Evaluation of the Cornell Net Carbohydrate and Protein System (CNCPS) in predicting the nutrient utilization and milk production of buffaloes

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ABSTRACT: The Cornell Net Carbohydrate and Protein System was used to predict the nutrient utilization and milk production of buffaloes under complete confinement system of management. There were 243 lactation records involving the age of the animals, live weight, body condition score (BCS), milk production, % milk fat, % milk protein; climatic conditions and the actual feed ration.

Simulation results showed that age, number of lactation, body weight and calving interval had no direct effect on the actual milk production and nutrient utilization of the dairy buffaloes. Significantly higher metabolizable energy (ME) and metabolizable protein (MP) allowable milk were predicted by the model compared to the actual milk production of the buffaloes. Using the actual ration, the model predicted 91 days for the buffaloes to gain one BCS while 70 days was needed when the CNCPS feed library is used. The model predicted significantly lower DMI (12.8 vs. 16kg/d) and forage intake (9.10 vs. 10.3 kg/d) with a difference of 21 % and 16 % than the actual ration. Significantly lower ME, (33.85 vs. 36.13 Mcal/d) was supplied by the actual ration but on the contrary, the MP supply (1,655 vs. 1,556 g/d) was higher than the CNCPS feed library. Significantly higher ME, MP and mineral (Ca, P, and K) balances were observed from the two rations indicating that more nutrients were supplied than what is required by the dairy buffaloes. The estimated manure and urine excretions were not significantly affected by the model predictions.

Key words: Cornell net carbohydrates, Protein system, Carabao, Dry matter intake, Body, Condition score, Metabolizable energy, Protein allowable milk.

INTRODUCTION - The water buffaloes remain important in the Philippine agriculture because of its significant role in the country’s farming systems. The carabaos are the major source of draft power and provide additional income from the sale of milk and live animals for slaughter or breeding purposes.

In ruminant nutrition, numerous models have been developed. These are extensively used to assess the feeding programs with greater accuracy and efficiency. Simulation models are the alternative methods in generating information instead of using live animals which are expensive and laborious.
The model “Cornell Net Carbohydrates and Protein System (CNCPS)” was developed to assess the nutritive value of feedstuffs and evaluates animal performance under dynamic conditions. This has a rumen sub-model that accounts ruminal and intestinal degradation of carbohydrates, proteins, minerals and vitamins, (Russell, et al. 1992 and Fox et al. 2003). The model also estimates mechanistically the nutrient requirements, nutrient utilization and excretion, environment effect and animal performances at different physiological conditions (Fox et al., 2003). With the enumerated unique features of the CNCPS, hence this study on buffaloes.

MATERIAL AND METHODS - Two hundred forty three (243) lactation data of buffaloes were used as the inputs of the CNCPS model. The inputted data involved 583 kg BW, and a BCS of 3.75. The rolling herd average was 1,367 kg at a lactation period of 272 days. The fat and protein contents of milk were 7.72 % and 4.2 %. The ration of buffaloes composed of Napier soilage (22.4%); Corn silage (20%); rice straw (24%); brewers spent grain (11.2 %) and dairy concentrate pellets (22.4%). The buffaloes were fed basal forages and spent grain at the free stall barn while the dairy concentrate was fed at the parlor during milking. The buffaloes were milked twice daily (4:00 AM and 3: 00 PM) using a tandem type milking machine with a capacity of 12 cows/batch.

The ambient temperature, relative humidity and wind speed observed at the farm were 28 oC, 2.1 kph and 80%. Other inputs such as the length of exposure to sunlight (30 min), the time spent for standing (12 hours), the distance walked by the animals (50 m/d) and the animals’ hair coat (medium) were also used in the simulations.

RESULTS AND CONCLUSION - Nutrient Requirements, Supply and Balance:
There was no significant difference between the actual ration and the CNCPS feed library on predicted ME requirements of buffaloes (Figure 1a). The actual ration however, has significantly lower ME supply (33.8 vs. 36.1 Mcal/d) and ME balance than the CNCPS feed library. Significantly higher MP supply and MP balance were also observed in the actual ration as against the CNCPS, (Figure 2b).

DMI and Forage Intake: The CNCPS predicted significantly lower DMI (12.8 vs. 16.5 kg/day) and forage intake (9.3 vs. 10.3 kg/day) than the actual ration of the buffaloes. These predictions disclosed limitations of the model in predicting accurately the feed intake of the buffaloes. Similar findings were reported by Russell, (1992) and Aquino, (2002) on DMI and forage intake of dairy cattle fed with corn or Alfalfa silage. In their reports, 15 and 20 % variations on DMI and forage intake were observed compared to the actual intake of the dairy cows.
Rumen Degradation Rates: The total protein degraded in the rumen was higher in the actual ration than the values observed from the CNCPS feed library. Of the total protein fractions, the peptide contents has the highest degradability values followed by the B2 (intermediately degraded), A (soluble N), B1 (fast) and the lowest was recorded in the B3 (slowly degradable) protein fraction. The actual ration contains significantly higher feed protein that escaped rumen degradation (891 g/d) compared to 810 g/d for the CNCPS feed library. The CNCPS library gave significantly higher prediction of carbohydrate fractions degraded in the rumen compared to the actual ration. The B1 and the B2 carbohydrate fractions account the highest degradation rates among the degradable carbohydrates from the diet.

Actual vs Predicted Milk Production: The predicted milk productions were expressed in terms of ME, MP, and amino acids (Methionine or Lysine) allowable milk. The predicted milk production relative to ME (9.88 vs. 11.3 kg/d) was significantly lower in the actual feed ration compared with the CNCPS feed library, however, in terms of MP allowable milk, the observation was reversed (15.32 vs. 13.76 kg/d) with the actual ration giving significantly higher milk production than the CNCPS. Neither the actual ration nor the CNCPS library is used, the model predicted significantly higher milk production ME, MP and amino acids allowable milk compared to the recorded actual of buffaloes.

The buffaloes given the actual feed ration required 91 days to gain one BCS while 70 days was needed with the CNCPS feed library. Based on the findings, it was concluded that the CNCPS model is best suited for evaluating performance of dairy cattle. Refinement of CNCPS and more validations are needed for future adoption in buffaloes. The identified factors that limit the accuracy of the model predictions include the feed intake, breed effect, allowable milk production and other metabolic characteristics of the feedstuffs used.
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