

Qualitative *versus* quantitative feed restriction in Pekin breeder ducks during the rearing period

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Four male and 16 female eight-week old Pekin breeder ducks per pen were randomly allocated to nine deep-litter pens to compare the effects of qualitative (0,35% lysine) and quantitative (60% of a group fed *ad lib*) feed restriction during the rearing period with a control group fed a conventional diet fed *ad lib* on subsequent reproductive performance. At the end of the rearing period a pelleted commercial duck breeding diet was fed *ad lib* to all groups until the end of the experiment at 60 weeks. Significant differences ($P \leq 0,05$) were observed between treatments with regard to 20 weeks body mass, feed consumption from 8–20 weeks, number of days to sexual maturity (50% production) and fertility of incubated eggs. No significant differences were found between treatments with regard to 60 week body mass, feed consumption from 20 to 60 weeks, egg numbers, average egg mass, percentage egg sizes, peak production, terminal production, hatchability of fertile eggs or laying house mortality.

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Vier manlike en 16 vroulike agt-weke-oue Pekin-teeleende per toom is ewekansig toegeken aan nege diepskropgoed-tome om die effek van kwalitatiewe (0,35% lisien) en kwantitatiewe (60% van 'n groep *ad lib* gevoer) voerbepierking gedurende die groeistadium ten opsigte van latere produksievermoë te vergelyk. Die kontrolegroep het 'n konvensionele dieet *ad lib* ontvang. Aan die einde van die groeiperiode het al die groepe 'n verpilte kommersiële teeldieet vir eende *ad lib* ontvang tot aan die einde van die proef op 60-weke-ouderdom. Beduidende verskille ($P \leq 0,05$) is verkry tussen behandelings wat betref 20-weke-liggaamsmassa, voerinnname van 8–20 weke, getal dae tot geslagsrypheid (50% produksie) en vrugbaarheid van eiers. Geen beduidende verskille is verkry tussen behandelings wat betref liggaamsmassa op 60-weke-ouderdom, voerinnname van 20–60-weke-ouderdom, aantal eiers, gemiddelde eiermassa, persentasie eiergroottes, piekproduksie, eindproduksie, uitbroeibaarheid van bevrugte eiers en lêhuismortaliteit nie.

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Introduction

There are two main disadvantages in using quantitative feed restriction to reduce growth rate and delay sexual maturity. Since the amount of food supplied to the ducks must be predetermined the method is time consuming. Secondly, it is difficult to make accurate adjustments to the amount supplied to the ducks consequent to sudden changes in ambient temperature. For this reason it would be preferable to feed *ad lib* a diet designed to have all the advantages of a quantitative feed restriction programme. The most promising diets which will reduce growth rate and delay sexual maturity when fed *ad lib* are a low protein diet (Lillie & Denton, 1966) or a diet that is limiting in one or more of the essential amino acids (Couch & Abbott, 1974).

The object of this experiment was to compare a low protein – low amino acid diet (which will be referred to in the text simply as a low lysine diet) with a quantitative food restriction treatment (60% of *ad lib*) fed to Pekin breeder ducks during the rearing period (8–20 weeks) and to assess the effect of these dietary rearing treatments on subsequent reproductive performance.

Procedure

Pekin breeder ducklings from the Cedara strain were used in the experiment. A commercial crumbled broiler starter diet was fed to all the ducklings from day-old to two weeks of age. This was followed by a pelleted broiler finisher diet up to eight weeks of age, at which stage the body mass of the ducklings was measured before randomly allocating an equal number of female ducklings to each of nine deep-litter pens. Sixteen female and four male ducklings were used per pen.

Treatments were randomly allocated to the different pens. The feed treatments during the rearing period (8–20 weeks) were (1) *ad lib* commercial diet (2) 60% of *ad lib* on the commercial diet as fed in (1) and (3) a low lysine (0,35%) diet. There were three replicates of each treatment. The diet fed during the rearing period in treatments 1 and 2 was a pelleted 14% protein duck developer commercial diet. The amount of feed required for the 60% of *ad lib* group were calculated from the *ad lib* consumption during the previous seven-day period and the restricted birds were fed on alternate days. The low lysine diet was fed *ad lib*. Starting at the end of the rearing period a commercial 19% protein pelleted duck breeders' diet was fed *ad lib* to all groups until the end of the experiment at 60 weeks of age. The body mass of the ducks was measured at 8,20 and 60 weeks of age. Feed consumption was measured weekly throughout the experiment. The low lysine diet con-

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tained the following ingredients: Yellow Maize Meal 78%; Wheaten Bran 2%; Lucerne Meal 17%; Limestone Powder 0,7%; Monocalcium phosphate 2%; Salt 0,2% and Vitamin + Mineral Premix 0,1%. The feed companies supplying the commercial diets were not prepared to divulge the ingredients used and therefore a determined analysis on the three diets is shown in Table 1.

Daily egg production records were kept for each pen, involving an egg count, the mass of each egg and a record of the number of eggs in each of four classes graded according to egg mass. Since there are no officially specified size categories laid down for duck eggs in this country the following masses were used: extra large > 89 g; large 80–89 g; medium 70–79 g; and small, < 70 g. Sexual maturity was regarded as the age at which the ducks reached 50% production.

All the duck eggs were incubated at weekly intervals in a forced draught Mayfair incubator at 37,5°C and 75% R.H. The eggs were turned five times a day and on the 24th day the eggs were transferred to the hatching trays in the same incubator. The hatch was taken off on the 29th day. Egg numbers, infertile eggs, fertile eggs, dead embryos and ducklings hatched were recorded for each of the nine pens.

Each variate was subjected to statistical analysis of variance (Rayner 1967) and least significant differences at $P \leq 0,05$ and $P \leq 0,01$ were calculated.

Table 1 Determined analysis of diets used in the experiment (on an air dry basis)

		Low lysine diet	Duck developer diet	Duck breeder diet
Crude protein	%	10,07	12,60	19,40
Metabolizable energy (MJ/kg)		12,28	10,80	11,80
Calcium	%	0,85	1,00	3,00
Phosphorus	%	0,66	0,55	0,70
Lysine	%	0,35	0,63	0,75
Arginine	%	0,49	0,78	0,84
Methionine	%	0,20	0,28	0,32
Methionine + cystine	%	0,59	0,63	0,66
Tryptophan	%	0,11	0,15	0,19

Results and Discussion

Body mass

The average live body mass figures at 8, 20 and 60 weeks of age are shown in Table 2 as are the ranges in body mass observed at 20 weeks of age.

As the ducklings were randomly allocated to the nine pens the body mass results as expected showed no significant dif-

ferences at eight weeks of age.

At twenty weeks of age the 60% of *ad lib* treatment was significantly different ($P \leq 0,05$) from the *ad lib* and low lysine treatments with respect to body mass. The ducklings on the 60% of *ad lib* treatment were on average 8% lighter than they were at 8 weeks. This difference was less than the 12% obtained in an earlier experiment by Olver, Kuyper & Mould (1978). In the present experiment the ducks fed the 60% of *ad lib* diet were, however, 22% lighter on average than those ducks fed *ad lib*. The ducklings on the low lysine diet were only 1% lighter than those fed *ad lib*. This was unexpected as work by Couch & Trammel (1970) with broiler breeder pullets showed that the average mass of pullets on the low lysine diet (0,42%) were 33% lighter than those fed a diet adequate in lysine (0,70%) from 7–22 weeks of age. Later work by Couch & Abbott (1974) also with broiler breeder pullets obtained a difference in average mass of 20% when compared to a diet adequate in lysine. The diet fed in this present experiment to ducklings was even lower in lysine (0,35%) than those fed by Couch and co-workers (0,42 and 0,40%) and thus a larger difference in average body mass than 1% was expected. Low lysine diets only reduce body mass if the quantity of lysine consumed is well below the requirement of the bird for lysine. The low lysine diet (0,35%) used in the present experiment did not reduce the voluntary food intake of the ducks as much as was expected and the ducks consumed an average of 207 g of feed per day (Table 3). This gave them a lysine intake of 0,72 g/bird/day which was an adequate amount and therefore explains the negligible difference in body mass between the low lysine and *ad lib* fed ducklings. Ducklings consuming an average of 200 g of feed per day would need a lysine level of at least 0,20% in order to consume a daily level of lysine below the daily requirement of the bird. Since it would be extremely difficult to make a practical diet containing less than 0,20% lysine it would appear that quantitative feeding of low lysine diets is necessary, especially when feeding ducks older than eight weeks of age.

At 60 weeks of age there were no significant differences in body mass between treatments although the ducks fed *ad lib* were still the heaviest and those ducks fed 60% of *ad lib* still the lightest. Olver *et al.* (1978) obtained a similar trend. With the low lysine diet, however, Couch & Trammel (1970) obtained significant differences ($P \leq 0,05$) with regard to final body mass between the *ad lib* and low lysine diets fed to broiler breeder pullets. This was not the case with ducks in the present experiment.

The ranges in body mass (the heaviest and lightest duck in a replication) are also shown in Table 2. All the ducks that underwent some form of feed restriction exhibited a more uniform body mass distribution than was the case with the control birds. The greatest uniformity with regard to body mass was obtained by the 60% of *ad lib* ducks whereas the *ad lib*

Table 2 Body mass of ducks (grams) during the experiment

Treatment	8 Weeks	20 Weeks	60 Weeks	Ranges in body mass at 20 weeks of age			Average range in body mass at 20 weeks of age
				Rep. 1	Rep. 2	Rep. 3	
<i>Ad lib</i>	2890 ^a	3405 ^b	3199 ^a	2569–4350	2643–3945	2568–4066	1527 ^b
60% <i>ad lib</i>	2884 ^a	2646 ^a	3021 ^a	2210–3190	2239–3156	2361–3375	970 ^a
Low Lysine	2881 ^a	3379 ^b	3099 ^a	2753–4064	2705–4086	2504–3800	1329 ^b

Means with different superscripts are significantly different ($P \leq 0,05$)

ducks showed the least uniformity. The uniformity of the low lysine fed ducks resembled that of the *ad lib* fed ducks although they were slightly more uniform.

Food consumption

Food consumption of the ducks on the different rearing treatments is shown in Table 3.

Table 3 Average food consumption figures of ducks at different periods during the experiment

Treatment	Food consumption per duck (kilograms)		
	8–20 weeks	20–60 weeks	8–60 weeks
<i>Ad lib</i>	18,4 ^b	52,2 ^a	70,6 ^b
60% of <i>ad lib</i>	12,0 ^a	52,6 ^a	64,6 ^a
Low lysine	17,4 ^b	51,7 ^a	69,1 ^b

Means with different superscripts are significantly different ($P \leq 0,05$).

From 8–20 weeks of age the feed consumed by the ducklings on the 60% of *ad lib* treatment was significantly different ($P \leq 0,05$) from the *ad lib* and low lysine diets. The differences between the *ad lib* and 60% of *ad lib* were obvious as the ducklings were fed a quantitative amount of feed during this period. However, the low lysine diet did not reduce the feed consumption of the ducklings as much as was desired. Couch & Trammell (1970) obtained a difference of 10% of food eaten between the adequate lysine diet (0,70) and the low lysine (0,42) diet for the period between 7 and 22 weeks. This figure is very similar to the figure of 9,5% obtained in the present study. This decrease in food consumed would amount to a small saving in the cost of feed when compared to the more expensive *ad lib* diet.

The food consumed per duck from 20–60 weeks of age was very similar and thus no significant differences between treatments were obtained. It is interesting to note that the 60% of *ad lib* ducks ate slightly more feed during the laying period than did the *ad lib* ducks. This could possibly be explained by the compensatory food consumption that occurred when the restricted ducks were fed *ad lib* and this compensatory period usually lasted for about six weeks before levelling out (Olver *et al.* 1978). Similar food consumption figures for the laying period (20–60 weeks) were obtained by Lee, Gulliver & Morris (1971) with broiler breeder pullets that were fed both quantitative and on low lysine diets during the rearing period.

The feed consumed per duck from 8–60 weeks followed the same trend as it did during the rearing period. The ducks

fed 60% of *ad lib* during the rearing period ate significantly ($P \leq 0,05$) less feed than did the ducks reared on the other two treatments. It is interesting to note that almost the same amount of feed that was saved during the rearing period between the *ad lib* and 60% *ad lib* ducks (6,4 kg) was saved for the duration of the experiment (6,0 kg).

Egg production

The effect of the different rearing treatments on the egg-production characteristics of ducks is shown in Table 4.

The restrictive treatments were responsible for a delay in sexual maturity (measured as days to 50% production) compared with birds fed *ad lib* during the rearing period. However, only the 60% of *ad lib* treatment was significant ($P \leq 0,05$) taking an average of 22 days longer to reach sexual maturity than did the *ad lib* ducks. The low lysine ducks took six days longer than the *ad lib* ducks to reach sexual maturity and this difference was not significant. The figure of six days obtained with ducks in the present experiment was far less than the 26 days obtained by Couch & Trammell (1970) and 10 days obtained by Lee *et al.* (1971) with broiler breeder pullets.

The number of eggs laid per duck was highest for the 60% of *ad lib* reared ducks and lowest for the ducks reared on the low lysine diet although the differences were not significant. The ducks on the 60% of *ad lib* treatment laid an average of three more eggs per duck than those fed the *ad lib* treatment. This is similar to the two-egg difference in average egg numbers obtained in an earlier trial with ducks (Olver *et al.* 1978). Couch & Trammell (1970) obtained no significant differences ($P \leq 0,05$) regarding egg numbers produced by broiler breeder pullets on lysine adequate and deficient diets.

The slight delay in sexual maturity brought about by food restriction caused an increase in average egg mass although it was not significantly so. The eggs from the ducks on the 60% of *ad lib* group were 2,9 g heavier on average than those of the ducks fed *ad lib*. The eggs laid by the ducks on the low lysine treatment were on average 0,7 g heavier than the eggs laid by the ducks fed *ad lib*. Couch & Trammell (1970) obtained a similar figure (0,6 g) with broiler breeder pullets whereas Lee *et al.* (1971) obtained the heaviest egg masses with the *ad lib* fed broiler breeder pullets.

With regard to percentage egg sizes again there were no significant differences between treatments although the delay in sexual maturity of the restricted fed ducks caused them to lay fewer small eggs and more extra large eggs than those ducks fed *ad lib*.

No significant differences ($P \leq 0,05$) existed between the values for peak and terminal rate of lay although the 60% of *ad lib* treatment was the highest in both cases.

Table 4 Sexual maturity, egg production, egg mass, egg sizes and rate of lay in Pekin ducks under different rearing treatments

Treatments	Days to 50% prod.	Number of eggs per duck	Ave. egg mass	Egg sizes %				Peak prod.*	Terminal prod.**
				XL	L	M	S		
<i>Ad lib</i>	164 ^a	92 ^a	82,1 ^a	19,4 ^a	39,3 ^a	33,5 ^a	7,7 ^a	71,0 ^a	31,3 ^a
60% of <i>ad lib</i>	188 ^b	95 ^a	85,0 ^a	26,7 ^a	47,7 ^a	22,3 ^a	3,2 ^a	79,3 ^a	46,0 ^a
Low lysine	170 ^a	87 ^a	82,8 ^a	24,4 ^a	36,6 ^a	31,3 ^a	7,6 ^a	69,0 ^a	37,7 ^a

Means with different superscripts are significantly different ($P \leq 0,05$)

* Rate of lay for best 7 day period

**Rate of lay for last 7 days

Fertility and Hatchability

The results obtained with the incubated eggs are shown in Table 5.

Table 5 Percentage fertility and hatchability of duck eggs

Treatment	Fertility %	Hatchability of fertile eggs %	Hatchability of eggs set %
<i>Ad lib</i>	60,6 ^a	53,4 ^a	32,4 ^a
60% of <i>ad lib</i>	73,7 ^b	54,5 ^a	40,2 ^b
Low lysine	67,2 ^c	55,3 ^a	37,2 ^{ab}

Means with different superscripts are significantly different ($P \leq 0,05$)

The ducks restricted during the rearing period had significantly ($P \leq 0,05$) better fertility than the ducks fed *ad lib*. This was similar to the results obtained by Olver *et al.* (1978) with ducks and Lee *et al.* (1971) with broiler breeder pullets. However, the fertility results obtained with low lysine reared ducks in this present experiment were different from the low lysine results obtained by Couch & Trammell (1970) and Lee *et al.* (1971) with broiler breeder pullets. These latter researchers got better fertility results with the *ad lib* fed diets.

No significant differences were observed between treatments with regard to hatchability of fertile eggs although the low lysine reared ducks achieved the highest hatchability and the *ad lib* reared ducks the lowest.

The hatchability of total eggs set in the incubator more or less followed the same trend as did the fertility results except that the low lysine treatment was not significantly different ($P \leq 0,05$) from the other two treatments. The 60% of *ad lib* reared ducks had significantly ($P \leq 0,05$) higher hatchability of eggs set than did the *ad lib* reared ducks. This was due mainly to the poor fertility experienced by the *ad lib* ducks and this was also noticed in the earlier study with ducks (Olver *et al.* 1978).

Mortality

There was no mortality during the rearing period (8 – 20 weeks) but a few ducks died during the laying period. The mortality obtained during the laying period for the *ad lib*, 60% of *ad lib* and low lysine reared ducks was 11,7; 8,3 and 16,7% respectively. There was no significant differences ($P \leq 0,05$) between treatments although the 60% of *ad lib* reared ducks had the lowest mortality. Lee *et al.* (1971) also observed that the lowest laying period mortality was obtained by the quantitative-

ly reared broiler pullets whereas the highest mortality was observed in the severest low lysine reared diet (0,40%) which was the case in this present experiment with ducks.

Conclusions

Only quantitative feed restriction during the rearing period reduced the body mass of the ducks significantly ($P \leq 0,05$) at 20 weeks of age. Marked compensatory live mass gain was observed following the period of restriction, however, all restricted ducks remained lighter at 60 weeks than the control ducks.

Food consumption was reduced to 20 weeks by the two restriction treatments, the reduction being significant ($P \leq 0,05$) in the case of the quantitative restriction treatment. In general, following the lifting of restriction, feed consumption returned to a level comparable to that of the control ducks so that the total intake to 60 weeks reflected the actual feed savings in the period of restriction.

Sexual maturity was delayed by the restriction treatments but only significantly ($P \leq 0,05$) by the 60% of *ad lib* rearing treatment. These ducks took an average of 24 days longer to reach sexual maturity than did the ducks fed *ad lib*.

Both the 60% of *ad lib* reared ducks and the low lysine reared ducks had significantly ($P \leq 0,05$) better fertility than did the ducks fed *ad lib*. This trend was again reflected in the hatchability of eggs set although not significantly so with regard to the low lysine diet.

No significant differences were found between treatments with regard to number of eggs, average egg mass, percentage egg sizes, peak production, terminal production, hatchability of fertile eggs or laying house mortality.

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