Alligator farming is a well-developed industry in Louisiana that currently contributes about US$60 million of farm-gate value to the state’s agricultural economy. The industry is based on production of wild stock obtained under regulatory oversight of the Louisiana Department of Wildlife and Fisheries (LDWF) through its highly successful alligator management program. The LDWF permits farmers to raise alligators obtained from the wild and requires that a specified proportion of farmed animals be returned to the wild to maintain populations. Farmers collect eggs of American alligator Alligator mississippiensis during the nesting season and incubate them on their farms. Hatchlings are stocked into temperature-controlled production houses and raised to a marketable size of 1.25 m in about 16 months. Skins, which enter the luxury leather market, are the most valuable item produced, but alligator meat is also sold domestically throughout the United States and exported around the world.

In the early days of alligator farming, Louisiana producers fed meat obtained from various sources, often dead chickens from poultry farming operations and animal carcasses obtained from fur trappers. As production grew, the need for dry diets that could be handled easily and stored without refrigeration became increasingly important, and feed companies began to produce compounded diets for alligator aquaculture, similar to those used in intensive fish culture. Dry, extruded feeds are now the industry standard in alligator production operations.

Despite the widespread use of compounded diets, very little is known about the nutritional needs of captive-reared alligators. Feed companies ensure their products produce the growth results their customers expect by producing well-fortified diets that are unlikely to possess deficiencies of any essential nutrients. Typically these diets are high-protein, high-fat formulations that utilize large amounts of animal products to satisfy the perceived needs of a carnivore. They are expensive and some of the nutrients they provide are not well utilized. This results in greater than necessary feed costs and requires increased sanitation measures to remove waste nutrients from the production environment. Thus, improvements in the nutrient balance of alligator feeds can be expected to reduce production cost, provide better environmental conditions for growing alligators and lead to cleaner effluents discharged from production facilities.

**Recent Nutrition Research**

Like other farmed animals, alligators have specific minimum dietary requirements for certain nutrients that must be consumed in sufficient quantity to support growth, reproduction and good health. Unlike terrestrial livestock and poultry, and some farmed aquatic species, such as salmon, trout and channel catfish, the minimum dietary requirements of the American alligator are unknown. Nonetheless, the nutritional needs of the alligator can be estimated based on knowledge of its natural feeding habits and the known nutritional needs of other aquatic species, which already have been determined.

While critical differences exist among species, reasonable assumptions can be made. For example, to maintain good health, all animals must consume protein to obtain the ten essential amino acids that cannot be synthesized by the body. Virtually all animals studied to date require the same ten dietary essential amino acids, as well as vitamins, minerals and some fatty acids; most other compounds can be synthesized by the body as needed. Different feedstuffs contain different amounts of these critical amino acids and animal proteins are generally better sources of dietary essential amino acids than plant proteins. However, despite nutritional differences among feedstuffs, many kinds of ingredients can be used in animal feeds if enough information is available to allow ingredients to be mixed in ways that provide proper nutrition at reasonable cost.

When formulating a diet, the amount of protein and energy required to produce a desired growth response is a major consideration. Protein intake is an important factor affecting animal growth because the quantity and quality of dietary protein, its amino acid composition, greatly affects tissue production. Under optimum environmental conditions, the more high-quality protein an animal consumes, the faster its growth rate, up to a point beyond which there is no further increase as a result of the limits of metabolism. At that point, unused dietary protein is converted to fat and the nitrogen it contained is excreted as ammonia. The loss represents money wasted on unutilized protein, plus the added expense of removing excess ammonia from the production system. So what changes are needed?

The research begun several years ago at Louisiana State...
University is investigating the practical nutritional needs of American alligator to provide recommendations for improving the diet of farm-raised animals. One long-term goal is the development of plant-based diets for alligator aquaculture. Digestibility studies showed that alligators efficiently utilized crude protein and energy in corn, soybean meal, soy protein concentrate, wheat gluten and menhaden fish meal, and the availability of dietary essential amino acids in these feedstuffs often exceeded 90 percent when they were provided at concentrations of 30-45 percent of diet weight (Reigh and Williams 2013). Amino acid availability coefficients indicated that alligators efficiently utilize protein from an assortment of plant products of diverse chemical composition. The LSU research also has shown that 45 percent dietary protein is sufficient for alligators fed a diet similar in composition to the commercial diet now used by most Louisiana farmers. A 45 percent protein diet produced growth comparable to a similar formulation containing 55 percent protein and generated less ammonia in the production environment (Reigh et al. 2013). Most recently a study was conducted to determine the appropriate dietary energy to protein ratio for alligators fed a plant-based diet.

**Latest Feeding Trial**

Eighty young-of-year alligators (approximately 100 g mean body weight) were stocked, two per tank, in 0.3-m² tanks in a recirculation system and fed one of four diets for 225 days. Water temperature was 31 C; water depth was 7 cm at the beginning of the study and increased to 15 cm at the end. Tanks were flushed several times per week to remove solid wastes and the biofilter was flushed daily. Three, cold-pelleted, experimental diets containing 43-47 percent digestible protein and graded digestible energy (DE) to digestible protein (DP) ratios of 42, 38, or 34 kJ DE/g DP were evaluated by comparing growth performance of alligators fed these diets to that of a control group fed the commercial diet most commonly used by Louisiana alligator farmers (56 percent crude protein). Primary components of the experimental diets were soybean meal (32-35 percent), wheat gluten (27-29 percent), menhaden fish meal (15-16 percent), yellow corn (11-16 percent), plus vegetable oil (1-12 percent), vitamin and mineral supplements, and water-soluble binder (all 1 percent), with all ingredient proportions expressed on a dry-weight of diet, as-fed basis. Ingredient composition of the commercial diet was proprietary, but its proximate composition and amino acid composition were determined by analysis.

It was assumed, for the purpose of diet formulation, that the whole-body amino acid composition of alligator provided an approximation of dietary amino acid requirements. Data on available energy and available amino acids in feedstuffs, which had been obtained during previous digestibility trials, as well as concentrations of essential amino acids in the whole-body of young-of-year alligators (determined by analysis), were entered into a computer program that was used to formulate experimental diets to meet specific restrictions on protein content, DE to DP ratio and available essential amino acid composition. Diets were formulated to provide essential amino acids in quantities that were similar to those in alligator body tissues, so relative proportions of critical amino acids would remain consistent among the three dietary treatment groups.

Alligators were fed to apparent satiation daily, and weighed and measured monthly. Results of the feeding trial indicated the diet containing 45 percent DP and 38 kJ DE/g DP produced gains in body weight that were not significantly different from those obtained with the control diet (Fig. 1). The amount of crude protein (54 percent) in dry feces of alligators fed the control diet also was significantly greater than the amount of protein (33-37 percent, dry) in feces of alligators fed the three experimental diets, suggesting dietary protein utilization was lower among alligators fed the high-protein commercial diet than among those fed lower-protein, plant-based experimental diets.

Results of this study showed a diet consisting of more than 80 percent plant products was adequate for young-of-year alligator when the dietary essential amino acid balance was similar to that of alligator whole body. Results also indicated that American alligator can effectively utilize dietary carbohydrate of plant origin, although the limit of that capability has not been determined. These results suggest that plant products can be used as alternatives to animal products in compounded alligator diets and at relatively high inclusion rates in some cases. However, to maximize the value of plant products in alligator feeds, information is needed on the digestible protein/energy content and available amino acid content of a wide selection of ingredients available for use when economic conditions warrant a change in diet formulation.

**Next Step**

An upcoming experiment will test the 45 percent DP diet in a full-scale, 12-mo production trial to determine its effects on alligator growth, skin quality and muscle composition under simulated production conditions. Results of that study will identify future research needs and support additional recommendations on the improvement of diets for alligator aquaculture.

**Notes**

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