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Comparative analysis of gas production profiles obtained with buffalo and sheep ruminal fluid as the source of inoculum

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Abstract

An in vitro study was conducted to investigate effects of inoculum source (i.e., sheep versus buffalo rumen fluid) on gas production profiles, and to evaluate the suitability of various mathematical equations to fit the profiles and provide accurate values of degradation attributes. Incubations were completed using ruminal fluid obtained from sheep or buffalos fed the same diet (600 g/kg grass hay and 400 g/kg concentrate). Kinetics of fermentation of five feeds commonly fed to ruminants, being maize silage, grass silage, wheat straw, barley grain and a mixed hay, were studied with a gas production technique using an automated pressure evaluation system (APES). Ruminal fermentation characteristics (i.e., substrate disappearance, pH and VFA production) were determined after 120 h of incubation. Five mathematical functions (i.e., exponential, France, Gompertz, logistic, Morgan) were fitted to the experimental data to estimate rate and extent of feed degradation. Model comparison

Abbreviations: A, asymptotic gas production; AIC, Akaike's information criterion; APES, automated pressure evaluation system; DM, dry matter; *E*, extent of degradation at a given rumen passage rate; EXP, simple exponential model; FRN, France model; GMP, Gompertz model; LOG, logistic model; MRG, Morgan model; NDF, neutral detergent fibre; OM, organic matter; RMS, residual mean square; S.E.D., standard error of the difference; $t_{1/2}$, half time; t^*, time at point of inflection; VFA, volatile fatty acids; $\mu_{1/2}$, fractional rate of fermentation at half time

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was based on goodness-of-fit assessed from analysis of residual variance and Akaike's information criterion. The logistic and Morgan functions were best overall, although the goodness-of-fit attained with all models was considered acceptable. Except for the Morgan, there were small differences among models in values derived for extent of degradation. There were differences between sources of inoculum in gas production measured at intermediate times (i.e., gas volumes with buffalo rumen fluid of 133 and 164 ml/g organic matter (OM) at 24 h for grass hay and silage, respectively, were smaller than those with sheep rumen fluid of 182 and 208 ml/g OM), but not at earlier or later incubation times. As a result of this trend, shorter half times, faster fermentation rates and higher extents of degradation occurred when feeds were incubated in sheep (estimated OM degradability was 0.308 and 0.402 g/g OM for grass hay and silage, respectively) compared with buffalo rumen fluid (0.246 and 0.330 g/g OM). Differences were larger for more fibrous substrates (i.e., grass silage, straw and hay) and negligible for barley grain.

Keywords: Gas production; Rumen; In vitro fermentation kinetics; Buffalo; Sheep

1. Introduction

Rumen degradation of feeds has usually been studied in cattle and sheep and so less information is available with other ruminant species, in particular water buffaloes (*Bubalus bubalis*) (Grant et al., 1974; Infascelli et al., 1995; Malakar and Walli, 1995). This is an important species in some parts of the world, especially southeast Asia, and within Europe a considerable number of Mediterranean buffalo farms have long been established in the south of Italy for the production of Mozzarella cheese.

Characterisation of the nutritive value of feeds for buffaloes is an important area of study to facilitate improvements in their productivity (Di Lella, 1997; Zicarelli, 1999; Bartocci et al., 2002). Although there may be substantial differences among animal species in the degradability and digestibility of feeds, most tabulated data on feed nutritive values have been derived from studies conducted with sheep, primarily because of the convenience of working with these small ruminants.

Most comparisons between buffaloes and other ruminant species in the ruminal degradation of feeds have been with cattle (Malakar and Walli, 1995; Calabrò et al., 2004). It is often assumed that buffaloes are more efficient than cows in digesting fibrous feeds, and better adapted to a wider range of forage resources. However, comparative studies involving cattle and buffalo are controversial, probably because of the different procedures and experimental conditions of each study, in particular the feeds tested (Sarwar et al., 1998), as well as the type of diet fed to each species (Calabrò et al., 2004). In contrast, few results are available that compare buffalo with sheep. In vitro gas production techniques can provide valuable information about digestion kinetics of feeds in the rumen, and can be useful in investigating differences between and within animal species in ruminal fermentative activity (Williams, 2000).

One of the objectives of this study was to evaluate effects of donour animal species (i.e., sheep versus buffalo) on measurement of gas production kinetics and fermentation characteristics using both forage and concentrate substrates. Another objective was to compare