Evaluating a Submersible Diet for Ducks and Other Species

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The use of an alginate-calcium complex to formulate a durable submersible diet was evaluated in a feeding trial with growing ducklings. Growth, feed intake (FI), gain:feed ratio (GF), dry matter digestibility, metabolizable energy (ME), nitrogen-corrected ME and excreta moisture did not differ between birds fed a commercial 22% crude protein duck starter diet and those fed the same diet incorporating an alginate-calcium treatment (ACT) fed dry. The ACT diet fed submersed showed good durability. Birds receiving this diet showed a higher FI, poorer GF and lower ME than the other two diets. The higher intake was primarily attributed to a higher activity level of ducklings fed in this manner. Alginate-calcium treatment allows formulation of feeds for aquatic and semi-aquatic species without affecting nutritional quality of the diet.

Key words: submersible diet, ducklings, alginates, feed formulation

INTRODUCTION

Ducks kept in zoo or wildlife displays are generally given a dry pelleted or crumbled feed separate from their water supply. Since waterfowl typically dive or dabble when foraging for food in the wild (Bellrose, 1980) they frequently demonstrate their natural feeding behaviour by submersing the dry diet in water before consuming it. This results in loss of feed due to disintegration, resulting in contamination of the water which must be changed more frequently. Crissey et al. (1989) noted further disadvantages of exposed feed, including its accessibility to rodents and other pests which leads to feed loss and possible disease transmission. They formulated and evaluated the stability of a submersible diet which would alleviate many of these problems, resulting in cost savings, more natural feeding behaviour in exhibits and potentially reduced health problems. Previous experiments with submersible diets for snapping turtles (Filice and Atkinson, unpublished) had led to the development of an alginate/calcium treatment (Andrew and McLeod, 1970) which produced a very durable feed. The present study was designed to determine whether this treatment significantly affected the nutritive value of the diet in a feeding trial with rapidly growing ducklings.

METHODS

Sixty day-old Pekin ducklings (King Cole Ducks, Aurora, ON) were wing-banded, weighed and allocated to 4 categories by weight. One bird from each category was assigned to each of 1 5 pens in a Petersime battery. Five pens with 4 ducklings per pen were randomly assigned to each of the 3 dietary treatments.

The control diet was a pelleted corn-wheat-soybean commercial duck starter diet (22% crude protein; UCO, Guelph, ON). The submersible diet was prepared by grinding the pelleted starter diet in a hammermill through a 2 mm screen. The powdered feed was thoroughly mixed with 2% by weight of alginate (Sanofi Bio- Industries, Mississauga, ON) in a Hobart mixer. Sufficient water was added to produce a firm dough (1 3L per 20 kg feed) and the resulting mixture extruded through a food grinder with the cutter removed, using a plate with 4 mm diameter holes. The resulting strands were immersed in a 5% calcium chloride solution, drained, spread evenly onto metal trays and dried at 60°C in a forced-air oven. The dry strands were crumbled by hand into pellets approximately 2.5 cm long.

All pens of ducklings received the 22% duck starter diet for the first 4 days. Those pens allocated to the submersible diet then received their new diet for a 3-day acclimatization period. In one treatment, 5 pens received the dry submersible diet fed conventionally in place of the starter pellets. In the other, sufficient feed to amply meet the estimated needs for a day were placed in the feeding trough and sufficient water (1.5L) added to completely submerse it. Feed troughs for these birds were emptied, cleaned and refilled daily. Drinking water in a separate trough was constantly available to all pens of birds. The acclimatization period was followed by a 4-day collection period when feed intake, weight gain and excreta production were monitored. For the Control and dry submersible diet, feed was weighed at the beginning and end of the collection period and the intake per pen calculated by subtracting the weight of spilled feed, which was minimal. Since the dabbling action of the ducks broke up the submersible feed, troughs were emptied and refilled every 8 hours throughout the collection period. Feed intake was calculated by weighing the total dry feed placed in the trough and subtracting waste feed from this. Waste feed is was determined by pouring the leftover feed and accompanying water into a separate large container for each pen, which was left in a cooler for the duration of the trial, while waste feed settled to the bottom. At the end of 4 days the clear supernatant layer was carefully decanted off and the remaining slurry of waste feed oven dried at 110°C to obtain the dry weight for each pen. Ducklings were weighed at the beginning and end of the collection period. The excreta produced was collected daily for the 4 days and oven-dried to constant weight. The total dry excreta per pen was retained for analysis.

Excreta collected and samples of the control and submersible diet were ground in a Wiley mill and analyzed for gross energy by bomb calorimetry, nitrogen by the macro Kjeldahl method and analytical dry matter by oven-drying.

Metabolizable energy (ME) and nitrogen corrected ME (ME_n) values were calculated for each pen (Scott et al., 1982) using a correction value of 8.22 kcal/g nitrogen retained. Apparent dry matter digestibility (DMD) was calculated as dry feed intake corrected for dry excreta production per pen.

Data were subjected to ANOVA and differences between means compared using Duncan's multiple range test at the $p < .05$ level of significance. (Steel and Torrie, 1960).

RESULTS

Performance parameters of ducklings receiving the 3 dietary treatments are show in Table 1. Birds grew equally well on the 3 diets. However, those fed the submersed diet had a higher feed intake ($P < 0.05$), resulting in an overall lower efficiency of feed utilization ($P < 0.05$), measured as the gain:feed ratio. The DMD was the same for all 3 diets but ME was significantly lower for the submersed diet than the other two ($P < 0.05$) .This difference disappeared when energy availability was expressed as ME_n. Excreta moisture was not affected by diet treatment, implying that the gel-forming characteristics of the alginate had not affected water resorption in the hindgut.

DISCUSSION

Formulating a diet containing 2% alginate treated with calcium chloride solution after extrusion gave a submersible product which showed excellent durability. The concern addressed by this study was that the stable gel structure formed by the alginate-calcium complex would adversely affect the metabolizability and nutritional quality of the diet. No such effect was evident, since the submersible product fed dry produced no difference in any of the performance parameters measured when compared to the control duck starter diet. Differences were observed when the alginate-calcium treated diet was fed submersed, however, primarily in feed intake, which was 14% greater than the control diet. This may reflect error in estimating true feed intake by ducklings receiving the diet in water. The dabbling action of the ducks resulted in disintegration of some of the submersed diet. Though intake was corrected for the unconsumed feed and particulate matter remaining in the feed trough, soluble components may have been lost when decanting the supernatant water. Since these would be assumed to have been ingested by the birds, intake may be inflated. However, laboratory trials prior to the feeding experiment showed only 10% disintegration of the submersible diet over a 10 hour period, with most of the disintegrated material recoverable as particles. The possible error due to dissolution is estimated to be only a few percent, not the 14% observed. It is also possible that the greater intake was an attempt to compensate for the significantly lower ME of the submersed diet. Again, this seems unlikely, since both DMD and ME_n did not differ between diets, implying very similar efficiency of utilization. An alternative explanation is in the pattern of energy expenditure by the birds. Since birds grew equally well, the energy expended in productive processes was presumably similar. However, from observations of feeding behaviour, the activity level of the ducklings receiving the submersible diet was clearly higher than those fed the dry submersible or duck starter diets, though no attempt was made in the present study to quantify this effect. The energy expended in the greater exploratory and ingestive activity may account at least in part for the higher feed intake observed. Though this may have reduced the efficiency of feed use, compared to the other methods employed, the stimulus provided by feeding a submersed diet more closely approximates the natural feeding behaviour of ducks and would be a benefit in wildlife and zoo displays.

CONCLUSION

The use of an alginate-calcium complex to prepare a durable submersible diet gives a product which encourages normal feeding behaviour without compromising the growth performance of rapidly growing ducklings. Given its ability to support birds at this demanding stage of the life cycle, such a diet would certainly be appropriate for more mature birds fed at maintenance level. The technique would also be appropriate for formulating diets for other semi-aquatic and aquatic species.

REFERENCES

Andrew, T.R., Macleod, W.C. Application and control of the algin-calcium reaction. FOOD PRODUCT DEVELOPMENT, 4:99-1041 1970.

Bellrose, F.C. DUCKS, GEESE AND SWANS OF NORTH AMERICA. Harrisburg, PA., Stackpole, 1980.

Crissey, S., Stevens, E., Cusimano, F., Derrickson, S. A submersible diet for ducks to control disease and cost. JOURNAL OF ZOO AND WILDLIFE MEDICINE, 20:68- 72, 1989.

Scott, M.L., Nesheim, M.C., Young, R.J. NUTRITION OF THE CHICKEN. Ithaca, N.Y., M.L. Scott and Associates, 1982.

Steel, R.G.D., Torrie, J.H. PRINCIPLES AND PROCEDURES OF STATISTICS. New York, McGraw-Hill, 1960.

TABLE 1. Performance of ducklings fed conventional and submersible diets[1]

Performance parameter	Diet treatment		
	Duck starter	Submersible diet (dry)	Submersible diet (wet)
Weight gain (g)	1172	1105	1179
Feed intake (g)	1464[a]	1466[a]	1667[b]
Gain:feed ratio	0.80[a]	0.75[ab]	0.71[b]
Dry matter digestibility (%)	82	83	84
ME (kcal/g DM)	3.47[a]	3.48[a]	3.38[b]
ME_n (kcal/g DM)	3.26	3.28	3.20
Excreta moisture (%)	86	86	85

[1]Means of 5 replicate pens, 4 ducklings per pen for 4d collection period.
[a,b]Means in rows with differing superscript letters are significantly different ($P < 0.05$).