Energy and protein metabolism and nutrition

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Mario Luiz Chizzotti

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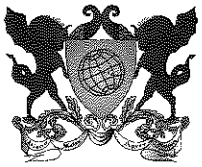

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Results and discussions

High starch diet increased (P=0.01) milk production in goats and B[illegible]es (Figure 1). After the meal intake, plasma glucose concentration did not significantly cha[illegible]pt for LS ewes, NEFA level decreased (P=0.005) from 60 min to 180 min, according to [illegible] studies (Marie *et al.*, 2001). In contrast to other studies (Takahashi *et al.*, 2008), the variation of insulin, IGF-1 and leptin concentration were limited. Plasma GH concentration decreased after the meal intake (P=0.0007) and then started to increase in a different way among groups, showing more oscillation in goats than in ewes. The level of starch did not affect any of these metabolic parameters. In terms of species, goats had a higher GH and leptin concentration that probably drove more nutrients toward mammary gland and confirmed the high aptitude of this species to have high milk production persistency. In ewes, the highest glucose, insulin and IGF-1 concentration probably drove more nutrients toward body reserves and, explained the higher accumulation of body reserves compared to goats. The constant availability of feed during the experiment probably limited the variability over time, due to the diets, of hormones and metabolites.

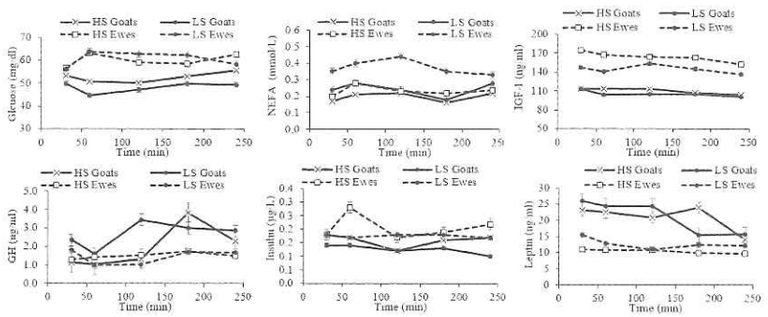

Figure 1. Post-prandial evolution of glucose, NEFA, GH, insulin, IGF-1 and leptin in mid-lactating Sarda ewes and Saanen goats fed a high starch (HS) and a low starch (LS) diet. The effect of diet was always not significant. The effect of time was significant for NEFA (P=0.005), GH (P=0.0007) and leptin (P<0.0001). The effect of species was always significant except for NEFA (Glucose: P<0.0001; GH: P=0.037; insulin: P=0.018; IGF-I: P<0.0036; leptin: P<0.0001).

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Orange leaves and rice straw in the diet of lactating goats: effect on energy balance

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Abstract

The aim of this work was to determine the effect of horticultural byproducts on energy balance and efficiency of utilization of ME for milk production (k_l) of lactating goats. Two isoproteic and isoenergetic (180 g/kg DM and 17 MJ/kg DM) diets were assayed with alfalfa hay as forage source, and peas and horsebean as protein source. A control diet (CON) incorporated barley as energy source (concentrate) and an experimental diet (EXP) replaced barley with orange leaves and rice straw. Ten Murciano-Granadina goats at mid-lactation were used following a cross-over design. Feed intake, refusal, fecal and urine output, and milk yield were recorded daily for 5 d. Then, heat production (HP) was determined during 24 h by indirect calorimetry. Greater ME intake and HP (P<0.05) in CON vs EXP diet were found but k_l value was not different (0.64 on average). Energy loss as CH_4 was lower (P<0.05) in EXP than CON diet. Greater recovered milk energy was obtained in EXP than CON diet. The body retained energy was greater (P<0.05) in CON than EXP diet. The use of the byproducts orange leaves and rice straw improved the energy milk content with no detriment of k_l value and reduced the CH_4 production in lactating goats.

Keywords: *byproduct, efficiency, methane*

Introduction

The Spanish ruminant production system (FEDNA, 2009) is based on high use of concentrate (40-70%) instead of pasture. Goat livestock occupies the second position in the EU with 30% of the total milk production. In Spain, the Valencian Community is one of the oldest citrus production areas in the world and also has traditional rice cultivation. Many foods and beverage by-products from processing become residues generating environmental problems. There is an increasing interest in use of these waste byproducts for ruminant diets. The aim of this work was to determine the effect of waste horticultural byproducts on energy balance and efficiency of utilization of ME for milk production (k_l) of lactating goats.

Material and methods

Ten Murciano-Granadina goats at mid-lactation (45±0.3 kg BW) were used in a cross-over design. Two isoproteic and isoenergetic diets (180 g/kg DM and 17 MJ/kg DM, respectively) were assayed, with alfalfa hay as forage source (37%) and peas and horsebean as protein (concentrate) sources. A control diet (CON) incorporated barley as energy source and an experimental diet (EXP) replaced barley with orange leaves (19%), rice straw (12%) and soya oil (2%). After 15 d of adaptation in pens, the goats were allocated to individual metabolism cages and after 7 d of adaptation, feed intake, refusal, total fecal and urine output, and milk yield were recorded daily during 5 d period. Then, heat production (HP) was determined (Brouwer, 1965) during 24 h using a mobile open-circuit indirect calorimetry system connected to a head box. The retained energy was calculated as ME intake-HP, the body retained energy as ME-HP-recovered milk energy, and k_l as corrected milk energy/(ME intake-MEm) assuming MEm=401 kJ/kg$^{0.75}$ BW/d (Aguilera *et al.*, 1990). The gross energy content of dried feed, feces, urine and milk was analyzed using an adiabatic bomb calorimeter. The data were analyzed by ANOVA-I. The differences were significant when P<0.05.

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Results and discussion

No differences ($P>0.05$) between diets were observed in gross energy intake (Table 1). Energy loss in CH_4 was lower ($P<0.05$) in EXP than CON diet. Greater ($P<0.05$) ME intake and HP in CON than EXP diet were found although no difference ($P>0.05$) in k_l was found (0.64, on average), a value similar to that reported by Aguilera *et al.* (1990) with the same breed (0.67) and Tovar-Luna *et al.* (2010) with Alpine goats (0.63). The body retained energy was greater ($P<0.05$) in CON than EXP diet. Greater recovered energy in milk was observed in EXP than CON diet. The use of the waste byproducts orange leaves and rice straw reduced the loss as CH_4 and improved the energy milk content in lactating goats.

Table 1. Energy partitioning (kJ/kg$^{0.75}$ BW/d) of mid-lactating goats (n=10) fed a control (CON) and an experimental (EXP) diet replacing barley with orange leaves and rice straw.

	Diet		SEM	*P*-value
	CON	EXP		
Gross energy intake	2,189	2,217	27.5	0.586
Energy losses in feces	687	842	15.7	0.001
Energy losses in urine	61	101	3.6	0.001
Energy losses in methane	96	88	1.3	0.001
ME intake	1,345	1,187	20.7	0.001
Heat production	736	693	8.9	0.014
Body retained energy	163	18	24.1	0.001
Recovered milk energy	446	476	13.4	0.001
k_l[1]	0.65	0.63	0.014	0.067

[1] Efficiency of utilization of ME for milk production.

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The increasing human population, growing income and urbanization worldwide creates a rapidly growing demand for livestock products. Not only quantity matters, sustainable production is getting increasingly important. To maximize efficiency and minimize the environmental footprint of livestock products, one needs to deeply understand animal biology. Knowledge in animal sciences, particularly in farm animal nutrition, is vital to meet those demands, and that is where this book can help.

This book focusses on combining basic and applied research and its implications on energy and protein nutrition and metabolism. Relevant topics are presented and discussed in detail. The most important issues are: sustainable use of energy and protein in animal nutrition, new feeds, dietary additives, feed processing methods, mitochondrial and amino acids kinetics. Effects of heat stress, sanitary challenges, and feeding behaviour on energy metabolism, and methods and modelling approaches applied to animal nutrition are also part of the book. This makes 'Energy and protein metabolism and nutrition' an excellent source of knowledge for those who would like take animal nutrition into the future.