UTILIZED METABOLIZABLE ENERGY AND ITS IMPACT ON THE MANAGEMENT OF GRASS PASTURES IN THE CENTRAL CHACO OF PARAGUAY

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ABSTRACT

Animal production from sown pastures of Gatton Panic (*Panicum maximum* Jacq.) and Estrella (*Cynodon nlemfuënsis* Vand.) on a luvic Kastanozem in the Central Chaco of Paraguay (mean annual rainfall 850 mm) was measured over two years (Sep. 1992 to Nov. 1994). The pastures were grazed continuously by Brahman X Hereford steers at six stocking densities, ranging from 0.5 to 2.0 American Animal Units (1 AU = 454 kg) per hectare. Herbage availability, chemical composition (ME, XP, fibre) and cattle liveweight gains were measured at four weekly intervals. Building regression models for Utilized metabolizable energy (UME in GJ/ha) and ME requirements for maintenance (RM in GJ/ha) over stocking densities, the maximum energy conversion was obtained with 1.8 AU/ha. At this stocking density, 29 % of UME was transformed into liveweight gain. The calculated intersect of the UME and RM functions occured at a stocking density of 3.4 AU/ha when, theoretically, animals only maintain their body weight.

KEYWORDS

Grazing experiment, continuous grazing, utilized metabolizable energy, stocking density, energy conversion, Central Chaco, Paraguay

INTRODUCTION

More than 90 % of the agricultural income in the Central Chaco of Paraguay is made by animal production (milk and meat) on improved or sown pastures. The two most important grass species are Gatton Panic (*Panicum maximum* Jacq.) and Estrella (*Cynodon nlemfuënsis* Vand.), covering more than 60 % of the total pasture area. In this summer dominant rainfall region (600-900 mm year $^{-1}$), stocking densities range from 0.5 to 2.5 animals per ha with liveweight gains from 300 to 800 g per day during summer and sometimes severe weight losses during winter (June to September). The utilized metabolizable energy (UME in GJ/ha) is a measure of the totally ingested metabolizable energy of grazing herbivores within a defined period (Glatzle, 1990). The objective of this study was to calculate UME for the different stocking densities and to determine with a regression model the ideal stocking density at which the feed energy conversion into liveweight reaches its maximum. This should lead to a better determination of the production potential of improved pastures in the Central Chaco of Paraguay.

MATERIALS AND METHODS

The experimental site is located 100 km S.S.E. of Filadelfia (lat. 23° 05' S; long. 59° 37' W) on a luvic Kastanozem with soil pH of 7.2, organic matter content of 2.4 %, total soil nitrogen of 0.17 % and a phosphorus level of 78 ppm (Sep. 1992). In total, 12 plots of 4 ha each of Gatton Panic and Estrella were established in Nov. 1991. Plots were stocked with Brahman X Hereford yearling steers (Sep. 1992 - Oct. 1993; Nov. 1993 - Dec. 1994) at six stocking densities ranging from 0.5 to 2.0 American Animal Units per ha and continuously grazed. A repetition of the design was omitted in favor of doubling the number of stocking density levels applied. Mean initial liveweight was 216 kg ± 5.6 kg (±Std.Error) in Sep. 1992 and 235 kg ± 3.3 kg in Nov. 1993. The fixed stocking densities were adjusted, as animals grew, by removing individual animals from the plots. Liveweight gain and standing biomass was measured at four weekly intervals. Standing biomass was determined by clipping in rectangular frames (0.5 m^2) to ground level (t' Mannetje, 1978, Frame, 1981). Chemical composition (ME, XP, fibre) was determined for the leaf and stem fractions.

RESULTS AND DISCUSSION

Figure 1 shows the dynamics of ingested metabolizable energy (GJ/ha) during the average grazing year (Oct. to Sep.) for maintenance (IME-M) and for maintenance and growth (IME-Total) at the highest stocking density (2.0 AU/ha). The ME requirements were calculated according to the formulas published by the Agricultural Research Council (ARC, 1990) for bullocks of breeds of medium mature size. The calculations were based on actual liveweight (kg), liveweight gain (g/day) and ME-content in the leave fraction of the standing biomass (MJ/kg dry matter) measured in monthly intervals, averaging grass species and years. The difference between IME-Total and IME-M represents the ingested metabolizable energy for growth. As from June on, IME-Total could not maintain liveweight and body weight shrunk to cover maintenance requirements. By integrating both functions over time, utilized metabolizable energy (UME = $\vee$ IME-Total) and ME requirements for maintenance (RM = $\vee$ IME-M) were obtained. The regression model for UME over stocking densities applied (Fig. 2), resulted in a quadratic relationship (R^2 = 0.986), whereas a strictly linear relationship (R^2 = 0.998) was found for RM, as stocking densities were fixed. The difference of both functions results in a new function (not shown), describing the quantity of metabolizable energy transformed into liveweight gain within one grazing year. This function has a maximum at 1.8 AU/ha which defines the stocking density with the highest ME conversion level of 29 %. By extrapolation, the intersection of both functions was calculated at 3.4 AU/ha. At this stocking density, all weight gains during the growing season would have been compensated by weight losses during winter and liveweight would only be maintained. Even higher stocking densities would result in a steady decline of liveweight. This model describes a more comprehensive method of calculating the production potential of a grazing system as it accounts for the energy conversion at different stocking densities. However, to sustain a profitable grazing system, ecological (Leach et al., 1976) and economical factors (Nix, 1989; Parsch et al., 1989) also have to be taken into account. For the Central Chaco of Paraguay, stocking density should therefore never exceed 1.5 AU/ha.

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Figure 1
Dynamics of ingested metabolizable energy (GJ/ha) for maintenance (IME-M) and for mainte-nance and growth (IME-Total) within one grazing year (Oct. to Sep.) at 2.0 AU/ha.

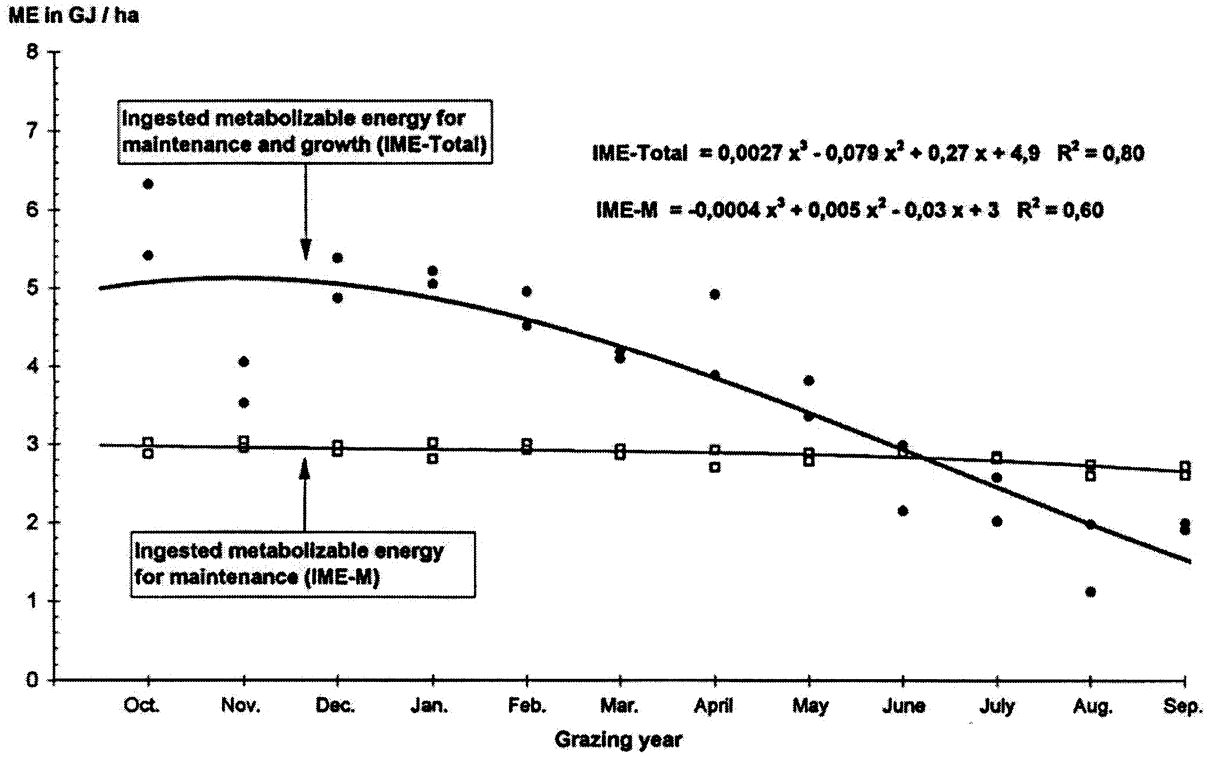

Figure 2
Utilized metabolizable energy (UME) and ME requirements for maintenance (RM) (GJ/ha year $^{-1}$) over stocking density.