation in poultry, as well as important in many biochemical processes like hormone production and fluid balance in the bird's body. Many of the minerals needed by poultry can be supplemented by forages.

By far, the most common mineral deficiency is calcium, especially for laying hens. Calcium plays a critical role in poultry health, comprising approximately 70% of the mineral content in a bird. Calcium works hand-in-hand with phosphorous inside of the bird to build strong bones and eggshells. The calcium content of grains is very low, and typically sources like oyster shells, limestone, or calcium salts are added to feed. Forages can provide supplemental minerals, and the calcium found in plants like alfalfa is highly bioavailable. A bird's digestive system is able to utilize calcium from forages as efficiently as calcium from more common sources like limestone or oyster shell (Blair, 2008). Although pasture can supply around 25% (Horsted, 2006) of the calcium required by layers, it cannot serve as the long-term sole source of calcium. Good pasture with access to supplemental limestone or oyster shell, however, will provide all the calcium the flock needs.

Of particular importance in raising poultry, there is one amino acid that can often be limiting: methionine.

Proteins

Proteins are used by animals to build muscles, organs, and all other tissues. Crude protein is a basic measure of what percentage of a particular feed item is protein. Proteins are comprised of amino acids, of which there are over a dozen types. An easy way to understand protein nutrition is to imagine crude protein as a completed wall made up of individual amino-acid bricks. Each type of amino acid is like a different type of brick, and each animal requires a completed wall (crude protein) with a certain pattern of amino acid bricks (i.e., particular types and numbers of amino acids). When looking at the crude protein of a food, it is important to understand that not all proteins are the same, and that different animals have different levels of amino acid requirements.

Of particular importance in raising poultry, there is one amino acid that can often be limiting: methionine. In grains, methionine is found only in relatively low levels, and the best natural source for methionine is animal proteins – typically fish (fed as a meal), or insects and other animals found while ranging. In the modern poultry industry (including organic), most methionine is supplied in poultry diets by synthetically produced protein powders (the only way that so-called vegetarian poultry diets are possible).

Chickens and turkeys especially crave methionine. One sign of methionine deficiency is an increase in feather pecking or even cannibalism in the flock. One of the major advantages of allowing poultry to forage on pasture is that it allows the birds to hunt and eat insects and other invertebrates that they find while ranging, thus satisfying the bird's craving for animal protein. Indeed, research has demonstrated that even commercial Cornish Cross broilers are able to make up for some methionine deficiencies by consuming vegetation and insects on pasture (Mortiz et al., 2005; Horsted, 2006).

For decades, poultry farmers have noted that hens given access to pastures full of alfalfa and clover need less protein than hens raised in confinement. Experience has shown that hens purposefully fed protein-deficient diets increased their consumption of pasture forages compared to flocks fed a ration with adequate protein levels (Horsted, 2006). The same behavior was exhibited by broilers fed a protein-deficient diet (Eriksson, 2010). Horsted (2006) reported a 50% increase in forage consumption in hens fed a restricted diet of wheat and oyster shell compared to hens with access to a balanced layer ration. Similarly, poultry scientists have found that consumption of forages is inversely tied to protein levels – i.e., a higher protein content (methionine) in the feed ration can result in a lower amount of plant matter consumed on pasture (Heuser, 1955; Mortiz et al., 2005). A study in 2007 demonstrated that poultry are able to utilize the majority of the amino acids that they consume in forages, finding that the amount of methionine and lysine digested was 88% and 79% of the respective amount consumed (Buchanan et al., 2007;). Rivera-Ferre et al. found that broilers on pasture were able to meet around 7% of their protein needs from forag-

ing (2007). For more information about methionine in poultry, consult the ATTRA publication *Organic Poultry Production: Providing Adequate Methionine*.

Among plants, the legume family is the king of protein production. Legumes are unique in the plant world because they house a group of bacteria called *Rhizobia* in their roots that are able to pull atmospheric nitrogen (which composes roughly 70% of the air we breathe) and are able to convert it as a nitrogen fertilizer source for the legumes. In return, the *Rhizobia* are able to get shelter, water, and sugars from the cells in the legumes' roots. The abundant nitrogen production of legumes leads to elevated levels of valuable nitrogen-rich protein in these plants. Legumes important in poultry production are soybeans and various field peas, as well as pasture forages like alfalfa, lespedeza, clovers, and vetches.

Energy

As mentioned previously, forages are poor sources of energy, but they still contribute some calories to fuel the bird's need for energy. Buchanan et al. (2007) reported that a chicken gains anywhere from 129 to 246 calories for each pound of forages consumed (or 285 to 542 kcal/kg) and Rivera-Ferre et al. reported that broilers raised on pasture got only 3% of their energy need from forages (2007). Yellow dent corn, the main supplier of energy in poultry rations, by comparison, supplies around 1,632 calories per pound (3,596 kcal/kg). While grains are obviously one of the most important sources of energy in poultry rations (along with oils), even the small amounts of energy supplied by forages are important when feed prices soar. Forages can play a small but key role in reducing the feed bill in a pastured poultry operation.

Fiber

Although fiber is often overlooked, research is increasingly showing that it is an important component of poultry diets. Fiber generally falls into two categories: digestible and indigestible. Both types have roles in maintaining a healthy poultry digestive system.

Digestible fiber is fiber that gets broken down by the bacteria in the bird's digestive tract. Digestible fiber is an excellent food source for beneficial bacteria like *Lactobacillus sp* and *Bifidobacteria*. Additionally, lactic acid and other beneficial compounds are produced as these beneficial bacteria ferment digestible fiber, stimulating gut health. The competitive presence of populations of these beneficial bacteria, as well as the lower pH resulting from the fermentation of the fiber, creates a difficult environment for the establishment of *Salmonella* and other pathogenic populations (Nurmi and Ratala, 1973; Esmail, 2012).

Indigestible fiber does not get broken down as it moves through the bird's gut. This type of fiber does, however, slow things down considerably by bulking up the food and helping the gut "grip" the feed. Indigestible fiber typically is very water-absorbent, and allows water more time to be absorbed by the digestive system, especially in the large intestines.

When evaluating the nutrition of a particular feed item, it is helpful to understand a few terms that involve fiber:

Crude Fiber (CF) – CF expresses the percentage of the feed item that is made of fiber, both digestible and indigestible.

Total Digestible Nutrients (TDN) – this term refers to the sum of all the digestible parts of a feed item, including fiber, fats, proteins, and carbohydrates. Expressed as a percentage, it represents

Table 1. Changes in Alfalfa Quality Due to Maturity

Alfalfa Stage of Maturity	% Total Digestible Nutrients	% Crude Protein	% Acid Detergent Fiber
Pre-Bud	65	21.7	28
Bud	62	19.9	31
Half Bloom	56	16	38
Full Bloom	54	15	40
Mature	52	13.6	42

Source: Nutrient Requirements of Dairy Cattle, 3rd edition. National Research Council. 1966.

Appropriate grass height encourages foraging and vegetation consumption by the flock. Photo: NCAT

what can be digested by the animal; the remainder is indigestible.

Acid Detergent Fiber (ADF) – refers to the indigestible plant parts, including cellulose and lignin, that make up the outer walls of individual plant cells and, on a larger scale, the walls of leaves and stalks.

When building poultry rations, the greatest concern associated with fiber is having too much in the diet, which can cause a drastic drop in poultry performance and health. It is advisable to stick with a ration recipe formulated by a poultry nutritionist, especially in confinement situations. Poultry have the ability to at least partially regulate fiber intake, as birds in confinement have been observed supplementing their fiber intake by eating wood shavings from the litter when fed a fiber-limited diet. With access to pasture, poultry are able to round out any fiber deficiencies on their own, especially if given a wide variety of forages to choose from. Grasses are more fibrous than legumes, and grasses often have two or three times the fiber concentration of legumes in similar growth stages (Buxton and Redfearn, 1997).

Forage Impacts on Poultry Meat and Egg Quality

One of the main marketing points that pastured poultry farmers use to sell their products is that their meat and eggs are different from those produced by confinement-based poultry. While some critics dismiss these claims, a multitude of customer experiences reinforces the claim that pastured poultry is indeed different.

As pastured poultry production fills an ever-larger niche, research is beginning to explore claims of different nutritive profiles for pastured eggs and meat. In the case of eggs, evidence is emerging that the poultry products from grass-fed flocks tend to have less cholesterol, more vitamins A and E, multiplied Omega-3 content, and a healthier ratio of Omega-3s to Omega-6s.

Rybina and Reshetova found that egg cholesterol decreased as alfalfa and grass meal increased in a hen's diet (1981). A steady increase in egg vitamin A and carotene content was observed as the amount of grassmeal increased in the diet of a flock (Davtyan and Manukyan, 1987). A study at Penn State demonstrated that hens with access to good pasture had eggs with at least twice as much vitamin E and Omega-3s, as well as more vitamin A, as eggs from hens with no access to pasture (Karsten et al., 2010). Another study, with funding from the Sustainable Agriculture Research and Education (SARE) program of the USDA, examined eggs from pastured laying flocks in Pennsylvania. The pastured eggs tested had one-third less cholesterol, one-third more vitamin A, and nearly triple the amount of

Omega-3s (Gorski, 2000). Lopez-Bote et al. also found increased Omega-3 content in eggs laid by free-ranging hens (1998). These studies bolster an independent study that tested eggs from 14 pasture-based farms across the country. Vitamins A and E, Omega-3, beta carotene, saturated fat, and cholesterol were all tested and compared to the nutrient qualities of a standard production egg. The vitamin E, Omega-3, and beta carotene contents were all significantly higher—in fact more than twice as high—as those in eggs produced by chickens in confinement with no access to vegetation. The vitamin A content was higher as well (Long and Alterman, 2007).

It's worth noting that there are conflicting studies and industry claims that free-range eggs have little or no difference from eggs produced in confinement. The problem, though, is that "free-range" simply means having outdoor access, without stipulations on the amount of time, pasture condition, minimum space requirements, or even whether the birds have access to the ground.

The results of poultry meat production on pasture are similar. Studies have shown elevated Omega-3 levels in meat from pasture-raised broilers as well as higher levels of vitamin E (although no difference in cholesterol) (Ponte et al., 2008a) and other nutritive factors (Gorski, 2000). Pastured poultry meat may possibly have a longer fresh-product shelf life (Sun et al., 2012a), as well as a discernible difference in taste according to a 30-person untrained tasting panel (Ponte et al., 2008b), although there was no significant difference among the meat qualities affecting taste as measured by the researchers in the laboratory. Sun et al. (2012a) also reported higher vitamin E and iron content in thighs and breast meat from broilers reared in grasshopper-rich alpine pastures, as well as lower cholesterol and a higher Omega-3 content (Sun et al., 2012b).

Factors Affecting Forage Consumption

Common experience among pastured poultry producers is that the birds will readily consume large amounts of forages, even if they have good rations available: poultry crave greens and eat them readily even if a balanced ration is provided (Blair, 2008). Just because poultry have access to pasture, though, does not necessarily mean that the birds will consume the available forages. There are several factors that determine how appealing a plant is to a bird (called the plant's palatability), including the plant type/species; the nutritional content, height, and stage of growth of the plant; as well as the nutritional needs of the bird, how hungry it is, and its foraging instincts. These factors are explored below.

Poultry Foraging Behavior

One of the main factors that determines the amount of plant matter that chickens and other poultry consume while foraging is the actual behavior of birds. Several factors affect a bird's ability to forage, including:

- ***Species/Type*** – Different breeds of poultry have different foraging habits and consumption rates. On two separate ends of the spectrum, geese are able to meet nearly all their nutritional needs with the vegetation they graze on, whereas modern broilers like the Cornish Cross can only make modest (though still economically and nutritionally important) supplements to their diet from pasture. Turkeys are voracious foragers, and will forage as a flock, forming a line and cleaning a pasture of insects, tasty forages, and seeds with almost military precision. Among chickens, laying hens forage much more than their meaty broiler cousins. Many pastured poultry farmers who have experience with both modern layer hybrids and heritage breeds of hens see little general difference between the two in terms of foraging, but quite a difference in feed conversion and production from the more modern breeds. Additionally, producers notice variability in grazing ability from hatchery to hatchery, flock to flock, and even among individuals within the same breed (Salatin, 2001). Pousga et al. point to research that suggests genetics also play a role in chickens' ability and efficiency in balancing their nutritional deficiencies, at least in free-choice feeding systems (2005). They report that brown-egg layers seem to be able to adapt more readily to free-choice feeding systems than white- or tinted-egg layers. Within a flock, individuals show a range in their capability to select for their own needs, along the same lines as the experiences mentioned above.

Poultry crave greens and eat them readily even if a balanced ration is provided

- *Time of day* – Poultry are most active during the morning and evening hours. Of the two times, poultry are most active right before sunset (Dawkins et al., 2003). Danish research has found that laying hens with constant access to forages consumed the most vegetation prior to sunset (Horsted et al., 2007). The birds really prefer to fill up before they head off to the roost for a good night's sleep. Filling up their crops enables them to digest the seeds, feed, insects, plants, and other food items overnight. Likewise, the birds will be out foraging first thing in the morning, looking to get food into their empty stomachs, but not to the same extent as they do at night.

  Long-time pastured poultry producer and innovator Joel Salatin, with decades of pastured poultry experience under his belt, advised in the 1990s of the importance of providing chickens fresh pasture early in the morning, noting that "the birds' most aggressive grazing period is two hours pre-daylight, which occurs long before the sun rises. Every quarter hour we wait to move pens after daylight reduces the grazing time period. As the dew comes off and the day gets warmer, the birds begin lounging not because they have grazed their fill, but because physiologically they demand a rest period" (Salatin, 2001). The results of research and experience are clear: give access to forages in the morning and evening if you want to maximize forage utilization.

- *Experience* – It takes time for a flock of birds to adapt to new types of feed (Jones, 1986). Novel food types require time for the birds to figure things out. Some producers give their birds a head

Sericea Lespedeza – Poor Man's Alfalfa for Poor Southern Soils

Sericea Lespedeza is an adaptable, high-protein, heat-loving legume that was introduced into the United States in the 1930s for erosion control. Known for its toughness, sericea was once called poor man's alfalfa in the South, a reference to this tough legume's ability to grow in poor-quality soils. Other uses for the plant, which include restoring surface mine spoils or roadbank cuts, testify to sericea's ability to grow in low-fertility, acidic soils. The author of this publication has successfully grazed layers and turkeys on naturalized, pure stands of sericea for researchers (Moyle et al., 2012). The poultry like serecia best when it is still immature and soft and will readily graze the whole plant. Once the plant starts to mature, getting around eight to 10 inches high, the stems become too woody for the birds, but they will continue to strip the leaves off and, later, the seeds, throughout the growing season. The plant is not the most preferred poultry forage, but often it can be the only one available, as sericea will grow and thrive on ground so poor that other forages cannot get started. In record-breaking drought and high heat, sericea will remain green and grazable, even when other forages have withered away. Additionally, the high tannin content of the plant has been proven to be an effective, natural de-wormer in sheep and goats (Coffey et al., 2007) and may have similar properties in poultry (Moyle et al., 2012; Todd and McSpadden, 1947).

A stand of nearly pure sericea lespedeza on a clay and shale bench that has been used as poultry pasture for turkeys and layers at Across the Creek Farm in West Fork, Arkansas. Photo: NCAT

start by placing a tray of chopped forages daily in the brooder (lawn clippings work well). Others dig a chuck of sod and place it in the brooder for the chicks to investigate and pick through. Broiler intake is positively correlated with age (de Almeida et al., 2012). When broilers are first put on pasture, they may pick half-heartedly at forages or totally ignore them. This will change over time, but with the short lifespan of broiler chickens (as short as seven weeks), the sooner they get on pasture, the faster they learn that forages are food. Poultry raised in pens tend to learn faster than those in day-range-style systems because the birds feel a competitive drive to eat fresh forages before their flockmates gobble them up first. Laying hens seem to learn to eat forages faster than their broiler kin, but it must be remembered that meatbirds grow much faster than layers, and although their body size is large, they are still essentially chicks in terms of instincts and habits that they are developing.

- *Shade* – Shade/protective cover encourages foraging (Dawkins et al., 2003), most likely from the protective effect of shelters (Rivera-Ferre et al., 2007). Shade, whether from trees or shelters, especially encourages layers to roam. Chickens originated in the jungles of Southeast Asia, and turkeys in the hardwood forests of Eastern America. Staying hidden under tree or plant cover seems to afford the flock an instinctive sense of protection from predators (a false sense when it comes to hawks!). Brightly lit, open areas are one of the least desirable habitats for most poultry, and for centuries farmers have noticed that poultry will often overgraze the areas immediately surrounding their housing even if undergrazed forages are available just a little further away.

- *Height of forage* – Poultry like their forages relatively short. Virginia producer Joel Salatin prefers forages under four inches (Salatin, 2001) but ideally around two inches. Before his birds get to the pastures, he grazes ruminants until the pastures are the preferred height for the birds (Salatin, 1996). Meanwhile, Oregon producer Aaron Silverman prefers a sward height of six to eight inches for his chickens (Silverman, 2000). Producer and research observation have noted that chickens go for shorter forages over longer plants when given the choice (Horsted, 2006). Turkeys do not seem to be nearly as picky, eagerly ingesting long strands of grass either in pieces or whole, like slurping noodles. It is worth considering, though, that forage height usually correlates with palatability, as younger, more succulent plants tend to be shorter.

Palatability

The term "palatability" refers to how "tasty" a bird finds a particular plant to eat at a particular time. Whether or not a plant is palatable is one of the most critical factors for birds on pasture: if the bird won't eat a plant, the benefits of the plant—no matter how nutritious—are worthless. Several things directly affect palatability:

Whether or not a plant is palatable is one of the most critical factors for birds on pasture: if the bird won't eat a plant, the benefits of the plant—no matter how nutritious—are worthless.

Plant Species/Variety – Like people, poultry find some plants highly palatable, while others are completely unappealing and will not be eaten. Some plants have strong flavorings that poultry love, like the tart taste of yellow wood sorrel or clover seed pods, or despise, like the bitter fluid from milkweed. Generally, legumes and young, soft grasses are appreciated, while forbs and shrubs can be hit or miss. Clovers and alfalfa have long been considered among the best forages for a variety of reasons: high protein content (legumes), lush leaves, perennial growth, and, importantly, because these legumes mature slower and stay palatable much longer than grasses. Grass leaves on average contain twice the fiber of legume leaves. Fiber content in alfalfa and crimson clover leaves at the mid-blooming stage is around 25%, compared to fescue and orchardgrass leaves that have fiber contents near 50% and up to 70% in big bluestem and bermudagrass as the plants go to seed. Given their structural purpose of supporting seeds, it comes as no surprise that stems are typically much higher in fiber than leaves (Buxton and Redfearn, 1997).

The specific variety of a plant can affect the amount of grazing a bird does on pasture. For instance, alfalfa varieties high in bitter tannins or saponins are less palatable than varieties with little of these compounds. The tannins can also depress protein digestibility and reduce overall feed intake, which

can reduce feed conversion. Therefore, in the case of alfalfa, variety can play a significant role in the amount of vegetation consumed.

Feeding Poultry, a poultry nutritional text from 1955, makes the following suggestion on desirable species for poultry production:

> "For poultry pastures, plants capable of forming a dense, hard-wearing, and lawn-like turf are desirable. Wild white clover and ladino clover are suitable legumes. Grasses suitable for poultry turf are perennial rye grass, meadow grasses, the fescues, creeping bent, and crested dog's tail. However, poultry does not like the plants after they have become aged and woody and will then only eat them as a last resort. Turkeys prefer ladino clover, but other grasses can be satisfactorily used for grazing." (Heuser, 1955)

Aaron Silverman from Oregon has settled on a complementing blend of highly palatable clovers and more persistent grasses, "a balanced mixture of orchardgrass, perennial ryegrass, tall fescue, annual ryegrass, subclover, and New Zealand white clover" (Silverman, 2001).

- ***Stage of growth*** – As pasture forage plants near maturity, they will direct energy and nutrients away from producing nutrient-dense leaf mass and into producing the next generation of seeds. Funneling nutrients into the seeds, which includes pulling nutrients from existing leaf mass, greatly decreases the livestock feed value of the forage. Additionally, the lignin content (roughly, the "woodiness") of the plant increases as the plant gets closer to producing fruit or seeds, especially in the stems (resulting in higher fiber content). As an example, alfalfa's nutritive qualities plummet after the blooming stage (see Table 1 on page 5). It makes sense that the younger the forage, the more tender and palatable it will be. Plant stems become lignified faster than leaves, and rapidly become indigestible and unattractive to poultry.

Although grasses can be higher in several nutritive qualities, other plants may be preferred as forages because they stay palatable for a longer time during the growing season. It was noted in the 1950s that "clover and alfalfa ranges are preferred [for poultry], primarily because the green stuff is available over a longer period of the year. They do not grow up and become tough and unavailable, as grass does. Frequent mowing of grass, either with ruminants or machinery, however, will help keep it tender" (Heuser, 1955).

Insects provide around four times more usable protein and energy for chickens and other poultry by weight, compared to poultry feed rations.

Insects and Other Animals as Forages

Insects are an important source of nutrition for birds worldwide. Insects and other invertebrates provide around four times more usable protein and energy for chickens and other poultry by weight, compared to poultry feed rations (Bassler, 2005). Chickens, turkeys, ducks, and other species of fowl will greedily consume every insect on pasture, as these are excellent sources of protein and energy (see Table 2).

Poultry consumption of insects not only promotes the health of the flock while saving on feed costs, but also helps the pasture, as many insects feed on and negatively impact high-value forage species. Crickets and grasshoppers especially can be problematic. Pastured poultry turns this pest problem into a valuable asset in much the same way that brush and weeds despised by

To Seed or Not to Seed

A common question from new pastured poultry farmers is "What should I plant?" While this is an understandable question, an even better question would be "Should I plant?" In most areas, if the soil provided the right environment, then highly desirable forages would already be growing. Spending money on high-dollar seeds and sowing them into infertile ground is essentially throwing hard-earned (and probably limited) money away. Many producers are surprised by how quickly their pastures benefit from pastured poultry production—especially broilers, which lay down a lot of manure. Over a couple of seasons, as the soil environment changes (pH, nutrients, organic matter, etc.) from the manure inputs of the birds, farmers typically see some sort of ecological transition that includes new, often desirable, plant species like clovers, chicories, and vetches appearing in their fields. If you do decide to seed forages into new or existing pasture, make sure that you take a soil test and that your soil environment is favorable to establishing the forages that you are sowing.

Table 2. Protein and Energy Value of Common Pasture Invertebrates

Invertebrae Type	% Protein	% Fat%
Cricket	6.7%	5.5%
Grasshopper	14.3%	3.3%
Large Spider	63%	10%

Source: National Research Council. 1996.

cattle ranchers are valued by goat farmers. On the author's farm (Across the Creek Farm), the summer of 2012 was one of the most brutal on record for our county in Northwest Arkansas. The second record-breaking drought in a row, with barely a drop of rain over a period of months, left pastures in the county in a poor state. Then the grasshopper population exploded. It was all over the news: stories of hay fields, gardens, and lawns being plagued by the hoppers. Our layers and broilers gorged themselves on the pests. We noticed our feed consumption dropped quite a bit, without a drop in production from the birds. As a bonus, the birds were getting forages that they did not normally touch, like barnyardgrass, into them because the grasshoppers were eating these undesirable plants and then getting gobbled up by the hens and broilers. It didn't take long before grasshoppers became pretty scarce in our pastures. At least we know now that there's an upside to droughts.

The best way to increase the population of insects in your pastures is to improve the quality of the forages in your fields. The denser and more diverse the pasture sward, the greater the quantity and diversity of insects the birds have for foraging. It's worth noting that insects are not the only animals that poultry relish. Other invertebrates such as worms, spiders, and ticks and even vertebrates like snakes, lizards, amphibians, and mice are fair game if the birds can catch them.

Utilizing Native Pastures

The most profitable strategy for utilizing forages often means using those that are already established. With the host of challenges that face a pastured poultry operation, especially new operations, spending money on planting forages may not make economic sense. Seed costs can be significant, especially for smaller farms, and a farmer would do well to assess current pasture resources before expending cash.

An existing pasture often has a large community of plants that are already established and have survived on your farm at no cost and with minimal attention. With an investment of a little bit of management, such as the addition of the nutrients from pastured poultry manure, existing forages will likely pay dividends by offsetting feed cost. Additionally, the soil more than likely has a diverse seedbank that was decades in the making, full of new species that will appear and thrive when conditions become favorable. Rotational grazers of all animals are very familiar with the phenomenon of reaping what they do not sow when pasture management takes priority. Joel Salatin, the modern-day grandfather of pastured poultry, has this to say about native pastures:

> "Every geographic region has its native forage species. I have not found any forages that the chickens dislike. Whether it is fescue or lovegrass, the height and density seem far more important. In areas where grass grows sparsely, it may be necessary to move the pen more frequently to ensure that the birds get enough to eat… The critical factor is that it be fresh, short, and preferably composed of many different species so that the birds have a great variety." (Salatin, 1996)

Mob Grazing with Chickens

Poultry are one of the smallest sizes of livestock. It should be fairly obvious that they will struggle trying to forage through chest-high grasses. Poultry prefer to forage through relatively short vegetation. They do well in pastures where clump grasses are present, as they'll move in between the clumps searching for insects and forages. Over time, poultry will trample down tall grasses. Pasture systems that use mobile floorless pens, such as Salatin-style pens, will help lay tall grasses down, essentially mulching the ground with grass stems and leaves as the pen is moved in high grass. If seeds are formed, the poultry will eagerly consume them, and the manure that they lay down in the knocked-down grass will form a protective mat of fertility that shields the ground, similar to the results of high density mob-grazing in rotational grazing systems using ruminants. Old lignified grasses are high in carbon and, when trampled into the ground and covered with manure rich in nitrogen, decompose readily, essentially composting in place and feeding soil biota while creating an excellent seedbed for future forages.

A diverse pasture, containing a mix of cool- and warm-season grasses, legumes, and broadleaves of different heights and stages of maturity, gives the poultry a constantly changing "saladbar" (a term coined by Joel Salatin) of forages to choose from. "I hesitate to rank the species in order of preference because someone may then try to provide only the most desirable thing," writes Salatin. "Actually in their first few minutes of grazing, some birds eat fescue and others eat seeds and others eat clover leaves, just as people would pick over a salad bar that would contain 'favorites' and 'I need to eat this because it's good for me' items" (Salatin, 1996).

One of the greatest things about utilizing existing pasture, besides the fact that it is essentially free, is that it requires little maintenance—there's no liming or fertilizing needed. The existing plant community is hardy and well-adapted to the current environment. The pasture should only respond positively to the manure and activity of a well-managed pastured poultry operation.

Establishing Poultry Pastures

Despite the economic sense of utilizing existing pasture resources for pasturing poultry, there are situations where establishing pastures for poultry makes sense. Perhaps land is being converted from cropland or forest to pasture, or the current pastures are filled with weeds and brush without any real value for poultry. In this case, the following advice for establishing a poultry-friendly pasture may be of help:

> [O]ats and peas sown together very thinly with a liberal seeding of red clover and a very little rape make a good combination. The oats and peas furnish a rapid growth of green feed. Much of it will get tramped down and some go to seed, but will serve to protect the clover and the rape, which will make good feed late in summer and fall. Three pecks of oats, two of peas, a pound of rape and 5 quarts of red clover seed make a good proportion for sowing an acre. The oats and peas should be first harrowed in deeply, then the clover and rape sown mixed and lightly scratched in. (Kains, 1920)

Protecting Pasture from Poultry

While the benefits of poultry on pasture have been discussed at length, it is worth ending with a caution to the producer about the damage that poultry can do to pasture. Poultry production can be seen as a neutral tool for pasture management: the birds can either improve or destroy pasture health. The keys to maintaining healthy pastures are to move the birds often and to watch the condition of the pasture. If possible, avoid grazing pastures when they are wet and the soils are at their weakest. Laying hens, with their constant scratching, and heavy birds, such as mature turkeys, are hardest on pasture. Additionally, if broilers are left too long in one spot, they can put so much manure on the ground that the soil becomes too rich and "burns" plants trying to grow there. Many pastured poultry farms use designated areas as "sacrifice paddocks" during the winter months, wet season, or other periods when the forages are dormant and vulnerable. Observation and common sense go a long way in keeping pastures healthy and making sure that your pastures will be providing forages for your flocks for years to come.

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Appendix 1: Sprouted Oats

Source: Practical Poultry Management, by J. Rice and H. Botsford. 1930.

Sprouted oats.—Sprouted oats furnish one of the most desirable winter succulents. They also provide the most satisfactory means of using oats, since the absorption of water, while not increasing the nutriment, makes the grain more palatable and digestible. One hundred pounds of oats in sprouting will absorb enough water to make about 350 pounds of the sprouted grain.

The sprouter.—Anyone handy with a hammer and saw can make a good sprouter out of wood. A very satisfactory device consists of a rack holding seven trays, one above the other (Fig. 63). For the corners 2 × 2-inch posts 6 feet long should be used. Brace them with 1 × 2-inch strips each 2 feet long, and 9 inches apart, on which the trays slide. The trays may be made 2 feet square and about 2 inches deep. (Use 1 × 2-inch lumber.) An advantage of square trays is that they can be given one-quarter turns, thus exposing all sides to the light. The bottom boards, made of ½-inch lumber, should be set ⅛ inch apart to allow excess water to drain off.

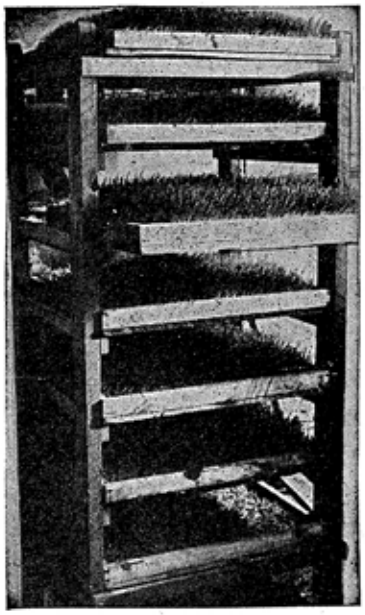

FIG. 63.—Homemade Oat Sprouting Rack.

Sprouting.—The sprouting can be done best in a well-lighted room where a temperature of 60° to 70° F. can be maintained. The grains will not sprout well in a temperature below 60° F., and mold will usually result. The room should also have provision for ventilation. The grain, before it is put into the sprouter, should be soaked and treated with formalin to prevent the development of molds. For each tray (2 × 2 feet), place in a pail 6 quarts of oats and 6 quarts of lukewarm water to which has been added one teaspoonful of formalin. Cover with an old bag or burlap and allow to soak for 36 to 48 hours. Then spread out on the trays from about ¾ to 1 inch deep.

Sprinkle thoroughly each day so as to keep the oats always moistened. Cover the tray with building paper to prevent too rapid evaporation, thus hastening the sprouting. Stir the oats daily until the sprouts are about ¼ inch long. The trays should be reversed occasionally so that all sides will

[1] West Virginia Bulletin No. 178.

have exposure to the light. The oats should be started on the bottom tray and the trays moved upward each day, the feeding being done from the top trays. This gives the growing oats at the top the most light, which is necessary.

Under favorable conditions, the oats should be ready to feed in about a week or ten days. When the trays have been emptied, they should be disinfected with a 5 per cent solution of formalin to prevent the development of mold in the wet trays.

The oats usually are fed when the sprouts are from 1 to 3 inches high. The sod is removed, broken into chunks, and fed in troughs or on clean litter. From 1 to 2 square inches for each hen should be fed regularly each noon.

Germinated oats.—Many poultrymen prefer to feed the oats after germinating, or when in the racks but four or five days.

These are similar to sprouted oats except that they are fed when the grain has just sprouted and has not yet turned green. Many of the best feeders use germinated oats in preference to sprouted oats. When fed thus the formalin treatment is not necessary.

Roots and tubers.—In this group, yellow carrots are the most desirable. "They are satisfactory substitutes for field-grown greens." [1] Mangels are next in importance. Mangels should not be wilted or tough when fed. They are probably one of the cheapest and most easily handled succulents. Mangels are low in vitamine content.[2] From 10 to 12 tons may be raised to the acre; this should be enough to feed from 1400 to 1600 hens. Mangels can be stored in a root cellar or pit. The birds should be given all they will eat from noon until night; and 100 fowls can be expected to eat from 8 to 10 pounds a day during the winter. The golden tankard variety is one of the best.

Turnips, *rutabagas*, and other roots may be used where there are no beets. They usually yield less, however, do not keep so well, and are not so well liked by the fowls.

Cabbage.—Cabbage is less expensive to raise but more difficult to store than mangels. It is an excellent succulent, especially for fall and early winter. Fowls prefer cabbage to most other vegetable feeds. The small, unmarketable heads may be used to advantage for poultry.

Any vegetable, such as lettuce, onions, spinach, kale, and the like, may be used as green food. The dandelion is especially desirable for chicks. Fowls relish a variety of greens.

[1] Bulletin 384. University of California.

[2] Two per cent of cod liver oil in the mash, will, in all probability, prevent any loss due to vitamine A deficiency. Yellow corn is also effective. Bul. 384, University of California.

Notes

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