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# Evaluation of Metabolizable Energy of Common Poultry Feed Ingredients Using the Pekin Duck as an Experimental Animal

**A. Anwar, H. El-Alaily, H.S. Soliman, M.El-Zeiny and Karima S. Mohamed**

*Animal Production Dept., Faculty of Agriculture, Ain-Shams Univ., Shoubra El-Kheima Cairo, Egypt.*

CORRECTED ME was determined using Pekin ducks as experimental animals and the values obtained were used in the formulation of their starting rations up to 8 weeks of age. The results obtained proved that the ME values were higher when ducks were used, and that the minimum ME requirements in their starting rations are 2900 K Cal/kg feed. The use of excess energy in rations having the same protein level (16%) caused increase in the carcass fat and decrease of its protein. Other carcass characteristics, however, did not seem to be affected by using a ME range between 2900 and 3050 K. Cal/kg feed.

The increase in ME values was not related to an increase in the utilization of fibers alone but to all feeding compounds.

In common practice, the metabolizable energy values (ME) for ingredients used in poultry rations are generally measured with chicken as experimental animals ( Hill and Anderson, 1958). The tendency of ducks however to deposit fat in their carcass is widely observed due to better energy utilization of the ingredients fed (Das *et al*, 1965).

There are also some unsolved problems associated with ME determination concerning differences some time detected between species (Slinger *et al*, 1964, Fisher and Shanonn 1973; Leeson *et al* 1974, and Sugden, 1974). Moreover, Das *et al*, (1965) reported differences in growth rate, body composition and in starvation heat production between ducks and chicks.

This work therefore, was designed to measure the ME values of some ingredients using the pekin duck as an experimental animal and the formulation of its rations according to these values.

## Experimental

Two experiments were carried out: the first included 160 day-old unsexed Pekin ducklings which were fed the control ration (Table 1) up to two weeks of age. The birds were distributed at random into 8 groups up to 4 weeks of age when each group was divided into two duplicates of 10 birds each.

The eight diets (Table 1) consisted of the reference diet and another 7 test diets were fed each to a different group(2 duplicate) for 2 weeks.The ingredients tested were corn, wheat, barley and wheat bran and which substituted 40 % glucose in diets 2,3,4 and 5. Fish meal, cottonseed meal and field bean, however substituted only 30 % glucose in diet 6, 7 and 8 (Table 1). ME / g feedstuff

$$= \text{ME/g. glucose} - \frac{\text{ME/g.glucose diet-ME/g.test diet}}{\%\ \text{of test feedstuff in the diet}}$$ (Hill and Anderson 1958)

The birds of the second experiment totalled 120day-old allotted into 4 groups with 2 duplicates of 15 birds each 4 experimental diets(Table 2) were fed in this experimental each for a different group (2 duplicates) from hatching up to 8weeks of age when the parameters tested were calculated. The 4 diets contained the same 16 % total protein level but each with a different ME level: 2600, 2750 2900 and 3050 $\pm$ 25 K.Cal/Kg as calculated from the values obtained from the first experiment (diets 1 m, 2m, 3 m &4 m). The feed and water were supplied *ad lib* during the whole experimental period.

At the age of 8 weeks 4 ducks were chosen from each group to study the carcass characteristics and composition.

Analytical data for feed, excreta and meat were obtained using the methods described in the A.O.A.C. (1960). The analyses of variance (Snedecor, 1967), and differences between means were determined by Duncans (1955), the multiple range and multiple "F" test were used for any statistical significance.

## Results and Discussion

The nitrogen corrected $ME_N$(Table 3) for corn, wheat, barley and wheat bran were 3521, 3413, 3318 and 1681 KCal/Kg. material, respectively. These values are in all cases significantly higher than those reported for chicken (NRC, 1977 )and which are commonly for the formulation of both chicks and ducks. The same trend of results was obtained for the protein concentrates tested except for fish meal which was only 1471 KCal/kg, while that for cottonseed meal and field beans were 2377 and 2394 KCal/kg. (Table 3). Those results are in agreement with those reported by Farrell (1981) who found that food and ME were significantly higher for pikin ducklings than for chicken. He also detected higher heat and energy production accompained by fat and protein retention in ducklings than chicken. Ducks whether Muscovy or Pekin were reported by Schubert *et al* (1982) to give better digestibility coefficient for organic matter, crude fiber, N-free extract and crude protein than the laying hen. It seems that he increase in ME values was not related to an increase in the fiber utilization alone. In the second experiment different calorie: protein ratio was used and calculated with the help of ME values as calculated from the chicken and as determined on the pekin duck. The results given in Table 4

TABLE 1. **Composition of diets used for first experiment. Reference and experimental diets.**

| Components | Diets | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Reference | Experimental | | | | | | |
| | | Energy sources | | | Protein sources | | | |
| | | a | b | c | d | e | f | g |
| Glucose | 43.1 | 3.1 | 3.1 | 3.1 | 13.1 | 13.1 | 13.1 | 13.1 |
| Yellow Corn | — | 40.0 | — | — | — | — | — | — |
| Wheat | — | — | 40.0 | — | — | — | — | — |
| Barley | — | — | — | 40.0 | — | — | — | — |
| Wheat Bran | — | — | — | — | 40.0 | — | — | — |
| Fish Meal | — | — | — | — | — | 30.0 | — | — |
| Cotton seed meal | — | — | — | — | — | — | 30.0 | — |
| Beans | — | — | — | — | — | — | — | 30.0 |

The rest of the 100% was fulfilled by 9% wheat bran, 17.5% cotton seed meal, 10.5% crude casin, 2.5% gelatin, 2.5% hydrogenated vegetable fat, 2.5% yeast, 5.0%fish meal 2.0% dried whey, 2.0% ground lime stone, 1.0% dicalcium phosphate, 0.5% dried salt (iodized), 0.4% mineral mixture, 0.5% vitamin mixture and 1 % ground rice containing 30% $Cr_2O_3$.

show significant differences ($P < 0.01$) at 8 weeks of age for average live weight gain, daily gain energy consumption, efficiency of feed utilization and that of energy as well.

It seems that the minimum ME requirements for pekin ducks are 2900 KCal/Kg. feed from hatching and up to 8 weeks of age as calculated on the duck itself (Table 4).

These results indicate that the differences in the averages of live weight, liv weight gains, daily gain and efficiency of feed utilization at 8 weeks of age were statistically significant between ducks given diets 4 or 3 and those given diets 2 or 1.

Also it was clear that the differences between the ducks given diet 4 and those given diet 3 were not significant (Table 4).

The data presented in Table 5 for carcass composition showed progressive increase in the fat content and progressive reduction in protein content parallel to the increase of feed energy. The ME value of 2600 KCl/kg caused the carcass to contain 20·20 % fat and 15·15 % total protein (diet 1) while the ME value of 3050 KCal/kg, caused the same two parameters to be 32·05 and 13·32 %, respectively (Table 5). These results indicate that the carcass fat mostly depend upon the energy to protein in the diet as reported by Scott *et al* (1959). Carcass characteristics, however did not seem to be very much affected within the calorie: protein ratio tried out in this experiment ((Table 6).

TABLE 2. **Composition of diets for second experiment.**

| Components | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Corn yellow | 21 | 28 | 35 | 42 |
| Wheat | 10 | 12 | 14 | 16 |
| Barley | 19 | 16 | 13 | 10 |
| Wheat bran | 28 | 20 | 12 | 4 |
| Cotton seed meal | 11 | 12 | 13 | 14 |
| Field beans | 5 | 6 | 7 | 8 |
| Fish meal | 4 | 4 | 4 | 4 |
| Calcium carbonate | 0.75 | 0.75 | 0.75 | 0.75 |
| Lysine | 0.12 | 0.13 | 0.14 | 0.15 |
| Methionine | 0.28 | 0.28 | 0.28 | 0.28 |
| Additives (1) | 0.85 | 0.84 | 0.83 | 0.82 |
| Total | 100 | 100 | 100 | 100 |
| Calculated analysis (2) | | | | |
| Kcal ME/kg (calculated from duck) | 2600 | 2750 | 2900 | 3050 |
| KCal ME/kg (calculated from duck) | 2280 | 2442 | 2606 | 2770 |
| Crude Protein | 16.27 | 16.25 | 16.23 | 16.20 |
| Estimated dry matter | 90.04 | 90.39 | 89.74 | 89.98 |
| Estimated crude protein | 16.49 | 16.86 | 16.09 | 16.01 |

TABLE 3. Classical nitrogen corrected metabolizable energy values of some ingredients measure.

| Ingredient | Experimental Brid | | | |
|---|---|---|---|---|
| | *** % Fibers | Pekin Duck | * Chicks | *** Difference |
| | Kcal/Kg | | | % |
| Corn yellow | 6.0 | 3521 | 3430 | 10.3 |
| Wheat | 7.0 | 2318 | 3120 | 11.0 |
| Barley | 7.5 | 3318 | 2640 | 12.6 |
| Wheat bran | 8.5 | 1681 | 1300 | 12.9 |
| Fish meal (29%) | ** | 1471 | 2820 | —47.8 |
| Cotton seed meal (45%) | 8.0 | 2377 | 2400 | — 1.0 |
| Field bean (26%) | 6.0 | 2394 | 2300 | 4.1 |

* NRC 1977
** The fish meal sample was a local product of very low quality.
*** The differences were not significant to fibre content alone.

TABLE 4 : Mean values with the SE for the perfomance of different groups at 8 weeks of age

| | Metabolizable energy level | | | | SE of Means | Sig.of differences between means |
|---|---|---|---|---|---|---|
| | $d_1$ 2600 KCal/kg | $d_2$ 2750 KCal/kg | $d_3$ 2900 KCal/kg | $d_4$ 3050 KCal/kg | | |
| Initial live weight (g) | 50 | 49 | 50 | 49 | 0.29 | Ns |
| Final live weight (g) | $2073_a$ | $2377_b$ | $2530_{bc}$ | $2530_c$ | 27 | ** |
| Live weight gain (g) | $2024_a$ | $2327_b$ | $2395_{bc}$ | $2481_c$ | 27 | ** |
| Daily gain (g) | $36^a$ | $41_b$ | $43_{bc}$ | $44_c$ | 0.75 | ** |
| Feed consumption (g) | $8322^a$ | 8111 | 7939 | 7907 | 131 | NS |
| Efficiency of feed utilization (g.. feed/g gain) | $4.11_{oa}$ | $3.49_b$ | $3.32_{bc}$ | $3.2_{oc}$ | 0.07 | ** |
| Energy consumption (Kcal) | | | | | | |
| Efficiency of energy utilization | $21637_a$ | $22306_{ab}$ | $23023_{bc}$ | -- 24116 | 367 | ** |
| Kcal ME/g. gain | $10.69_a$ | $9.59_b$ | $9.62_{bc}$ | $9.72_b$ | 0.19 | ** |

In this and subsequent tablets :-
* Significant at 5% level of probability.
** Sgnificant at 1% level of probability.
SE standard error.
Figures followed by the same letter did not differ significantly (5 Duncans, 1955)

TABLE 5. **Average chemical composition of duck flesh at different groups at 8 weeks of age.**

| | Metabolizable Energy Levels | | | | SE of Means | Sig. of differences between means |
|---|---|---|---|---|---|---|
| | (1) 2600 Kcal/kg | (2) 2750 Kcal/kg | (3) 2900 Kcal/kg | (4) 3050 Kcal/kg | | |
| Moisture % | $63.87 \pm 3.66_a$ | $59.68 \pm 2.99_{ab}$ | $55.07 \pm 2.18_b$ | $53.81 \pm 3.66^b$ | 1.84 | * |
| Fat % (other extract) | $20.20 \pm 1.50_a$ | $24.98 \pm 1.73_b$ | $30.10 \pm 2.01_c$ | $32.05 \pm 3.03_c$ | 1.24 | ** |
| Protein % | $15.15 \pm 2.10$ | $14.52 \pm 1.31$ | $14.07 \pm 0.19$ | $13.32 \pm 0.84$ | 0.76 | NS |
| Ash % | $0.78 \pm 0.07$ | $0.82 \pm 0.07$ | $0.76 \pm 0.06$ | $0.82 \pm 0.04$ | 0.04 | NS |

TABLE 6. **Average carcass characteristics of different groups at 8 weeks of age.**

| | Metabolizable Energy levels | | | | SE of Means | Sig.of differences between means |
|---|---|---|---|---|---|---|
| | (1) 2600 Kcal/kg | (2) 2750 Kcal/kg | (3) 2900 Kcal/kg | (4) 3050 Kcal/kg | | |
| Live weight (g) | 2173 | 3110 | 2760 | 2787 | — | — |
| Dressed weight (g) | 1903 | 2720 | 2403 | 2430 | — | — |
| Eviscreated weight (g)[1] | 1275 | 1875 | 1642 | 1705 | — | — |
| Ready to cook weight (g)[2] | 1462 | 2128 | 1955 | 1927 | — | — |
| Dressing % | $87.6 \pm 1.25$ | $87.4 \pm 2.02$ | $87.0 \pm 1.41$ | $87.1 \pm 0.83$ | 0.80 | NS |
| Eviscreating % | $58.8 \pm 2.78$ | $60.2 \pm 2.52$ | $59.4 \pm 3.67$ | $60.9 \pm 2.61$ | 1.69 | NS |
| Ready to cook % | $67.4 \pm 2.19$ | $68.4 \pm 1.91$ | $67.2 \pm 2.86$ | $68.9 \pm 1.69$ | 1.27 | NS |

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# تقييم الطاقة الممثلة لبعض مواد العلف المستخدمة فى تغذية البط البكينى ٠

أحمد أنور ، حسين العلايلى ، حسين سليمان ، مسعد الزينى وكريمة سيد محمد

كلية الزراعة – جامعة عين شمس – قسم الانتاج الحيوانى – مصر

باستخدام البط البكينى تم تقدير وتصحيح للطاقة الممثلة لبعض مواد العلف المستخدمة فى التغذية وطبقت القيم المتحصل عليها عند تكوين العلائق للبادئ، وذلك عند عمر ٨ أسابيع وقد أثبتت نتائج التجارب المتحصل عليها الى ارتفاع قيمة الطاقة الممثلة عند استخدام البط البكينى حيث كانت أقل قيمة للطاقة الممثلة واللازمة لتغطية الاحتياجات بعلائق البادئ للبط هى ٢٩٠٠ كيلو كالورى/كيلو جرام عليقة ٠

وعند زيادة الطاقة بالعليقة التى تحتوى على نفس مستوى البروتين (١٦٪) لوحظ زيادة فى كمية الدهن المترسب ونقص فى كمية بروتين الجسم كما ان بعض صفات الذبيحة لم تتأثر باستخدام مستوى الطاقة فى حدود ٢٩٠٠ ، ٣٠٥٠ كيلو كالورى / كيلو جرام عليقة كما ان الزيادة فى قيمة الطاقة الممثلة لم يكن يرجع الى زيادة معدل الاستفادة واستخدام الألياف فقط ولكن يرجع الى مجموع مكونات الغذاء ٠