Energy and protein metabolism and nutrition

EAAP publication No. 124

Scientific editor:

I. Ortigues-Marty
with the contribution of the National Scientific Committee

Managing editor:

N. Miraux
with the contribution of the Managing Editorial Committee

Language editor:

W. Brand-Williams

Wageningen Academic Publishers

ISBN 978-90-8686-041-8

ISSN 0071-2477

First published, 2007

Wageningen Academic Publishers
The Netherlands, 2007

Nitrogen metabolites and enzymatic activity during the weaning period in goat kids

D. Magistrelli[1], L. Pinotti[2] and F. Rosi[1]
[1]Department of Animal Science, Agricultural Faculty, University of Milan, Via G. Celoria 2, 20133 Milan, Italy
[2]Department of Veterinary Sciences and Technology for Food Safety, Veterinary Faculty, University of Milan, Via G. Celoria 10, 20133 Milan, Italy

Introduction

In mammals weaning is the transitional stage of life from milk to other sources of nutrients. It is characterised by several changes that can deeply influence growth, maturation of gastro-intestinal and reproductive apparatus (Garnsworthy, 2005) and even the quality of the end products (Schoonmaker *et al.*, 2002). In light of this, the aim of the present study was to evaluate the variations in protein metabolism and in the liver and pancreas enzymatic activity, involved in the adaptation process of young animals to the solid diet.

Material and methods

At birth, 11 Saanen goat kids were assigned to one of the two experimental groups: MILK (6 animals) and WMIX (5 animals). All kids were fed colostrum for 3 d and then goat milk (3.22% crude protein, 3.61% fat, 4.73% lactose, as fed) for the first 4 wk of life. Starting from the 5th wk, MILK group continued to receive goat milk, while the WMIX group was fed milk in decreasing quantity plus a weaning feed mixture (15.6% crude protein, 5.36% ether extract, 16.7% starch, as fed) *ad libitum*; on d 47 of age, the WMIX group was completely weaned. Weaning feed mixture was constituted by grass hay (30%), dehydrated alfalfa (10%), steam-flaked maize (19%), maize gluten meal (3%), dried sugar beet pulp (8%), soybean meal (15%), sunflower seed (4%), sugar cane molasses (4%) and mineral/vitamin supplement (7%). During the experimental period, mean feed intake of the two groups was recorded every d and individual body weight was recorded weekly. On wk 3, 4, 5, 6 and 7 of age, blood samples were taken before the first meal of the d. Blood was immediately centrifuged at 2000×*g* for 15 min and then stored at -20 °C until analysis for total protein, urea, creatinine (Giesse Diagnostics Snc, Roma, Italy), albumin, globulin (Boehringer Mannheim GmbH, Mannheim, Germany) and free aminoacid (Goodwin, 1968). On d 50 of age, all kids were slaughtered and carcass and liver weight recorded. Liver and pancreas samples were stored at -80 °C and then analysed for DNA and RNA (Munro, 1969). Phospholipid (Munro, 1969) and soluble protein level (Pierce, Rockford, IL, USA) and alanine aminotransferase (ALT) and aspartate aminotransferase (AST) activity (Boehringer Mannheim GmbH, Mannheim, Germany) were analysed in the liver. Zymogen content and α-amylase activity (Giesse Diagnostics Snc, Roma, Italy) were determined in the pancreas. Data obtained were evaluated by analysis of variance.

Results and discussion

Dry matter intake began to differ ($P<0.01$) on the 6th wk of age (328 vs. 407 g, for WMIX and MILK group respectively), when WMIX kids progressively began to ingest the weaning mixture. This difference can be explained by the difficulty of the WMIX group to accept the new diet. By contrast, no difference was observed in body weight, during the entire period, but the weight of WMIX kids could be overestimated by the presence of feed in the rumen. The weaning protocol significantly decreased ($P<0.01$) the overall mean of plasma free aminoacid and increased ($P<0.05$) plasma creatinine. Major differences were observed on d 50 of the experiment (Table 1), when free aminoacid and urea were lower ($P<0.01$) in the WMIX group than in the MILK one, as a possible consequence of the lower availability of nutrients in the solid diet. As shown in Table 1, plasma creatinine level was higher ($P<0.01$) in WMIX group, although no difference was observed in body and carcass weight, neither in plasma protein.

Table 1. Slaughtering parameters, plasma, liver and pancreas analysis on d 50 of age.

Slaughtering parameters	Body weight, kg	Carcass weight, kg	Liver weight, g	Liver weight, % BW
WMIX	15.3	9.54	330	2.17*
MILK	16.2	10.7	377	2.76*

Plasma	Total protein, g/L	Albumin, g/L	Aminoacid, mM	Urea, mM	Creatinine, mM
WMIX	53.1	38.9	4.21**	5.67**	78.9**
MILK	55.4	39.9	5.58**	7.66**	69.3**

Liver	DNA, mg/g	RNA, mg/g	Phospholipid, mg/g	Soluble prot., mg/g	ALT, U/g	AST, U/g
WMIX	2.96	5.47	3.80	223	7.71	200
MILK	2.54	5.29	3.87	238	8.22	229

Pancreas	DNA, mg/g	RNA, mg/g	Zymogen, mg/g	α-amylase, U/g	α-amylase, U/mg Z
WMIX	3.36	13.3	10.8	8.23*	0.70**
MILK	3.16	11.8	9.65	29.5*	2.79**

* $P<0.05$; ** $P<0.01$.

On d 50 of age, liver weight, hepatic DNA, RNA and phospholipid content and ALT and AST activity were not different between the two experimental groups (Table 1). However, liver weight expressed as a percentage of body weight ($P<0.05$) (Table 1), as well as liver RNA expressed on kg of body weight (118 vs. 146 mg/kg BW, $P<0.01$) and liver content of soluble protein on mg of RNA (40.4 vs. 44.9 mg/mg RNA, $P<0.05$) were lower in WMIX animals than in the MILK group. On d 50 of age, pancreatic zymogen, DNA and RNA content was not different between groups (Table 1). By contrast, pancreatic α-amylase activity expressed as unit on g of fresh tissue, as well as when expressed on zymogen (Table 1), on DNA (2.94 vs. 8.87 U/mg DNA), and on RNA (0.57 vs. 2.34 U/mg RNA), was more than three times lower ($P<0.05$) in the WMIX group than in the MILK one. Pancreatic amylase activity was also correlated with plasma free aminoacid concentration (r=+0.80; $P<0.01$). The data here reported suggest that weaning can affect protein metabolism and pancreatic amylase activity. However, it is surprising that the MILK group had a higher level of pancreatic α-amylase, even if there was no starch in the milk diet. So, more extensive experiments are required in order to establish what could be the stimulator of pancreatic α-amylase synthesis and secretion, at the time of weaning.

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