ADVANTAGE OF USING DIGESTIBLE PROTEIN AND DIGESTIBLE AMINO ACIDS TO FORMULATE POULTRY DIETS

M.A. ALI\(^1\), A. KHATUN\(^2\) and J.G. DINGLE\(^1\)

Summary

Azolla meal prepared from the aquatic fern azolla was included in layer diets at a level of 0, 50, 100, 150 or 200 g/kg by replacing sesame meal on a total protein and total amino acid or digestible protein and digestible amino acid basis. Feeding azolla meal on a digestible protein and digestible amino acid basis improved egg production by 5-10%, egg mass output by 3.2 -6.4 g/day and feed efficiency by 6-12%. Feeding azolla on a digestible protein and digestible amino acid basis maintained or improved protein utilisation efficiency. The yolk colour significantly improved with increased levels of azolla meal and duration of feeding. Feed cost per kg egg mass production reduced with an increased level of azolla meal in the diet and reduced proportionally more when formulated on a digestible nutrient basis.

I. INTRODUCTION

The cost of feed may be decreased in two ways. Firstly, use of cheaper unconventional feed ingredients may help to decrease feed cost but the effect of these ingredients on poultry production needs to be tested before they can be recommended. Secondly, nutritionists have recently become interested in formulating diets on the basis of digestible protein and digestible amino acids (Rhone-Poulenc Animal Nutrition, 1989; Fernandez et al., 1995) as a means of increasing the efficiency of feed utilization. It is suggested that it would be more desirable to formulate rations on a digestible nutrient basis because this would be a better indication of the relative nutritional value of the feed. It has been found that the performance of laying hens has improved when the feed formulation was based on digestible lysine and digestible methionine concentration rather than on total lysine and total methionine concentration (Bougon and Joly,1990). The present study was therefore undertaken to compare the productive and economic advantages of feeding a new ingredient, azolla meal, on a digestible protein and digestible amino acid basis compared with feeding on a total protein and total amino acid basis. Azolla is an aquatic fern found abundantly in ponds, ditches and paddy fields in tropical and sub tropical regions of the world. It contains 165-292 g/kg CP and has been found to be useful as a feed ingredient for poultry (Singh et al.,1983; Ali and Leeson, 1995).

II. MATERIALS AND METHODS

The fresh azolla (Azolla pinnata) was harvested from the Bangladesh Agricultural University poultry farm pond and then sun-dried. Azolla meal was analysed for proximate composition, acid detergent fibre (ADF) and neutral detergent fibre (NDF) using standard procedures, for metabolizable energy using the method of Sibbald and Slinger (1993) and for digestible protein using the method of McNab and Shannon (1972).

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Diets were prepared with azolla meal at a level of 50 and 100g/kg (Trial 1) and 150 and 200g/kg (Trial 2) on a total protein and total amino acid (TPTA) basis or on a digestible protein and digestible amino acid (DPDA) basis by replacing sesame meal and some whole soybean from wheat based control diets to adjust the digestible protein, digestible lysine and digestible methionine concentrations (NRC, 1994; Scruggs, 1994; Ali and Leeson, 1995). In trial 2, synthetic L-lysine HCl and DL-methionine were added to the diets formulated on a digestible nutrient basis to adjust the digestible lysine and digestible methionine concentrations. In trial 1, sixty laying pullets 43 weeks old, and in trial 2, eighty laying pullets (Shaver Starcross 579) 28 weeks old, were used. In trial 1, each diet was applied to three replications of 4 birds, while in trial 2 each diet was applied to four replications of 4 birds. The birds were reared in cages in an open house. All mash dry feed was supplied ad libitum and light was maintained at 16 h per day during the experimental periods. The experiments continued for 16 and 8 weeks for trials 1 and 2 respectively. During the experiments, daily egg production, egg weight and weekly feed consumption were recorded. In trial 1, one egg from each replicate was collected for the first three days and last three days of weeks 4, 8, 12 and 16 and in trial 2, one egg from each replicate was collected on the last three days of weeks 4 and 8 to determine egg quality. The external egg quality characteristics measured were egg weight, shape index, egg breaking strength, per cent shell and shell thickness. The internal egg quality characteristics measured were Haugh unit, albumen index, albumen dry matter, yolk colour score, yolk index, and yolk dry matter. Hen-day egg production, egg mass output, feed efficiency, protein efficiency ratio (PER) and feed cost were calculated. Data were subjected to analysis of variance and significant differences between treatments were identified by the least significant difference test.

### III. RESULTS

The chemical analysis and digestibility study of azolla meal indicated that the crude protein was 285g/kg, digestible protein was 220g/kg, ash was 169g/kg, ADF was 334g/kg, NDF was 446g/kg and crude fibre was 124g/kg. The metabolizable energy of azolla meal was 10.17MJ/kg. The performance of laying hens fed azolla meal (AM) at different levels either on a total protein and total amino acid (TPTA) basis or on a digestible protein and digestible amino acid (DPDA) basis is shown in Table 1.

#### Table 1. Hen-day egg production, (HDEP, %), egg mass output (EMO, g/d), food intake (FI, g/d), FCR, protein utilisation efficiency (PUE, %), livability (%), egg weight (g), feed cost/kg (c), feed cost/hen/unit egg mass output (AS) of laying hens fed azolla meal on total protein and total amino acid, or digestible protein and digestible amino acid basis.

<table>
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<th>Performance</th>
<th>0</th>
<th>0</th>
<th>50</th>
<th>150</th>
<th>50</th>
<th>150</th>
<th>100</th>
<th>200</th>
<th>100</th>
<th>200</th>
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<tr>
<td>(Control)</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
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<tr>
<td>(TPTA)</td>
<td></td>
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<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
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<tr>
<td>(DPDA)</td>
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<td></td>
<td>1</td>
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<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
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<tr>
<td>Level of azolla meal (g/kg)</td>
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<tr>
<td>HDEP</td>
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<td>72.1</td>
<td>70.7</td>
<td></td>
<td>82.1</td>
<td>73.3</td>
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<td>39.6</td>
<td></td>
<td>48.3</td>
<td>38.2</td>
<td></td>
<td>52.7</td>
<td>44.5</td>
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<tr>
<td>FI</td>
<td>118.4</td>
<td>107.3</td>
<td></td>
<td>118.6</td>
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<td></td>
<td>119.4</td>
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<tr>
<td>FCR</td>
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<tr>
<td>PUE</td>
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<td>25.1</td>
<td></td>
<td>26.4</td>
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<tr>
<td>Egg weight</td>
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<td>66.9</td>
<td>54.5</td>
<td></td>
<td>64.4</td>
<td>57.5</td>
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<td>65.7</td>
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<td>Feed cost/kg</td>
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<td>29.5</td>
<td></td>
<td>27.9</td>
<td>25.9</td>
<td></td>
<td>28.2</td>
<td>27.5</td>
<td></td>
<td>26.8</td>
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<td>Feed cost/ hen</td>
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<td>11.7</td>
<td></td>
<td>12.4</td>
<td>11.2</td>
<td></td>
<td>11.6</td>
<td>9.6</td>
<td></td>
<td>12.2</td>
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Means in the rows within trial bearing similar superscripts do not differ significantly (* P<0.05).
The hen-day egg production at 50 g and 100 g AM/kg using digestible protein and digestible amino acid (DPDPA) was improved by 9.92 and 5.67 per cent respectively (Trial 1), while in Trial 2, at 150 and 200 g AMDPDA/kg, egg production improved (P<0.05) by 2.58 and 4.24 per cent respectively compared with similar levels of AMTPTA. Feeding AMTPTA up to 150 g/kg maintained egg production equal to the control group but egg production reduced (P<0.05) at 200 g/kg diet. The egg mass output (g egg/day) at 50 and 100 g AMDPDA/kg improved by 4.43 g and 3.59 g (Trial 1), and at 150 and 200 g AMDPDA/kg improved (P<0.05) egg mass output by 6.36 and 3.18 g (Trial 2) compared with similar levels on a AMTPTA basis. The egg mass output of birds fed the control diet, 150 or 200 g AMTPTA, was similar. Feed consumption was similar in all dietary treatments (Trial 1) but significantly increased (P<0.01) for the 150 g AMTPTA (112.6 g) and the 200 g AMTPTA (113.6 g) diets above that of the control (107.3 g) diet (Trial 2). Feed consumption at 150 g AMDPDA (108.2 g) and 200 g AMDPDA (107.3 g) was similar to that of the control diet. Feed conversion ratios were found to be better for the 50 and 100 g AMDPDA diets than for the control, 50 and 100 g AMTPTA diets (Trial 1) but significantly improved (P<0.05) for the 150 and 200 g AMDPDA diets compared with the control or similar levels of the AMTPTA diets (Trial 2). PER significantly (P<0.05) improved at 50 g AMDPDA but reduced at 50 and 100 g AMTPTA diets compared with that of the control diet (Trial 1). The PER of the 150 g AMDPDA diet was significantly better than the PER of the control diet or the 150 g AMTPTA diet, while the PER of the 200 g AMDPDA diet was significantly better than the PER of the 200g AMTPTA diet but was similar to that of the control diet (Trial 2).

Livability was 100% in all dietary treatments in both the trials. The external characteristics of eggs such as shape index, egg breaking strength, percent shell, shell thickness, and internal egg quality characteristics such as Haugh unit, albumen index, albumen dry matter (%), yolk index, and yolk dry matter (%) of the eggs laid by hens in different treatments at starting, 4, 8, 12, and 16 weeks (Trial 1) and at 4 and 8 weeks (Trial 2) were similar except egg size and yolk colour. The egg size improved (P<0.01) when feed was formulated on the basis of DPPA (Trial 2). The yolk colour significantly improved (P<0.05) with increasing level of azolla meal and period of feeding whether fed on a total or a digestible protein and amino acid basis. The feed cost per hen per year at 50, 100, 150, and 200 g/kg azolla meal diet reduced by A$ 0.40 versus 1.23, A$ 0.65 versus 1.51 (Trial 1), A$ 0.53 versus 2.07, and A$1.20 versus 1.85 (Trial 2) compared with the costs of the control diets when fed on a TPTA versus DPPA basis respectively.

IV. DISCUSSION

Azolla meal was a moderate source of crude protein and metabolizable energy. The analysed crude protein of azolla meal was similar to the value reported by Singh et al (1983) but was greater than values reported by others (Tamang and Samanta, 1993; Ali and Leeson, 1995). Digestible protein was similar to the value reported by Querijero (1991) but was greater than that reported by Ali and Leeson (1995). The NDF and ADF content were less than reported previously in terms of total crude fibre. The metabolizable energy of azolla meal was similar to that of duck weed (Akhter, 1995) but greater than reported previously for azolla meal (Ali and Leeson, 1995). These differences indicate that the azolla meal used in these studies was of high quality. Feeding azolla meal on a DPPA basis improved egg production in laying hens, while egg production reduced at greater levels of azolla meal when fed on a TPTA basis. The results are partially consistent with Bastian (1987). These indicate that azolla meal can replace sesame meal on a DPPA basis up to 200 g/kg diet of laying hens but only up to 150 g/kg diet when fed on a TPTA basis. Feeding azolla meal on a TPTA basis
had no effect on egg mass output but output improved when birds were fed on a DPDA basis. The results confirm earlier observations of improved egg mass output in laying hens when fed on a digestible protein and digestible amino acids basis (Bougon and Joly, 1990; Joly, 1994). Feeding azolla meal at a lower level on a TPTA or on a DPDA basis had no effect on feed consumption but feed consumption increased at a higher level of azolla meal when fed on a TPTA basis. Feed efficiency improved even at 200 g/kg azolla meal when fed on a DPDA basis but reduced when fed on a TPTA basis. The results are similar to earlier observations (Bougon and Joly, 1990; Johnson, 1992; Joly, 1994) of higher feed efficiency when fed on a digestible nutrient basis. Protein efficiency ratios were maintained or improved when azolla meal was fed on a DPDA basis but reduced when fed on a TPTA basis compared with the controls.

No bird died in any treatment during the experiments, indicating that azolla meal had no deleterious effect on livability. Azolla meal had no influence on external or internal characteristics of eggs except egg size and yolk colour. Egg size improved when azolla meal was fed on a DPDA basis. Yolk colour improved with increased levels of azolla meal in the diets and for longer periods of feeding whether fed on a TPTA or a DPDA basis. Feed cost reduced with increasing level of azolla meal in the diet and reduced more when fed on a digestible protein and digestible amino acid basis than on a total protein and total amino acid basis.

V. CONCLUSION

Egg production, feed efficiency and profitability increased when azolla diets were formulated on a digestible protein and digestible amino acid basis compared with the usual formulation on a total protein and total amino acid basis.

REFERENCES