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To cite this version:
A.D. Anjum, M.Z. Khan, M.A. Toor, M.A. Majeed. PENICILLIN MYCELIUM RESIDUE FEEDING IN WHITE LEGHORN CHICKS. Annales de Recherches Vétérinaires, INRA Editions, 1978, 9 (1), pp.11-16. <hal-00900974>

HAL Id: hal-00900974
https://hal.archives-ouvertes.fr/hal-00900974
Submitted on 1 Jan 1978

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Penicillin Mycelium Residue Feeding in White Leghorn Chicks

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Résumé

ALIMENTATION DE POULETS LEGHORN BLANC AVEC UN RESIDU DE FABRICATION DE LA PENICILLINE. — La compétition alimentaire permanente entre l’homme et les animaux conduit progressivement à nourrir ces derniers avec un nombre toujours croissant de résidus industriels. Cette pratique comporte des risques. Cet article rapporte certains effets toxiques chez le poulet en croissance, de l’alimentation avec un résidu de la production de pénicilline (PMR) riche en protéines et minéraux.

Les gains de poids jusqu’à la dixième semaine et l’efficacité alimentaire ont été significativement plus faibles chez des poulets Leghorn blanc âgés de sept jours, qui reçurent une ration contenant 10, 15 ou 20 % de PMR séché au soleil, mais l’ingestion alimentaire restait inchangée. L’anémie a été le seul symptôme observé chez les animaux traités, dont la numération globulaire était significativement abaissée à la fin de la période expérimentale de neuf semaines. La leucocytose observée était surtout due à un accroissement des lymphocytes. Les hétérophiles et les monocytes étaient aussi légèrement plus nombreux dans le groupe qui recevait 20 % de PMR. Il en résulte que, sous cette forme et aux doses employées, ce résidu ne peut être préconisé pour l’alimentation du poulet en croissance.

Introduction.

Penicillin Mycelium Residue (PMR) is a semisolid mass left after the filtration of the antibiotic from cultures of Penicillium chrysogenum on Basmati rice. Every year, at the Antibiotic (Private) Ltd., Daudkhel, as much as 1,200 tons of this protein and mineral rich waste is said to pose disposal and pollution problem. In the fresh state it is a gray, almost odourless, homogenous mass which contains 80 to 85 per cent moisture. In this form, therefore, it is not stable. A 10 to 12 hours exposure to the sun initiates what looks like its decomposition: changing it first into a dirty looking and pungent smelling pulp (Irshad-ul-Haq, 1977). The final unwholesome and hard mass, obtained after several months, is almost insoluble in water. Mill hands involved in its pulverization, who had possibly inhaled its dust, were reported to have developed a transient rise of temperature which was accompanied with shivering of the whole body (Naeem-ul-Haq, 1976).

Along with fish meal, PMR was suggested to make substantial saving in the ration costs of poultry (Bose and Gupta, 1957). At
5 per cent level it was shown to be a more efficient growth promoting factor than even the groundnut de-oiled cake (Fernandes, 1960). Higher levels of PMR are used in the present study to test its nutritional value and safety among the growing White Leghorn chicks.

Materials and Methods.

Ground PMR, a pungent smelling sticky gray powder, was used at 10, 15 and 20 per cent levels to replace in part crushed wheat, guar meal, til cake, molasses and rice husk in a starter chick mash on isonitrogenous bases. In all the four test diets 59 per cent of the ingredients were constant. These include 35.5 of crushed maize, 12.0 of 60 per cent gluten meal, 5.0 of fish meal, 2.0 of blood meal, 2.0 of decorticated cotton seed cake, 1.75 of bone meal, 0.5 of a vitamin and mineral premix "Nutripole" of Pakistan Vitamin Products, and 0.25 of common salt. The remaining 41 per cent of the variable ingredients are shown in Table 1. The proximate analysis of each of the four diets is also given in the same table. Percentage composition of PMR as determined by various authors is available at Table 2.

The four test diets were fed ad lib. simultaneously to three replicates: in a completely randomized block design. Each group consisted of eight, 7-days-old White Leghorn chicks. Weekly rates of feed intake as well as gains in weight were recorded for nine weeks. Feed efficiency ratio was calculated by dividing the feed consumed with the weight gain.

Blood picture of all the 96 chicks was studied during the 11th week of age. Samples were obtained from the wing vein. Total erythrocyte count, total leukocytic count, differential leukocytic count and haemoglobin contents were all determined using the techniques described by Benjamine (1961).

The data was analysed using the analysis of variance test (Snedecor, 1964).

Results.

In comparison with a high energy and high protein diet D (Table 1) there was a significant drop in gains in weight among the PMR fed groups A, B, and C after the nine weeks trial (Table 4). The higher the PMR level the lower was the gain in weight, yet the rate of feed intake remained unaltered.
Table 4 shows that the differences in the feed efficiency ratios were also significant at the 5 per cent level. Weight gain was halved and the feed efficiency ratio almost doubled in group C given 20 per cent PMR (Table 3).

No chick died during the course of the nine weeks feeding trial. Wattles and combs of the PMR fed chicks were at times anemic. The discolouration became all the more pronounced during the 9th and 10th weeks of age: when some of the chicks were in addi-

Table 3.—(A) Average growth record: per chick, in grams, and (B) Average blood values immediately after the feeding trial.

<table>
<thead>
<tr>
<th>FACTORS</th>
<th>DIETS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>(A) Growth record:</td>
<td></td>
</tr>
<tr>
<td>Initial weight</td>
<td>42.4</td>
</tr>
<tr>
<td>Final weight</td>
<td>681.0</td>
</tr>
<tr>
<td>Total weight gain</td>
<td>638.6</td>
</tr>
<tr>
<td>Total feed consumed</td>
<td>3129.0</td>
</tr>
<tr>
<td>Feed efficiency ratio</td>
<td>4.9</td>
</tr>
<tr>
<td>(B) Blood values:</td>
<td></td>
</tr>
<tr>
<td>Haemoglobin contents (grams/100 ml)</td>
<td>8.5</td>
</tr>
<tr>
<td>Total erythrocyte count (millions/cu, mm,)</td>
<td>2.3</td>
</tr>
<tr>
<td>Total leukocyte count (thousands/cu, mm,)</td>
<td>25.9</td>
</tr>
<tr>
<td>Differential leukocyte count (absolute values in thousands)</td>
<td></td>
</tr>
<tr>
<td>Heterophils</td>
<td>6.80</td>
</tr>
<tr>
<td>Lymphocytes</td>
<td>16.50</td>
</tr>
<tr>
<td>Monocytes</td>
<td>1.50</td>
</tr>
<tr>
<td>Eosinophils</td>
<td>0.84</td>
</tr>
<tr>
<td>Basophils</td>
<td>0.25</td>
</tr>
</tbody>
</table>
tion dull and depressed. Throughout the course of the 9 weeks feeding trial their appetite and faecal colour as well as consistency remained comparable in all the four groups of chicks. One, three weeks old chick receiving 20 per cent PMR in his diet, however, showed a mild twisting of the neck which lasted only a day.

Total erythrocyte count was the only blood value found significantly different among the four groups of chicks (Table 4). The higher the PMR level the lower was the count. It is interesting to note that the differences in haemoglobin contents were not significant. Table 3 shows that the degree of leukocytosis among the PMR fed chicks had no relationship with the level of the PMR. This increase seemed primarily due to an increase in the lymphocytes. Heterophils and monocytes also became more numerous in group C, given 20 per cent PMR.

**Discussion.**

The findings of Sachan et al. (1972), who recorded unsatisfactory growth rate in White Leghorn chicks fed 10, 20 and 30 per cent of what they termed Penicillin Mycelium Waste, are thus ratified. Like Bose and Gupta (1957) a significantly superior growth rate and food conversion ratio was also obtained by Abdelsalam et al. (1971) by feeding 2 per cent Penicillin Mycelium (by-product) to day-old male chicks yet better (but not statistically tested) growth curves recorded among the PMR fed chicks by Fernandes (1960) cannot be attributed only to the presence of 5 or 10 per cent PMR in his diets, because:

(a) his PMR-free diet IV which contained dried liver residue, was the most efficient diet after the fourteen weeks trial;

(b) until the 10th week of age, the PMR-free diet D of the present study was even better than the PMR containing diets II and III of Fernandes, and

(c) PMR containing diets A, B, and C of the present study, although inferior to our control diet D, were superior to the PMR-free diets I and V of Fernandes.

It seems that although higher weight gains recorded by Fernandes (1960) looked all the
better because of his poor control diets I and V yet looking closely at the results of the two studies one is led to believe that irrespective of the basal ration the rate of weight gains among the PMR fed chicks was inversely proportional to the amount of PMR in the diet (Table 3). But this observation lacks in statistical backing. Furthermore, it may be argued that diet A of the present study and diet II of Fernandes, both containing 10 per cent PMR, showed different weight gains because of the differences in the other ingredients.

Feed efficiency ratio differed significantly among the four diets tested (Table 4). This seems mainly because of a highly significant difference between the gains in weight especially when the differences in rates of feed intake were not significant.

Feeding of 11 to 44 per cent PMR among the growing lambs led to a significant drop in the rate of their feed intake (Naeem-ul-Haq, 1976). Feed consumption became almost negligible in heifers when sun-dried PMR was used to completely replace cotton-seed-cake on protein equivalent basis (Mussadiq and Gilani, 1976). This was perhaps because of a noxious taste and nasty smell of dried PMR which seem to have affected the palatability of the total feed adversely. The little developed taste buds of the chicks were perhaps responsible for the unaltered rate of feed intake in the present study.

Significant reduction in weight gains, feed efficiency ratio and total erythrocyte count among the growing chicks of the present study tend to suggest that sun-dried PMR was not safe and as such may not be recommended for a starter chick mash at the three levels tested. The deleterious effects may be due to low grade of the available protein, in particular low in its essential amino acid contents, poor digestibility or some unidentified toxic substance which may have developed during the course of drying in the sun. Critical chemical analysis of PMR might throw some light on this issue. The recorded symptoms and the blood values do point towards what may be termed as anemia probably because of a malfunction of the haemopoietic system.

With a view to improve digestibility, minimize toxicity and enhance palatability, Akram (1977) proposed autoclaving the PMR before use. The suggestion is supported by the findings of Kirsanov (1973), who hydrolyzed the dry biomass of a culture of Penicillium chrysogenum with twice its weight of brewer's yeast. He found that the preparation was not only safe for rats when administered intramuscularly but the piglets fed this stuff gave weight gains better than those fed on skimmed milk. Furthermore, Carlton et al. (1968) demonstrated that some of the toxic activity of Penicillium species was thermolabile, as weight gains improved and the mortality reduced in mice fed maize cultures which had been steamed.

Accepted for publication, September 1977.

Acknowledgements.

The authors are grateful to Dr. A.H. Gilani for his valuable suggestions in the formulation of the rations. Thanks are also due to Mr. Irshadul-Haq of the Antibiotics (Private) Ltd., Daudkhel for his valuable suggestions and for the free of cost supply of the sun-dried PMR used in the study.

Summary

Unending competition between man and animals has forced a gradual shift of animals from conventional feeds to an ever-expanding list of industrial wastes. Yet the change has its own hazards. This paper records some of the deleterious effects of feeding a protein and mineral rich waste of penicillin production (PMR), in growing chicks.

Gains in weight up to the 10th week of age and feed efficiency ratio were significantly lower among the 7-days-old White Leghorn chicks given 10, 15 and 20 per cent sun-dried PMR but the rate of feed intake remained unaltered. Anemia was the only observable symptom among the PMR fed chicks. At the end of the nine weeks trial, their total erythrocyte count was found significantly lowered. What looked like leukocytosis was prim-
arily because of an increase in the lymphocytes. Heterophils and monocytes were also slightly more numerous in the group given 20 per cent PMR. In this form and at the three levels tested, this industrial waste, therefore, cannot be recommended to the growing chicks.

References


