SHORT COMMUNICATION

Nutrient digestibility of mulberry leaves (Morus alba)

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Abstract

The current study was conducted to determine the chemical composition of mulberry (Morus alba) leaf meal (MLM) and its nutritive value as a feed ingredient. Fifteen layer and fifteen broiler chickens were used in the digestibility trial. The dry matter (DM), crude protein (CP), ash, fat (EE), crude fibre, neutral detergent fibre (NDF), acid detergent fibre (ADF), calcium (Ca), phosphorus (P) and gross energy (GE) content of MLM were analyzed. The precision-feeding technique was applied to feed the birds 30 g/kg DM of MLM. The results showed that MLM contained a high content of CP (29.8%), Ca (2.73%) and NDF (35.77%). Layers and broilers chicken could utilize 73% and 72% of CP, respectively, in MLM. The nutrient digestibility of DM and NDF was higher in layers than in broilers. No significant effect was observed in ME and other nutrient digestibility between the two classes of fowls. In general, the incorporation of MLM into the chickens’ diet could be a good source of protein despite its high fibre content.

Materials and methods

Leaves from mulberry shrubs at four weeks re-growth were collected, stripped of their branches and sun-dried with frequent turning for 4-5 days. The sun-dried mulberry leaves were then hammer-milled to pass an 1 mm screen, and kept in airtight plastic bags. Fifteen layers ( Isa-Brown, 17-week-old) of uniform body weight (BW) (1.7 kg) and 15 male broilers (Cobb 500, 42-day-old) of uniform BW (3.3 kg) were obtained from a commercial company. The chickens were housed in 30 individual metabolism cages. In the cages they were fed ad libitum a layer and broiler finisher mash respectively, during three day adaptation period under continuous light. Each bird served as an experimental unit. All the birds were deprived of feed for 24 h to ensure that their alimentary canals were empty from feed residues (Sibbald, 1979); they were then fed the specific amount of mulberry (Morus alba) leaf meal (MLM). Once fed, the birds were individually housed in the wire cages over excreta collection trays and their housing time was recorded. Excreta, consisting of metabolic plus endogenous excretion, voided from 0 to 24 h and from 24 to 48 h after housing were collected quantitatively. Each bird served as its own negative control to estimate metabolic and endogenous excretion (Sibbald, 1980). Water was available ad libitum during the experimental period.

A stainless steel funnel with a 40-cm stem was used in the precision-feeding technique. Thirty gram MLM was used, based on preliminary assays with layer and broiler chickens. Total excreta were collected in plastic trays. The samples were frozen, freeze-dried, allowed to come to equilibrium with the atmospheric moisture, weighed and ground through a 1-mm sieve. MLM and faeces samples were analyzed for DM, CP, EE, ash, crude fibre and Ca using the standardized procedures of the AOAC (2007). Acid detergent fibre (ADF), neutral detergent fibre (NDF) and hemicellulose were analyzed according to Van Soest and Wine (1967). Phosphorus was determined according to Thomas et al. (1967). The gross energy (GE) was determined by adiabatic oxygen bomb calorimeter (Parr, USA).

The data were used to calculate apparent metabolizable energy (AME), apparent metabolizable energy corrected for nitrogen (AMEn), true metabolizable energy (TME) and true metabolizable energy corrected for nitrogen (TME) values according to the following formula (Farhat et al., 1998):

\[
\text{AME} = \text{IE} - \text{FE} \\
\text{TME} = \text{AME} + \text{FEL}
\]

where

IE, ingested energy,

FEL, faeces energy loss.
Table 1. Chemical composition of mulberry leaves at 4 weeks of age.

| Component                  | Value  |
|----------------------------|--------|
| Dry matter, %              | 89.25  |
| Crude protein, %           | 29.80  |
| Ether extract, %           | 5.57   |
| Ash, %                     | 11.81  |
| Crude fibre, %             | 13.11  |
| Neutral detergent fibre, % | 35.77  |
| Acid detergent fibre, %    | 28.00  |
| Calcium, %                 | 2.73   |
| Phosphorus, %              | 0.28   |
| Gross energy, MJ/kg        | 17.60  |
| ME, MJ/kg                  | 7.60   |

Table 2. Nutrient availability of mulberry leaf meal.

| Component          | Layers | Broilers | SEM |
|--------------------|--------|----------|-----|
| Dry matter, %      | 37*    | 35*      | 0.58|
| Apparent crude protein, % | 73     | 72       | 0.80|
| Apparent ether extract, % | 88     | 89       | 0.69|
| Apparent crude protein, % | 29*    | 27*      | 0.54|
| Availability       |        |          |     |
| AMEn, MJ/kg        | 7.7    | 7.6      | 0.06|
| AMEn, MJ/kg        | 6.5    | 6.4      | 0.03|
| TME, MJ/kg         | 8.4    | 8.3      | 0.04|
| TME, MJ/kg         | 7.0    | 6.8      | 0.03|

AME, apparent metabolizable energy; AMEn, apparent metabolizable energy corrected for nitrogen; TME, true metabolizable energy; TME, true metabolizable energy corrected for nitrogen. *Values with different superscripts within the same row are significantly different (P<0.05).

Results and discussion

The chemical composition of the MLM is presented in Table 1. The results indicated a high concentration of protein in MLM. Ash and EE values obtained in this study were 11.81 and 5.57%, respectively. The values of GE, NDF and ADF of MLM were relatively high as well. Phosphorus and Ca concentrations were 0.28% and 2.73% respectively. Values of DM, CP, ash, ADF and NDF in mulberry leaves are in agreement with those from previous studies (Sanchez, 2002; Saddul et al., 2004; Sarita et al., 2006; Al-Kirshi et al., 2009; Al-Kirshi et al., 2010).

The chemical composition of mulberry leaves is comparable with those of leguminous forages and trees such as lucerne and leucaena (Smith, 1994; FAO, 1998), especially the protein content. The ratio of Ca:P in mulberry leaves was found to be 10:1, which suggests the Ca and P in MLM is unbalanced. The consequence would be that P supplementation would be required when high levels of MLM are included in diets. The recommended level of Ca: P for other animals including chickens is 2:1, according to NRC (1994).

The apparent digestibility coefficients of DM, CP, EE and NDF in the MLM are presented in Table 2. The DM digestibility value in the layers was differed (P <0.05) from that of the broilers. The higher digestibility of DM in layers might be attributed to higher digestibility of NDF, which accounted for 36% of the total composition of mulberry leaves in this study. The digestibility of NDF ranged between 27%-29% for broilers and layers. This is in agreement with findings that the nutrients in diets containing high fibre levels are poorly digested in broiler (Annison et al., 1997).

The digestibility of EE ranged from 88% to 89% which is considered highly digested by both classes of birds. No significant (P>0.05) differences were observed in CP and EE digestibility between layers and broilers.

Data on AME and TME values for mulberry leaves are also shown in Table 2. It was found that layers and broilers utilized about 42% of the GE in MLM. The average AME value of MLM was 7.6 MJ/kg and AMEn 6.5 MJ/kg; TME and TME values were 8.4, 6.9 MJ/kg, respectively. However, layers digested more DM than broilers. The AME values in this study were 7.62 and 7.52 MJ/kg for layers and broilers, respectively. Those values are relatively higher than those reported for leucaena leaf meal (2.8 MJ/kg) (D’Mello and Taplin, 1978) and less than that reported for chaya leaf meal (8.8 MJ/kg) (Donkoh et al., 1990). No significant (P>0.05) differences were found that could be attributed to classes of chickens.

Conclusions

The results of this study provide information on the metabolizable energy and nutritive availability of MLM to chicks. The results also show that MLM can be used as a source of protein in poultry production. More research should be done to determine the optimum level of inclusion of MLM in diets for chickens.

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