A NUTRITIONAL AND FINANCIAL EVALUATION OF BREEDING AFIRICAN GREY PARROTS (*Psittacus erithacus*).

by

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PREFACE

The experimental work described in this dissertation was carried out at Shady Streams Bird Farm, from the 24th of November 2001 to 11th of December 2001, under the distance education program at Stellenbosch University. The supervisor was Dr. Mariana Ciacciariello.

These studies represent the original work by the author and have not been submitted in any other form to another university. Where use was made of the work by others, it has been duly acknowledged in the text.

David Thomas Dennison
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SUMMARY

African Grey Parrots are now being bred on a commercial scale in South Africa, mainly for the export market. In order to produce the best breeding results it is necessary to formulate balanced diets but no research has been done on the feeding value for African Grey parrots of ingredients used in formulating diets. Once the apparent metabolisable energy (AME) of extruded maize for African Greys has been established it will be possible to calculate the AME of other ingredients such as full fat soya, soya oil cake or sunflower oil cake. By feeding an extruded mix containing a known amount of maize mixed with a known amount of soya oil cake and establishing experimentally the AME of the mix, the AME of soya oil cake for African Greys can be calculated by difference. This information will make it possible to decide whether AME results obtained for poultry can be used in formulating diets for African Grey parrots.

The study consisted of two parts where the determination of the apparent metabolisable energy (AME) of extruded maize and the practical application thereof in formulating parrot diets, and the economic viability of a commercial African Grey parrot breeding operation was investigated. A reference procedure adopted by several European laboratories for the *in vivo* determination of metabolisable energy (ME) was used to determine the apparent metabolisable energy (AME) of extruded whole maize for African Grey parrots. The long term goal is to make a well balanced, extruded diet for these birds. Extruded maize is the form in which maize is generally included in commercial parrot diets and was therefore chosen as the experimental feed. Maize can be conveniently extruded with other single ingredients such as full fat soyabean meal, soyabean oil cake meal or sunflower oil cake meal to determine, by difference, the AME of those ingredients. For the first part of the study, ten, 3-year-old African Grey parrots were individually housed and fed in cages designed to facilitate collection of the faeces. Cage design varied between a tall type (n=6) and a low type (n=4). The parrots were acclimatized to their new environment before the trial commenced to ensure normal feeding behaviour.

The average AME value established for the ten African Grey Parrots was 16.8 MJ/kg. In the trial it became apparent that it is very difficult to get consistent results with the cages used and a modified cage design is proposed for the future.

The second part of the study investigated the economic viability of breeding African Grey parrots commercially, with extruded maize as part of their diet. It was generally concluded that the breeding of African Grey parrots for the pet market can be considered as an economical venture.

OPSOMMING

Afrikaanse Grys papegaaie word nou op 'n kommersiële skaal, hoofsaaklik vir die uitvoermark, geteel. Om die beste broeiresultate te verkry, is dit noodsaaklik om gebalanseerde diëte te formuleer maar tot sover is geen navorsing gedoen van die voedings waarde van bestanddele wat gebruik word in die formulering van diëte nie. As die waarskynlike metaboliseerbare energie (WME) van geëkstrueerde mielies vir Afrikaanse Grys papegaaie bepaal is, sal dit moontlik wees om die waarskynlike metaboliseerbare energie (WME) van ander bestanddele soos volvet soja, sojaoliekoek of sonneblomoliekoek te bepaal. Deur 'n bekende hoeveelheid mielies gemeng met 'n bekende hoeveelheid sojaoliekoek te voer, en die WME van die mengsel eksperimenteel te bepaal, kan die WME van sojaoliekoek, deur middel van verskille, vir Afrikaanse Grys papegaaie bepaal word. Hierdie inligting sal dit moontlik maak om te besluit of die WME resultate wat vir pluimvee verkry is, gebruik kan word in the formulering van diëte vir Afrikaanse Grys papegaaie.

In die studie is die bepaling van die waarskynlike metaboliseerbare energie (WME) van geëkstrueerde mielies en die toepassing daarvan in die formulering van papegaai diëte, asook die ekonomiese lewensvatbaarheid van 'n Afrikaanse Grys papegaai broeiery, ondersoek. Vir die eerste deel van die studie is tien, 3-jaar oue Afrikaanse Grys papegaaie gebruik. Die papegaaie is in onderskeidelik groot regop (n=6) en kleiner reghoekige (n=4) hokke aangehou.. Die ontwerp van die hokke die versameling van mis gefasiliteer. Die papegaaie is toegelaat om te akklimatiseer om enige abnormale vreetgedrag tydens die studie te voorkom. 'n Verwysingsprosedure wat in verskeie Europese laboratoriums gebruik word, is vir die bepaling van die waarskynlike metaboliseerbare (WME) energie van geëkstrueerde mielies gebruik. In kommersiële papegaai rantsoene word mielies in die geëkstrueerde vorm ingesluit. Mielies kan ook saam met ander grondstowwe soos volvet soja, sojaoliekoek of sonneblomoliekoek geëkstrueer word om dan deur middel van verskille, die waarskynlike metaboliseerbare energie (WME) te bepaal.

Die gemiddelde WME waarde wat vir die tien Afrikaanse Grys papegaaie vasgestel is, was 16.8 MJ/kg. In die proef het dit duidelik geword dat dit baie moeilik is om konstante resultate met die hokke wat gebruik is, te kry, en 'n gemodifiseerde hok ontwerp word vir die toekoms voorgestel.

Die tweede deel van die studie het die ekonomiese lewensvatbaarheid van 'n Afrikaanse Grys papegaai broei-eenheid ondersoek. Daar is getoon dat die kommersiële aanteel van Afrikaanse Grys papegaaie 'n goeie ekonomiese lewensvatbaarheid het en dat dié papegaaie winsgewend vir die troeteldiermark geteel kan word.

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Chapter 1

Determination of AME for extruded maize in African Grey parrots using a common European reference procedure.

1.1 Introduction.

In the past few years there has been a move to captive-breed parrots and other psittacine species to supply the pet market. This, in turn, has resulted in a need to supply captive birds with formulated diets with a view to improving their health and captive breeding results. Although parrots have been kept as pets for hundreds of years, they have in the past been fed diets consisting mainly of oil seeds like peanuts, sunflower seed, safflower seed and many other nuts as are available. In the last fifteen years parrots have become more expensive due to their increasing rarity in the wild following large-scale habitat destruction and trapping in their home ranges. It has been reported that some endangered species are still being trapped for the local cage bird trade in Indonesia but the main reason for their decline is deforestation (Low, 2001). At first the decline of parrot populations was blamed on capture for the American and European pet trade and this was partially true. What was not realized at first was that the simultaneous destruction of the habitat was forcing the parrots into closer contact with humans who were then able to trap them more easily.

Conservationists are working to preserve habitat and wild populations. Breeders need to focus on producing healthy, tame captive bred young parrots for pets to prevent wild caught birds entering the pet trade. Captive bred parrots make far superior breeding birds or pets than do wild caught birds because they are far less stressed in human company (Low, 1992). Many customers are willing to pay more for a hand reared parrot for a pet as it is already imprinted on humans as companions. Further, international protection for some of the popular species makes aviculture the only legal source of these birds as pets or potential breeding stock (Clubb *et al.*, 1992).

To achieve captive breeding success a number of questions must be addressed. How long is the breeding season? Is the bird a year round breeder, or does it have a short breeding season and, if so, at what time of the year? The answer to many of these questions can be found in text books such as "Parrots of the World" by Foreshaw (1973). In this book the breeding season for each parrot species is recorded. This information is invaluable to breeders as they need to know when to provide nests for breeding pairs and when to bring the birds from a maintenance diet to a breeding diet. All species of parrots do not breed at the same time of the year. The breeding season will relate to that time of the year when conditions are optimal for the survival of the young of that species (Immelmann, 1971). The cue could be rain, the availability of food or daylength. Many parrot and parakeet species begin to breed in spring when the increasing daylength is the *Zeitgeber* (Welty, 1982).

In the tropics the seasonal difference in day temperature is often less than the difference between day and night temperatures. Therefore these birds would not require a high energy diet in winter in their home range. However, in captivity these birds are kept in temperate and northern climates often in unheated aviaries. In South Africa keeping parrots in unheated aviaries is normal practice. Under these conditions parrots and parakeets will need high energy winter diets. How the birds respond to the ingredients in their diet depends on the dietary strategy that specie has evolved. In the wild the Hyacinth Macaw (*Anodorhynchus hyacinthinus*) eats mainly palm nuts, followed by seeds, fruits and vegetable matter. They have also been observed eating snails (Roth, 1979), so they probably take other insects and molluscs from time to time. At the other extreme we have the Red Lory (*Eos bornea*) which in nature eats nectar, pollen, fruit, blossoms and insects (Stresemann, 1914). At present much work needs to be done on the absorption of various dietary ingredients in captivity.

Another problem faced by the nutritionist when it comes to formulating diets for these birds is that most bird keepers maintain mixed collections of parrots and parakeets and there could be ten to fifteen or more species in the collection and not more than two or three pairs per specie. The nutrient requirements of the species differ from each other as do quail, partridges, guinea fowl, pheasants and chickens.

Up to 15 years ago, most feeds had been formulated empirically by aviculturists who observed breeding birds in captivity and adjusted the diet until acceptable breeding results were obtained. Feed companies manufacturing extruded diets for psittacines formulated their diets by applying data for poultry, with little if any allowances for the specific needs of psittacines. Unlike chickens that swallow their seeds whole, parrots and parakeets de-hull the seeds and nuts they eat and then, with their powerful beaks, reduce them in size to suit themselves. This means a lower fibre intake (Wolf & Kamphues, 1995) and often the crushing applied aids digestion.

Parrots like pigeons have a relatively shorter digestive tract than chickens (Kakuk, 1991). In nature parrots eat seeds with higher oil content, e.g. palm nuts and mimosa seeds, than do most Galliformes. Therefore, it might be expected that the efficiency of digestion of the various nutrients might differ from that of chickens. The AME values for most domestic ingredients in pigeon foods are much the same as for poultry or a little higher (Hullar *et al.*, 1999). However, the digestibility of carbohydrates (nitrogen free extract, NFE) was lower in pigeons than for chickens, while the ether extract (EE) for pigeons was greater than that for chickens. (Goodman & Griminger, 1969) suggested that pigeons could use lipids more efficiently as an energy source than carbohydrates.

In growing or producing birds it would be necessary to test protein retention by subtracting the total energy value of nitrogen retained from the total energy value of the nitrogen in the food. This would give by difference, the energy retained in the form of protein that was not metabolised as energy but retained in tissue anabolism or egg production. As these African Greys in the test were fully grown and not producing, the figure for retained nitrogen can be expected to be small (Hayes & Saunders - personal communication).

Hagen (2001) found that the mean daily existence energy for Goffin's cockatoos under caged, maintenance conditions was 48 kcal/bird/day or 184 kcal/day/kg body weight. This was about 2.2 times the basal metabolic rate (BMR) predicted for these birds from their body weight of 0.26 kg. This could have been due to the fact that the Goffin's were kept in a climate controlled room at 18° C and a 50% relative humidity (RH). Hagen recorded that the thermoneutral zone for Green-cheeked Amazon parrots (*Amazona viridigenalis*) was 26.5° C to 35° C. As Goffin's cockatoos come from a similar tropical environment, he suggested that Goffin's cockatoos probably had to expend considerable energy to maintain body temperature, when held at an ambient temperature of 18° C. This temperature is below the lower critical temperature (LCT) for adult laying hens whose thermoneutral temperature range is from a LCT 20° C to 25° C, the upper critical temperature (UCT) (Hayes, personal communication). Between these two temperatures chickens expend minimal energy on maintaining body temperature. At a constant body temperature, sensible heat loss equals heat generated by the bird. Below the LCT the bird has use energy to generate heat to maintain body temperature and above the UCT the bird has to actively use energy to decrease its body temperature (Dawson, 1958).

The BMR is not the same as the metabolisable energy (ME) requirement for maintenance. The ME for maintenance includes BMR + heat increment + thermoregulation + activity of gathering food and water. Free-living non-passerines commonly have a ME requirement that averages 2.5 times their BMR to forage for food and water, travel to roosting sites and thermoregulate (Nagy, 1987). By comparison, chickens have a daily ME requirement that only exceeds BMR by 50% (Klasing, 1998).

Using the constant 308 for non-passerines to calculate the BMR for the African Greys with an average weight of 500g it was found that the energy expended was approximately 2.13 the predicted value for their BMR. This is lower than the 2.5 times BMR for free living non-passerines (Nagy, 1987) and can be expected for such bird in confinement.

1.2 Life stage diets

Parrots in captivity are limited to the diet that they are fed and cannot adjust their nutrient intake to meet their life stage dietary requirements. It will, as a result, be necessary to produce diets to meet these requirements as is done with poultry. That is, a diet for maintenance, another for breeding (up to egg laying) and then rearing – especially hand-rearing.

Parrots lay an egg every second day so this means that the increase in daily energy requirements will not be more that 40% of normal daily requirements while essential amino acid requirements are not likely to be more than twice the maintenance requirements (Ricklefs, 1974). Therefore, parrots requirements for laying can be obtained from the diet rather than endogenously (Klasing, 1998). Of special concern are the nutritional requirements in the hot summer months as opposed to the cold winter months. None of these parrots are housed under controlled temperatures so they are exposed to large variations in ambient temperature. With artificially made diets, balance to suit the time of the year becomes important as the birds can no longer be selective and adjust their nutrient intake. This can lead to an excess intake of other nutrients such as protein during cold weather when the parrots are eating extra food for the energy. An excess of protein, even when well balanced in all amino acids, leads to a reduction in body fat as the excretion of the resulting uric acid requires approximately twice as much energy as the equivalent nitrogen excreted as urea (Mapes & Krebs, 1978). It will also lead to an increase in water intake in order to excrete the higher levels of uric acid in the blood. This leads to wet droppings (Scott, 1971). High levels of protein also produce classical symptoms of stress as can be seen by an increase in the size of the adrenal glands (Scott, 1971). Growth retardation in growing chicks on diets with high total protein is a result of reduced net energy resulting from an increase in gluconeogenesis.

1.3 Altricial *vs.* precocial

When formulating diets for parrots it must be kept in mind that African Grey parrots and other psittacines are altricial as opposed to the chicken, which is precocial. Altricial birds feed their chicks regurgitated food, which will have been soaked in the parents crop (Klasing, 1998). The newly hatched altricial chick has weak muscle development and a large digestive tract. When hand fed or parent fed, with a well balanced easily digested diet, they are capable of very rapid growth (Klasing, 1998). The seeds they eat will have been dehulled by the parents and can thus be expected to contain less fibre than for whole milled grains. While enzymatic digestion does not occur in the crop of parrots (Welty, 1982), the process of extrusion increases the digestibility of the protein in the diet (Srihara and Alexander, 1984) and the starch in the diet (Björck *et al.*, 1984) to the advantage of these altricial babies.

1.4 Apparent Metabolisable Energy from extruded maize

The reason for the determination of the (AME) for extruded maize is that the extrusion process breaks down long chain polysaccharides into shorter chain polysaccharides, thus increasing the digestibility for monogastic animals. Therefore extrusion, by improving the digestibility, could account for a difference in AME between raw maize and extruded maize for monogastric animals (Björck *et al.*, 1984).

Using the AME of extruded maize and then extruding maize with a calculated percentage of another ingredient such as soya oil cake, sunflower oil cake or any other ingredient the actual AME values of the different domestic ingredients can be established by difference. These values can then be used to formulate diets for parrots more accurately. This will need to be followed by research on comparative values for protein and if possible, amino acid requirements. To deduce the birds' actual nutritional requirements from observations on what they eat in the wild is not practical, hence the need to establish figures for available ingredients under local controlled conditions.

1.5 Materials and Method.

To determine the AME of extruded whole maize for African Grey parrots, a common European reference procedure for the determination of AME in poultry was used (Bourdillion *et al*., 1989). Ten 3-year-old African Grey parrots were used in the trial. They were individually housed in weld mesh cages, six tall (500 mm x 500 mm x 900 mm) and narrow and four approximately the same size but horizontal (900 mm x 500 mm x 460 mm) (Plates 1.1 and 1.2). Parrots are easily stressed by being placed in unusual accommodation therefore the birds were transferred to the experimental cages one month before the trial was to start and fed their usual diet.

The whole maize to be tested was extruded on an Instapro extruder, milled and graded into 1 mm crumb size on a Maize Master roller mill. The birds were fed *ad lib* on the whole maize crumb for 72h. After this period the feed hopper was removed at 4 pm on the third afternoon and replaced at 9 am the next morning. The ten birds were each offered 30 g of maize crumb per day for 5 days, split into two feeds at 9 am and 1 pm. The residual and spilled feed was collected and weighed daily for each parrot for 5 days. The total feed wasted by each parrot was subtracted from the 150 g fed over the 5 days and the amount eaten calculated by difference. Twenty four hours after the first 9am feed the faeces were subsequently collected from each bird daily at 9 am, added to the previous day's collection for that bird and dried in a Defy fan oven at 80°C. On the fifth day the total collected faeces for each bird was dried once more to constant weight at 70° C in a Defy fan oven and the final weight recorded for each bird.

A sample of the maize crumb diet used was also dried to constant weight at 80°C to determine the moisture content. The total amount of maize eaten by each bird was calculated by difference, as described in the paragraph above, and corrected for the moisture content. This corrected value was then used to determine the GE of the food intake.

The GE (gross energy) of the maize and the faeces collected from each of the ten parrots was determined by the Department of Animal Science, University of Stellenbosch, using an adiabatic bomb calorimeter.

1.5.1 Calculation of apparent metabolisable energy (AME)

AME = {(GE maize x dry weight of maize eaten) – (GE faeces x dry weight of faeces)}/dry weight of maize eaten

TME = GE food eaten – (GE faeces – EEL)

TME = GE food eaten – GE faeces + EEL

TME = AME + EEL

As the parrots were mature and not growing or producing in any way the correction between TME and AME for EEL could be expected to be small, between 2 – 5% (Guillaume & Summers, 1970). The parrots were not weighed individually during the experiment but were weighed as a group. There was no significant weight change during the experiment. The average weight was 0.5kg

1.6 Results

Table 1.1 Total maize fed g, total dry faeces collected over 5 days g, wasted food collected per day g, and total feed wasted per parrot for 5 days.

Parrot – 150 g feed/5day	Total dry faeces g in 5days	Wasted feed g day 1	Wasted feed g day 2	Wasted feed g day 3	Wasted feed g day 4	Wasted feed g Day 5	Total Feed wasted g
1 – 150	9.86	5.55	4.40	5.58	7.44	7.90	30.87
2 – 150	5.78	5.29	5.27	2.98	5.43	5.24	24.21
3 – 150	9.11	0.21	4.97	1.48	3.09	3.45	13.20
4 – 150	12.05	4.44	0.00	5.12	1.16	5.07	15.79
5 – 150	11.45	8.37	8.56	7.13	3.58	7.92	35.56
6 – 150	12.07	1.30	4.50	3.86	3.48	4.59	17.73
7 – 150	9.90	3.05	5.20	3.47	3.48	10.97	26.17
8 – 150	14.74	3.88	3.72	5.36	4.97	6.92	24.85
9 – 150	10.18	6.85	4.94	8.25	5.87	8.08	33.99
10 – 150	5.62	10.91	5.55	8.47	10.03	9.90	44.86

The percentage of dry material was calculated as follows:

385.23 g maize crumb was dried in a defy fan oven at 80º C to a constant weight of 360.61 g.

360.61 ÷ 385.23 x 100 = 93.17%

Table 1.2 Maize crumb eaten g (col. 1 – col.8 in **Table 1**), dry wt. maize eaten, av. per day

	Maize eaten g/5days	Dry weight g/5day	Av. eaten/day g dry wt.
Parrot 1	119.13	110.99	22.20
Parrot 2	125.79	117.20	23.44
Parrot 3	136.80	127.46	25.49
Parrot 4	134.21	125.04	25.01
Parrot 5	114.44	106.62	21.32
Parrot 6	132.27	123.24	24.65
Parrot 7	123.83	115.37	23.07
Parrot 8	125.15	116.60	23.32
Parrot 9	116.01	108.09	21.62
Parrot 10	105.14	97.96	19.59

Table 1.3 GE of maize and parrot faeces determined at the department of Animal Science, Stellenbosch University, using the adiabatic Bomb Calorimeter.

SAMPLE	GE MJ/kg	AVERAGE
Extruded maize	18.222	18.215
"	18.186	
"	18.192	
"	18.268	
PARROT 1 FAECES	16.155	16.194
"	16.232	
PARROT 2 FAECES	16.232	16.179
"	16.126	
PARROT 3 FAECES	17.049	16.932
"	16.815	
PARROT 4 FAECES	15.842	15.935
"	16.026	
PARROT 5 FAECES	16.348	16.356
"	16.363	
PARROT 6 FAECES	16.472	16.339
"	16.205	
PARROT 7 FAECES	16.164	16.251
"	16.337	
PARROT 8 FAECES	15.854	15.893
"	15.931	
PARROT 9 FAECES	16.224	16.212
"	16.199	
PARROT 10 FAECES	16.248	16.21
"	16.172	

The above tables contain the results which can now be used in the equations shown below.

AME Parrot 1 = (GE maize x dry wt. eaten g/day – GE faeces x dry wt. faeces g/day) ÷ dry wt. maize eaten g/day

= {18.22 x 22.2 – 16.19 x (9.86 ÷ 5)} ÷ 22.2

= 16.78 MJ/kg

AME for maize for Parrots 2 to 10 were calculated in the same way giving **Table 1.4.**

Table 1.4 AME for extruded maize calculated for each of the ten parrots.

Parrot	AME MJ/kg
1	16.78
2	17.42
3	17.01
4	16.68
5	16.46
6	16.62
7	16.82
8	16.21
9	16.69
10	17.29
Average	16.80
Std. Dev.	0.362

Average AME for maize for African Grey parrots 16.80 MJ/kg

1.7 Discussion

In the case of the African Grey parrots in the present experiment, it was found that they spent a great deal of time climbing around in the cages. They did not spend much time on the floor of the cages, except to eat and drink. At any time on entering the facility, the majority of the parrots would be found hanging from the wire near the top of the cage (**Plate 1.1** & **Plate1.2**). In this position they would expend considerably more energy than a resting, perching bird. At the time of the experiment, December 2001, the night temperatures varied between 20° C and 22° C. The day temperatures were from 27° C to 30° C. As African Grey parrots are tropical birds, they would have been in their thermoneutral zone most of the time and should, therefore, have used least energy relative to their body weight to maintain their body temperature.

Plate 1.1 African Grey AME experiment, tall cages 900 mm x 600 mm x 600 mm.

Plate 1.2 African Grey AME experiment, low cages 500 mm x 500 mm x 800 mm.

To deal with the behavioural problems of the parrots the method normally used for chickens had to be modified for the following reasons:

- Initially there was a perch in each cage. Due to possible boredom the parrots chewed their perches mixing wood chips in the faeces to be collected. The perches were removed from each cage.
- The parrots disliked the dry extruded maize and therefore carried the crumbed maize to their water dishes and dunked the maize in the water to soften it to their liking. This made it impossible to recover the uneaten maize accurately.
- Therefore the maize hopper had to be put into the cage at 9.00am and the water removed. At 10.30am the maize was removed from the cage and the water dish replaced. At 1.00pm the water dish was removed and the maize replaced until 16.30pm when the maize was taken out once more and the water dish returned. This meant that the parrots had no access to maize between 4.30pm and 9am the next day.
- The parrots did not enjoy eating the dry cooked maize and had trouble swallowing it in some cases. Although they were well used to eating the dry maize by the time the collections were done. All spilt crumbs were collected on the plastic sheet under the cage and added to the residual crumbs in the hopper.
- Excessive wastage took place when the crumb size was about 2.5mm. On reducing the crumb size to 1mm there was less wastage.
- Cage size was found to be too large for this work. The birds could occasionally eject faeces beyond the collecting area when hanging at the top of the cage. In the case of the lower cages the faeces were spread out over a large area, which was also not desirable.
- It was observed, in our experiment, that when the crumb size was reduced from 2.5mm to 1mm diameter, much less food was spilt.

In future cages 300 x 300 x 300 should be constructed with the food hopper outside the cage and a water drinker nipple such as used for chickens. This should simplify similar experiments in the future.

Chapter 2

Study on the economic viability of commercially breeding African Grey Parrots (*Psittacus erithacus*)

2.1 Introduction

In the introduction of chapter 1, it was mentioned that there is a need to captive breed as many species of psittacine as possible. To achieve this correct feeding for different life stages is necessary and a beginning has now been made to understand these requirements. In the last ten years some breeders have begun to specialize in single species for commercial breeding. This has happened with Indian Ringneck parakeets and African Grey parrots. To address these questions for African Grey parrots a case study was conducted on Shady Streams Bird Farm. Shady Streams Bird Farm houses 300 pairs of parrots and the construction of a new house formed the basis of the study. This case study was undertaken to establish the economic viability of such a project.

2.2 Housing requirements

2.2.1 Cages

The ideal cage size is one that provides the best breeding results, while providing sufficient space for exercise to keep the breeding birds fit and healthy. On Shady Streams Farm the best results were achieved in cages 0.90 m x 0.90 m x 2.7 m and 1.2 m x 1.2 m x 2.4 m. These cages are usually suspended 1.0 to 1.2 meters above the ground. The cages are constructed from welded mesh of 1.6 mm diameter wire with spaces 13 mm x 25 mm so as to exclude rodents. The cages are arranged "herring-bone" fashion on either side of a central aisle (see Plate 2.2). One third of the cage protrudes into the open with two thirds being covered by the roof. Then whole structure is then covered with hail cloth to exclude wild birds and bees. The wild birds are potential vectors for the spread of disease, while the bees are known to take over nest boxes and sting the occupants to death.

These "suspended cages" are currently the best choice for a commercial breeding venture and have become the accommodation of choice in the United States of America (Low, 1986). As in poultry, if the birds are to be housed in one place for a long time the less contact they have with the floor the better. Limited exposure to the cage floor will minimize the risk of parasites as well as bacterial and fungal infections.

2.2.2 Aviaries

Some aviculturists still prefer the traditional aviary that is built to the ground, believing that they provide more exercise for those species that normally forage on the ground instead of obtaining their food in the trees. Some find them more aesthetically pleasing and feel that they give the bird more space (Johnson & Clubb, 1992). In a commercial venture where the concentration of birds is much higher than in domestic enclosures risk of internal parasites, bacteria and fungal infections could outweigh all other considerations making aviaries the least desirable accommodation.

2.2.3 Visual Barriers

At the beginning of the breeding program it was discovered by accident, that African Grey parrots needed visual barriers between pairs in adjacent cages for successful breeding. This has subsequently been confirmed in many breeding collections in America, England and South Africa and has now become standard practice for commercial breeding. This probably results from the fact that in the wild there would be competition for nest sites and they would therefore normally be distant from each other. This would give privacy and minimal interference from other breeding pairs of African Grey parrots. The visual barriers installed in this facility can be seen in Plate 2.1 and Plate 2.2. This house is fitted with 32 breeding cages 900 mm x 900 mm x 2700 mm. The visual barriers are shown as well as the location of the nest boxes and feeding stations.

Plate 2.1 Exterior view of suspended cages showing visual barriers.

Plate 2.2 Interior of house showing suspended cages.

2.3 Selecting breeding pairs

Aviculturists in general want to buy adult breeding birds at a low price. As a result they may initially prefer wild-caught birds because the cost is lower when they are captive bred. While the occasional wild caught pair will produce in the first year, many are non-productive for years. Captive bred birds may produce well but they take several years to reach maturity (Clubb *et al.*, 1992).

2.3.1. Captive bred birds

At Shady Streams, captive bred African Grey parrots begin breeding at 4 to 5 years of age. These birds have now been bred to the fourth generation at this facility. The youngest recorded pair to successfully breed since 1985 was three and a half years old and had been bred at this facility so that their age was confirmed. This can be regarded as an exception but as parrots become more domesticated earlier breeding results may be obtained through selection for early sexual maturation, as has been done with poultry. It has been found that the majority of captive bred parrots will breed between 4 to 5 years of age but they may not be good parents unless they are allowed to socialize with their own species at weaning and are not imprinted with humans. The findings on this farm after hand rearing over 2500 large parrots over 19 seasons suggest that those young birds reared in groups of their own kind and weaned in larger groups of 8 to 20 individuals to maturity, made the best new parents once they became sexually mature.

2.3.2 Wild caught adults

Some breeders prefer wild caught adult African Grey parrots because they can potentially breed in their first year of captivity (Clubb, *et al.*, 1992), in contrast to young captive bred birds which will take 4 to 5 years to breed. However, wild birds, especially parrots are notoriously unreliable breeders. It was found that most commercial breeders (100 to 200 pairs of African Greys) only expect 50% to 60% of wild caught pairs to breed in the first five years of captivity, but some will breed in the first year giving some income, while a percentage never breed at all.

2.4 Feeding systems

For the purpose of this study the same 10 African Grey parrots that had been used in Chapter 1 were used. The birds were fed an extruded commercial diet, such as is used locally and in the USA. The purpose was to evaluate the amount of food consumed per day. That is, consumption and non-retrievable waste, as that will be the total cost of feed to the breeder. In Chapter 1 it was found that the birds consumed 22 g to 27 g of extruded maize per day. In this experiment all ten parrots were housed in a large outdoor aviary (7.2 m x 1.2 m x 1.2 m) which allowed space for normal activity. The birds were fed 500 g per day, allowing 50 gram of extruded pellets per bird per day, split between two feeding stations to minimize competition from dominant birds that might be inclined to prevent more timid birds from feeding. Each day it was noted that although the hoppers were virtually empty (only 40 g of powdery residual food was recovered from the hoppers in 11 days) there were variable amounts of wasted pellets on the floor beneath the cage each day. These wasted pellets could not be reused due to faecal contamination. Collection of the spilt pellets for weighing to determine by difference the exact weight eaten proved difficult as parrots take a pellet in their beak and fly several meters to a perch and then partially consume the pellet or sometimes roll it in their beak and drop it. These pellets are easily contaminated with faeces. Some pellets were taken to the water bowl by the parrots and dunked in the water and left there. It was concluded that the parrots were adequately fed as the spillage seemed to occur as a result of the parrots playing with the uneaten pellets until they had emptied the food hopper. This behaviour could be due to the natural need for these birds to de-hull seeds and nuts and then reduce them to a size to swallow. It will be necessary, under commercial conditions to calculate the daily weight of food required by difference between the amount fed and the amount spilt, to control the wastage of excess food. From the experiment conducted in Chapter 1, it was found that more tests need to be conducted on food particle size to control the wastage of food from the hopper.

2.4.1 Feeding costs – adults

One pair will be fed 100 g per day. This will allow an overage for spillage, weather changes, egg laying and the feeding of babies. At R12,00 per kg it will cost R1,20 per pair per day or R438,00 per pair per year. Feeding extruded pellets represents the highest food input cost but requires very much less labour, than feeding cooked maize, wheat, sorghum, an assortment of legumes and sunflower seed plus a supplement containing essential amino acids, vitamins, minerals and trace elements. This latter method may be cheaper but it is much more labour intensive. In this project extruded pellets will be used as the preferred feed. As the pellets are manufactured to a defined specification the nutrient quality and quantities will be more constant than a home cooked mix.

An African Grey parrot hen will lay a clutch of eggs (3 to 5 but usually 4). It would be best to supply extra food at this time but as it is extremely difficult to predict when laying will commence. The result is that it has not been possible to calculate how much is eaten to produce the clutch of eggs. However, considering that the female only lays an egg every second day, then the extra dietary requirements to lay an egg can easily be obtained from the amount of food otherwise wasted when feeding 50 g per parrot per day. The growth of the oviduct and the synthesis of several yolks are mostly complete before the first egg is laid (Grau, 1984). For species that only lay a few eggs, the amino acid requirements for reproduction are only about twice maintenance for about a week (Klasing, 1998). Once the babies hatch the adults will need to be fed 100 g of *Breeder* pellets (20% total protein, 10% fat) per day. The normal diet is *Maintenance* pellets (16.5% total protein and 8% fat). There will be sufficient food in the 100 g fed to the adults for them to feed the babies at least for the first two weeks. At two weeks of age the babies are taken from the nest to be hand reared in a nursery.

2.4.2 Feeding costs – hand rearing babies

To feed an African Grey baby from 2 weeks of age to weaning (approximately 12 weeks) takes typically 2.50 – 2.70kg of Hand Rearing food at a cost of R40,00 per kg = R108,00 per baby.

2.5 Labour for feeding, watering and cleaning

These results were gathered at Shady Streams research farm. When using suspended cages one labourer can easily prepare the food and water for 100 cages and clean, change nest material etc. If the labourer earns R100.00 per day then the labour cost per cage per day is R1,00 or R365,00 per year per cage. With extra staff for holidays and weekends the labour cost is more realistically R500,00 per cage per annum.

2.6 Cost of building cages

The cost to build a suspended cage 900mm x 900mm x 2700mm is as follows:-

2.6.1 Material cost

900mm wide roll of welded mesh, 30metre long roll = R1209,00

Length of wire required for one cage = 4 sides at 0.9m x 2.7m + 2 ends at 0.9m x 0.9m = 11.34metres,

30m roll of wire 0.9m wide @ R1209,00 per roll = R44,78 per metre

Therefore one cage costs R44,78 x 11.34 = R507,80

.2.6.2 Building cost

Building to accommodate 32 suspended aviaries = 26m x 5m = 130 square metres

Site leveling	@	R 1500,00 (contract)	
36 poles		R 2520,00	Poles: 3.60m x 100mm diam. = R70,00 each
Rafters:		R 3000,00 (quote)	
Roof sheets and ridge:		R 4784,00	
Paint:		R 540,00	
Labour carpenter:		R 3500,00	
Total cost of building		R15844,00	

2.7 Feasibility study for commercial breeding 32 pairs of African Grey parrots

It is assumed that the land is already owned.

2.7.1 Cost of breeding stock

Cost of a pair of African Greys of breeding age	R 4000,00
Cost of 32 pairs of African Grey parrots	R128000,00

2.7.2 Fixed assets

Building	R 15844,00
Cages	R 16249,00
Breeding stock	R128000,00
Total	R160093,00

2.7.3 Annual expenses

Labour	R 16000,00
Feed (adults)	R 14016,00
Feed (128 babies)	R 13824,00
Total	R43840,00

2.7.4 Income

Hand reared, parrots (128 @ R1500 ea.)	R192000,00

2.7.5 Cost of production

Expenses		R43840,00
Depreciation	25% on fixed assets	R40023,00
Total		R83863,00

2.7.6 Profit

Total income	R192000,00
less total expenses	R 83863,00
Net profit	R108137,00

2.8 Conclusion

Most aviculturists questioned confirmed that four babies per annum was considered to be the expected annual yield from active breeding pairs of African Grey parrots. This study shows that there exists an opportunity for individuals and farmers to generate an income or supplement their farming income by establishing a group of breeding African Grey parrots. Exporters confirm that there is an international market for captive bred, hand reared parrots which they are unable to satisfy and they do not see this market becoming saturated as the demand from China is growing annually.

As can be seen from the study above a capital investment of R160 000,00 can produce a net annual income of R108 000,00. It must also be noted that R40023,00 was allowed as depreciation which allows for replacement of stock and equipment. This means that the profit of R108 000,00 is very attainable. During the time this study was being conducted a number of similar operations were visited in KwaZulu-Natal, Free State, North West, Gauteng and Mpumalanga. These varied in size from 10 pairs to 200 pairs of parrots.

It is important for potential investors to realize is that not every housed pair will breed in the first year. This was discussed in sections 2.3.1 and 2.3.2. Therefore it is important for investors to begin such a project while other sources of income are available to them.

Chapter 3

General Discussion

This investigation has shown that there has been very little work done on the determination of the nutritive value of common feedstuffs for exotic birds. The differences shown, in some published papers, between pigeons and chickens in the digestion and utilization of the same feedstuff, leads to the conclusion that there are even greater differences between some of the psittacine species and chickens. Yet the only available figures for feedstuffs when it comes to formulating complete diets, are those for chickens. Therefore, it has become important to understand these differences so that when formulating diets using the matrices for chickens, the necessary allowances can be made for the needs of the exotic birds.

In all birds, mucus, epithelial cells of the wall of the intestine and urinary nitrogen products appear in the excreta as energy. To determine this energy component the birds are fasted, then fed a solution of glucose to stop the catabolism of muscle tissue for energy. The energy in faeces, collected under these conditions, will be the endogenous energy loss (EEL). This leads to the relationship between TME (true metabolisable energy) and AME (Guillaume and Summers, 1970).

At maintenance feeding with adult birds and well balanced diets low in fibre, there is little difference between TME and AME, for chickens (Sibbald, 1981). In this preliminary work no correction was made for nitrogen retention to correct AME for the energy in protein accretion or loss. None of the birds were fed sucrose or glucose solutions in order to determine EEL.

In growing or producing birds it would have been necessary to correct AME for nitrogen retention by subtracting the energy value of the nitrogen in the faeces from the energy value of the nitrogen in the food. This would, by difference, give the energy in the form of retained protein for tissue anabolism or egg production. The African Greys in the test were not growing and not producing.

The challenge for the aviculturist is to provide a mixed collection of psittacines with complete diets or supplementary diets to meet the nutritional demands of a mixed collection during the seasonal cycle and for all life stages. The challenge for the nutritionist is to be able to formulate these diets and describe the processing necessary for their absorption. The potential differences in feeding behaviour and digestive physiology have to be taken into consideration as this will determine their ability to digest and absorb nutrients from the feed. Not all psittacines can utilize common feedstuffs with out careful processing, cooking, baking and extruding. A comparison needs to be done on the digestibility of maize, for example, in the raw ground form and extruded form. The question then arises, to which species does this apply? At Shady Streams Bird Farm it was observed that uncooked millet and crushed maize passed through the lorikeet digestive tract intact, whereas extruded maize did not appear in the faeces and therefore was assumed to be well digested.

Parrots, parakeets and lorikeets are in demand as pets and for hobby breeders due to their interesting behaviour and their beautiful colouring. As part of this project we examined a case study involving the cost of housing and the cost of production of young African Grey parrots. It was shown that for a capital investment of R160 000 a net return of R108 000 could be achieved once all the pairs are breeding. This represents a return of 67.5% on capital and can therefore be considered to be a good business. However, without the right management and the correct nutrition it may not be possible to reach that figure of an average of four babies per pair housed. As the generations pass and the parrots become more domesticated, like lovebirds and Indian Ringneck parakeets, we can expect them to become more reliable breeders and it will then become easier to achieve the result as shown in the case study.

References

Björck, L., Asp, N.G., Birkhed, D. & LundQuist, I., 1984. Effects of processing on availability of starch for digestion in-vitro and in-vivo. I. Extrusion cooking of wheat flours and starch. Journal Cereal Sci. 2:91-103.

Bourdillon, A., Carré, B., Conan, L., Duperray, J., Huyghebaert, G., Leclercq, B., Lessire, M., McNab, J., Rigoni, M. & Wiseman, J., 1990. European reference method for the *in vivo* determination of metabolisable energy with adult cockerels: reproducibility, effect of food intake and comparison with individual laboratory methods. Br. Poultry Sci. 31, 557-565.

Clubb, S.L., Clubb, K.J., & Phillips, S. 1992. Aviculture, an alternative to trade in wild-caught birds. In: Psittacine Aviculture, Eds. Schubot, R.M., Clubb, K.J. & Clubb, S.L. Avicultural Breeding and Research Center, Loxahatchee, USA. pp. 3.1-3.5.

Dawson, W.R., 1958. Relation of oxygen consumption and evaporative water loss to temperature in the Cardinal. Physiological Zoology 31, 37-48.

Foreshaw, J.M., 1989. Parrots of the World 3rd ed.

Foreshaw, J.M., 1989. General notes – Nesting. In: Parrots of the World 3rd ed. Co-published by Bok Books International, Durban, R.S.A.

Goodman, H.M. & Grimminger, P., 1969. Effect of dietary energy source on racing performance in the pigeon. Poultry Science 48: 2058-2063.

Grau, C.R., 1984. Egg formation. In: Seabird Energetics. Eds. Whittow, G.C. & Rahn, H. Plenum Press, New York. pp. 33-37.

Guillaume, J. & Summers, J.D., 1970. Maintenance energy requirement of the rooster and influence of the plane of nutrition on metabolisable energy. Can. J. of Ani. Sci. 50 363-369.

Hayes, J.A. & Saunders A., 2000. True metabolic energy (TME) relationship to apparent metabolic energy (AME). In: Handbook on layer management in South Africa for M.Phil. students in Animal Production Science, University of Stellenbosch. p. 29.

Hagen, M. The metabolisable energy of sunflower seed kernel in Goffin's cockatoo (*Cacatua goffini*). Research performed at: Department of Animal and Poultry Science, University of Guelph, Ontario, Canada. http://shell.pubnix.net/~mhagen/ Research papers.

Hullar, I., Meleg, I., Fekete, S. & Romvari, R. 1999. Studies on the energy content of pigeon feeds I. Determination of digestibility and metabolizable energy content. Poultry Science 78, 1757-1762.

Immelmann, K., 1971. Ecological aspects of periodic reproduction. In: Avian Biology Vol. 1. Eds. Farner D.S. & King J.R., Academic Press, New York. Cited by Welty J.C. In: The Life of Birds 3rd Ed. Saunders College Publishing, Philadelphia.

Johnson T. & Clubb, K., 1992, Aviary design and construction. In: Psittacine Aviculture, Eds. Schubot R.M., Clubb, K. & Clubb, S.L. Avicultural Breeding and Research Center, Loxahatchee, Florida, USA. pp. 4.1-4.12.

Kakuk, T., 1991. Feeding of pigeons. In: Pigeon Breeders Manual, Horn P., Ed. pp 123-148. Mezõgazdasági Kiadó, Budapest, Hungary. pp. 123-148. Cited by Hullar, I., Meleg, I., Fekete, S. & Romvari, R., 1999.

Klasing, K.C., 1998. Comparative Avian Nutrition.

Klasing K.C., 1998. Energy – maintenance requirements. In: Comparative Avian Nutrition, Ed. Klasing K.C., CAB International, New York, USA. p. 216.

Klasing, K.C., 1998. Calculation of the daily energy expenditure for egg production. In: Comparative Avian Nutrition. Ed. Klasing, K.C., CAB International, New York, USA. p. 223.

Klasing, K.C., 1998. Altricial versus precocial development. In: Comparative Avian Nutrition. Ed. Klasing, K.C., CAB International, New York, USA. p.223.

Klasing, K. C., 1998. Amino acids, requirements for reproduction. In: Comparative Avian Nutrition. Ed. Klasing, K.C., CAB International, New York, USA. pp.144-146.

Low R., 1992. Captive bred parrots versus wild caught. In: Parrots. Their care and breeding – 3rd ed. Blandford Press, London. p. 9.

Low, R., 1992. Aviaries. In: Parrots. Their care and breeding – 3rd ed. Blandford Press, London. p. 24.

Low, R., 2001. Philippine Cockatoo hanging by a thread. In: PsittaScene - Magazine of the World Parrot Trust, Vol. 13, No.4, November 2001. pp. 2-3.

Mapes, J.P. & Krebs, H.A., 1978. Rate limiting factors in urate synthesis and gluconeogenesis in avian liver. Biochem. J. 172, 193-203.

Nagy, K.A., 1987. Field metabolic rate and food requirement scaling in mammals and birds. Ecological Monographs. 57, 111-128.

Ricklefs, R.E., 1974. Energetics of reproduction in birds. In: Avian Energetics, Ed. Paynter, R.A.J., Vol. 15. Nuttall Ornithological Club, Cambridge, Massachusetts. pp. 152-292.

Roth, 1979. Cited by Foreshaw, J. In: Parrots of the World, 3rd ed. 1989, Bok Books International, Durban, R.S.A. p.390.

Scott M.L., 1971. Signs and symptoms of excessive dietary levels of protein or essential amino acids. In: Nutrition of the Chicken. Eds. Scott, M.L., Nesheim, M.C. & Young, R.J. M.L. Scott & Associates, Publishers, Ithaca, New York, p. 103.

Sibbald I.R., 1981. Metabolic plus endogenous energy and nitrogen losses of adult cockerels: the correction used in the bioassay for the true metabolisable energy. Poultry Science 60, p.805.

Srihara, P. and Alexander R.A. 1984, Effect of heat treatment on nutritive quality of plant protein blends. Can. Inst. Food Sci. Technol. J. 17, 237-241.

Stresemann, E., 1914. Die Vögel von Seran, Novit. Zool. 21, 25-153. Cited by Foreshaw, J.M., In: Parrots of the World, 3rd ed.1989, Bok Books International, Durban, R.S.A. p. 58.

Welty, J.C., The seasonal reproductive cycle. In: The Life of Birds, 3rd edition. I982. Eds. Brown M., Smith P.L. & Low R., CBS College Publishing, Philadelphia. p. 174.

Welty, J.C., Anatomy of the digestive tract. In: The Life of Birds, 3rd edition, 1982. Eds. Brown M., Smith P.L. & Low, R., CBS College Publishing, Philadelphia. p. 104.

Wolf, P. and Kamphues, J., 1995. Zur Ernähung von Papageien – Fragen und Antworten. In: Jahrbuch für Papageienkunde II - Annual of Parrot Biology. Westarp Wissenschafts-Verlag, Magdebrug. pp. 143-162.