National Institute for Research & Development
in Animal Biology and Nutrition, ROMANIA

THE EFFECTS OF PARTIAL REPLACEMENT OF GRAINS WITH MOLASSES ON RUMINAL MICROBIAL PROTEOSYNTHESIS IN GROWING RAMS

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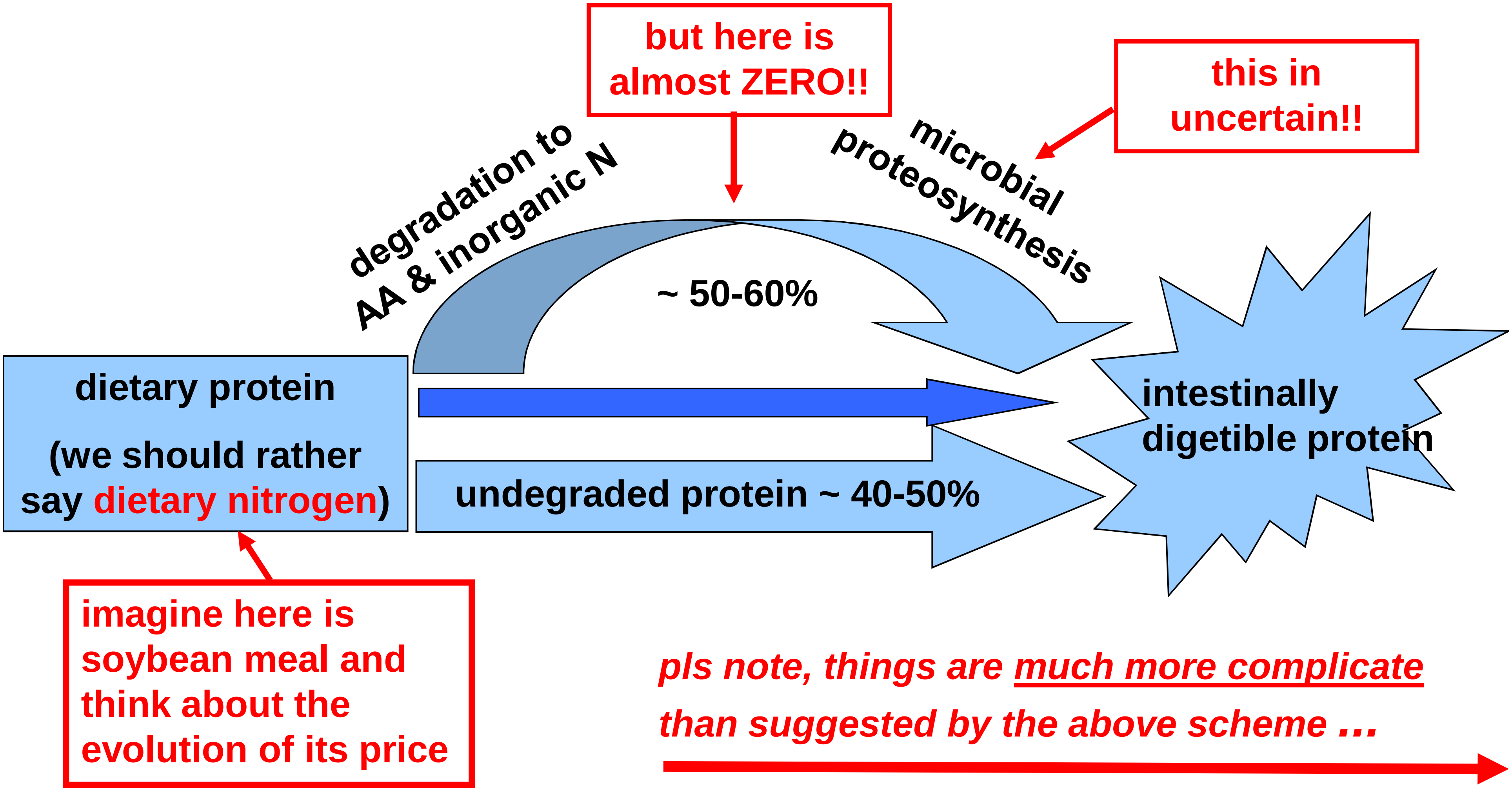
Presentation's overview:

- **Background & Interest for feed scientists;**
- **Opportunity of research & Objective**
- **Experimental framework**
- **Results**
- **Conclusions & Future work**

Background & Interest for feed scientists

Very simple representation of protein ruminal metabolism:



pls note, things are <u>much more complicate</u> than suggested by the above scheme …

there are two main processes involved:

- ruminal degradability (not discussed here)
- microbial proteosynthesis

there are two feeding strategies to follow / apply:

- the "expansive way" = use of slowly degradable sources, protection of high protein feeds against ruminal degradation (heat treatment, additives, dietary manipulation, etc.)

- the cheap way = ensure a minimum of proten by-pass and focus on the stimulation of microbial proteosynthesis (means ensuring appropriate conditions)

FACTORS ACTING ON NITROGEN METABOLISM: CP content of feeds, conservation, fertilisation, stage of plant development, mechanical & physical & chemical treatments, nature of protein (e.g. linkage to the plant cell walls), rumen environment (pH, redox potential, etc.), energy supply (in appropriate form, at appropriate moment), protein supply (idem), minerals, presence of some specific growth factors (some vitamins, some organic acids, etc) rumen dilution rate / retention time, diet composition, intake level, presence of probiotics,
AND MANY OTHERS ....

NOTE: - for each of these factors – tens of articles in literature & often the results are inconsistent / controversial

- rumen models are more and more complicate (see dynamic models, e.g. Djikstra, Sauvant...)

ATTN: - low awareness of farmers (fragmentation of properties, atomization of ruminants exploitation)

- low efficiency of many extenstion system (at least in Romania)

- lack of tools for estimation (while appropriate feed evaluation itself is an issue in some countries)

+ many farmers do not know the concepts of protein degradability and microbial synthesis

- degradability = directly related to the feeding costs (not only the %CP is important in establishing the price)
- protein synthesis = also related to the feeding efficiency (= feeding costs)

Q: how to make them manipulating the diets in order to maximize the protein synthesis (beside use of feed additives & similar)

? commercial protein-vitamin-mineral premixes

Opportunity of research & Objective

general agreement on the beneficial effects of rapid sugars on microbial proteosynthesis

but conditions for their use are still to be established (e.g. side effects on rumen pH, controverse on energy & protein synchronisation, rumen passage, etc.)

not always positive results

molasses = usual in animal feeding, known overall effects on animal performances (milk, weight gain)

? what about dirrect effect on microbial proteosynthesis, what about their use in a rather poor diets (supossed to bring added value)

Objective: assessing the effect of partial replacement of the energetic ingredients of the compound feed (grains)

Experimental framework

8 growing rams (Merino) in digestibility cages, two groups

general procedure for digestibility trials applied (Burlacu, 1991) + total collection of urine

diets designed to be isoenergetic and isonitrogenous; the only difference was the nature of energy (40% of the energy ingredients of the compound feed replaced with molasses)

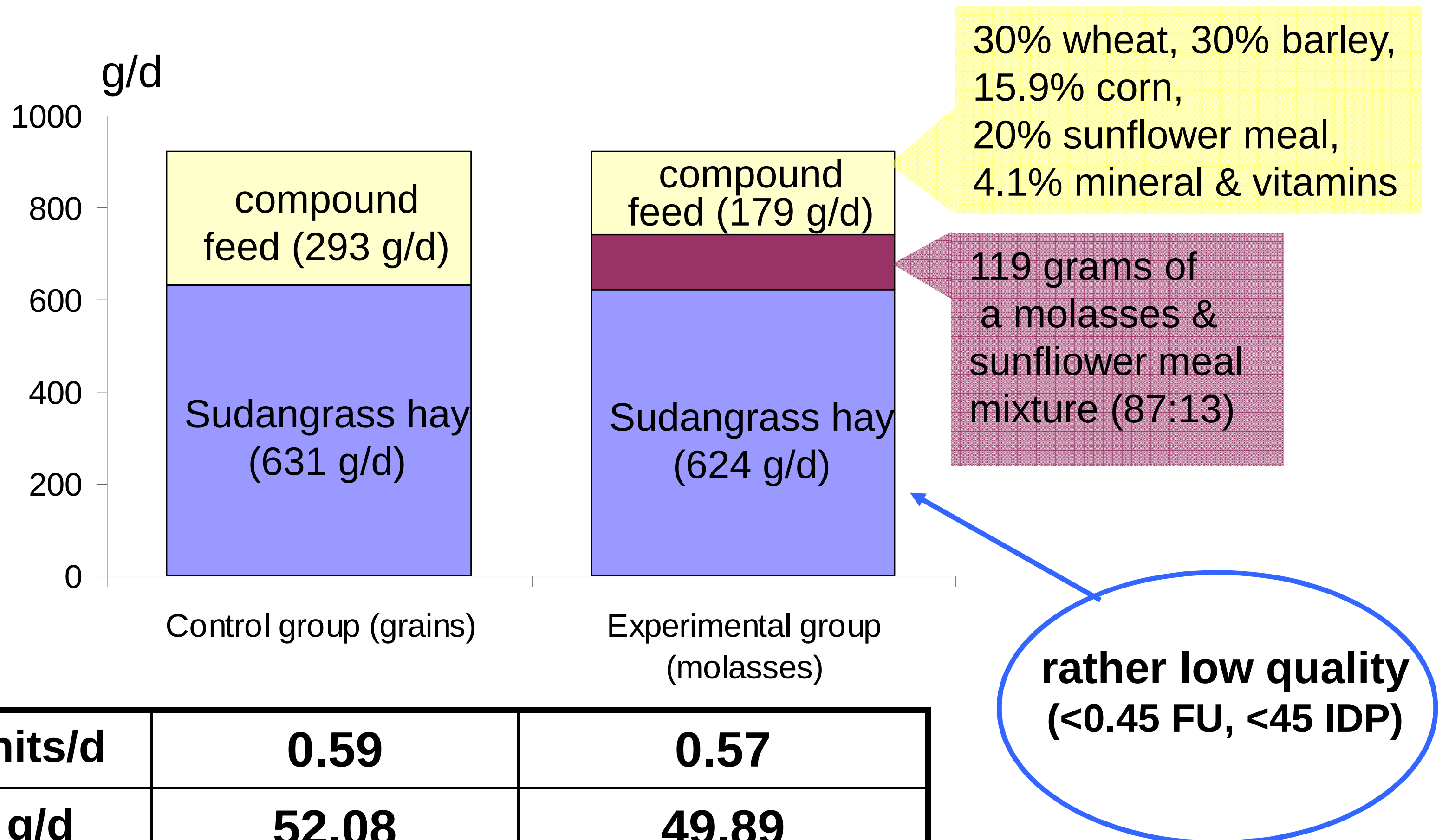
determination of purine derivatives (allantoin, uric acid, xanthine, hypoxanthine) + creatinine in urine samples using a HPLC method

microbial proteosynthesis estimated using the model (equations & coefficients) of Chen et al (1992)

statistical analysis: GLM procedure (Minitab software)

this is part of a larger set of trials on the use of molasses for direct stimulation of microbial proteosynthesis in rumen

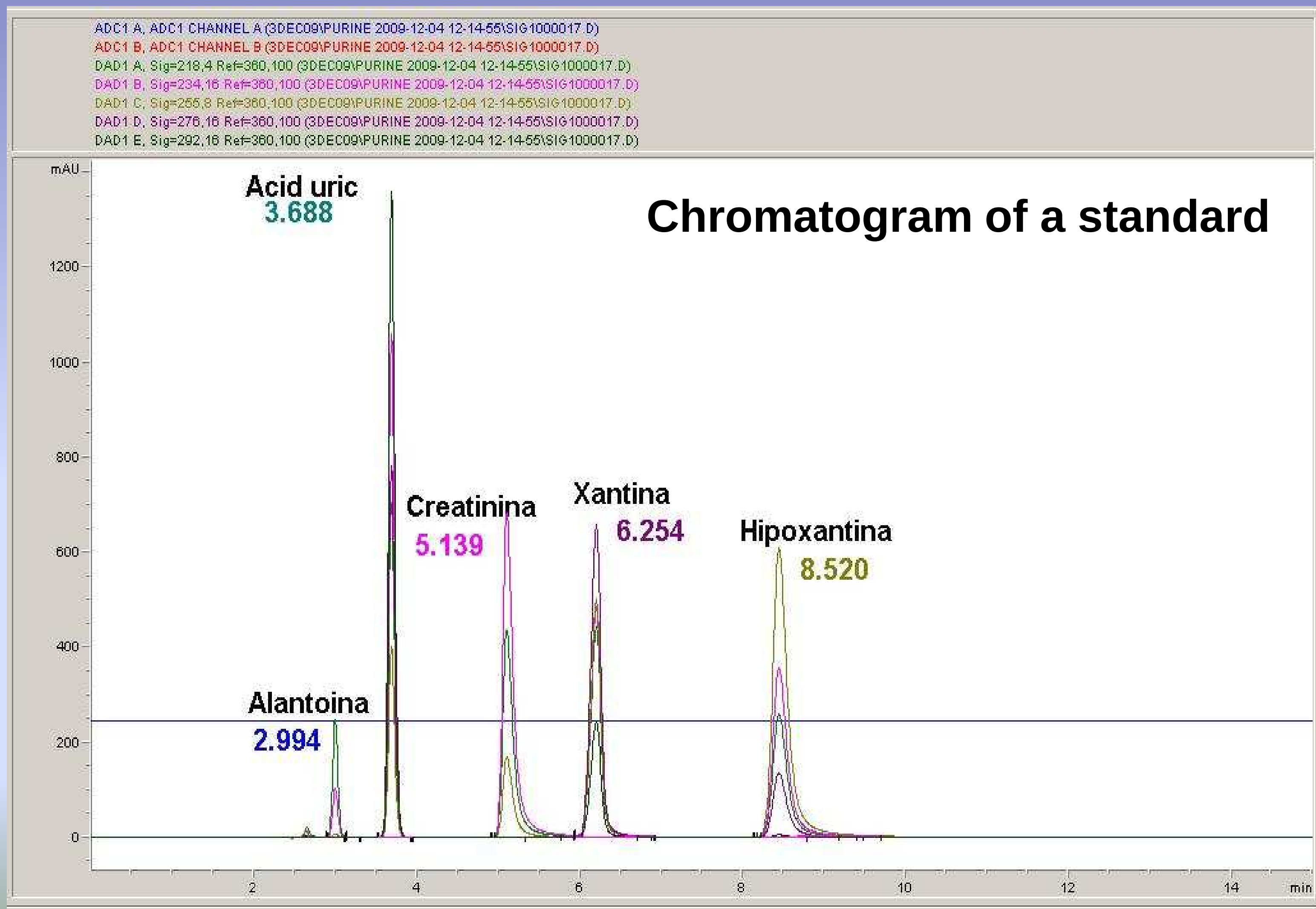
Ingested diets
(partial replacement of grains = 40%)



FU, units/d	**0.59**	**0.57**
PDIN, g/d	**52.08**	**49.89**
PDIE, g/d	**49.21**	**47.97**

* nutritive value assessed according to Burlacu Gh., 1996

Results



ADC1 A, ADC1 CHANNEL A (3DEC09\PURINE 2009-12-04 12-14-55\SIG1000017.D)
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Xantina
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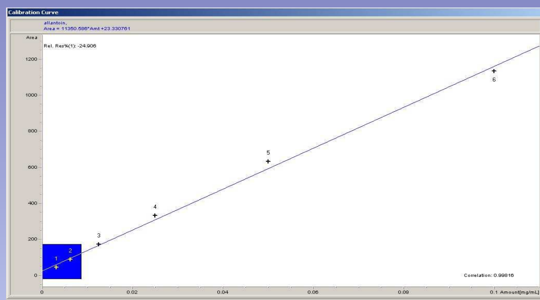

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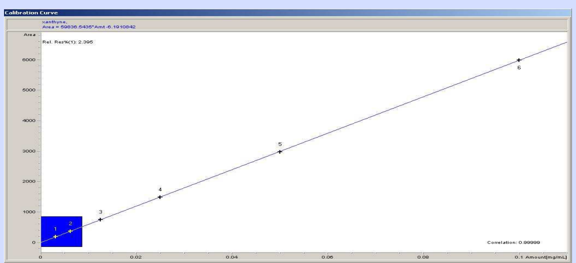

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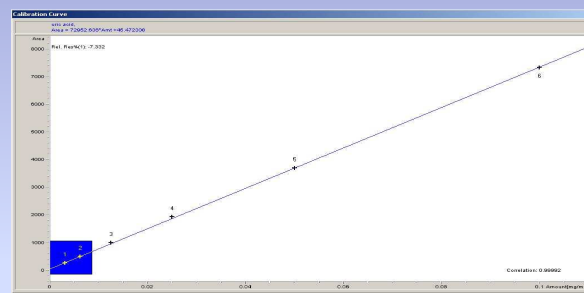

URIC ACID
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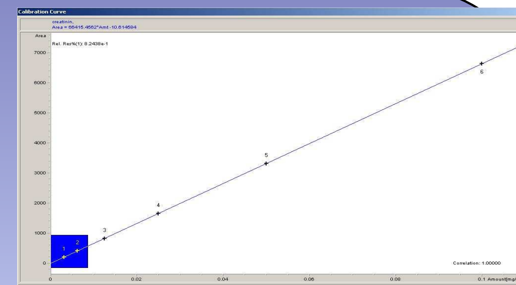
y = 72460,60952 X + 55,19241



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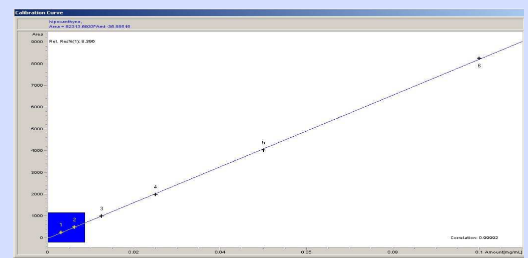
Y = 66441,89418 X - 7,82884



HIPOXANTHYINE
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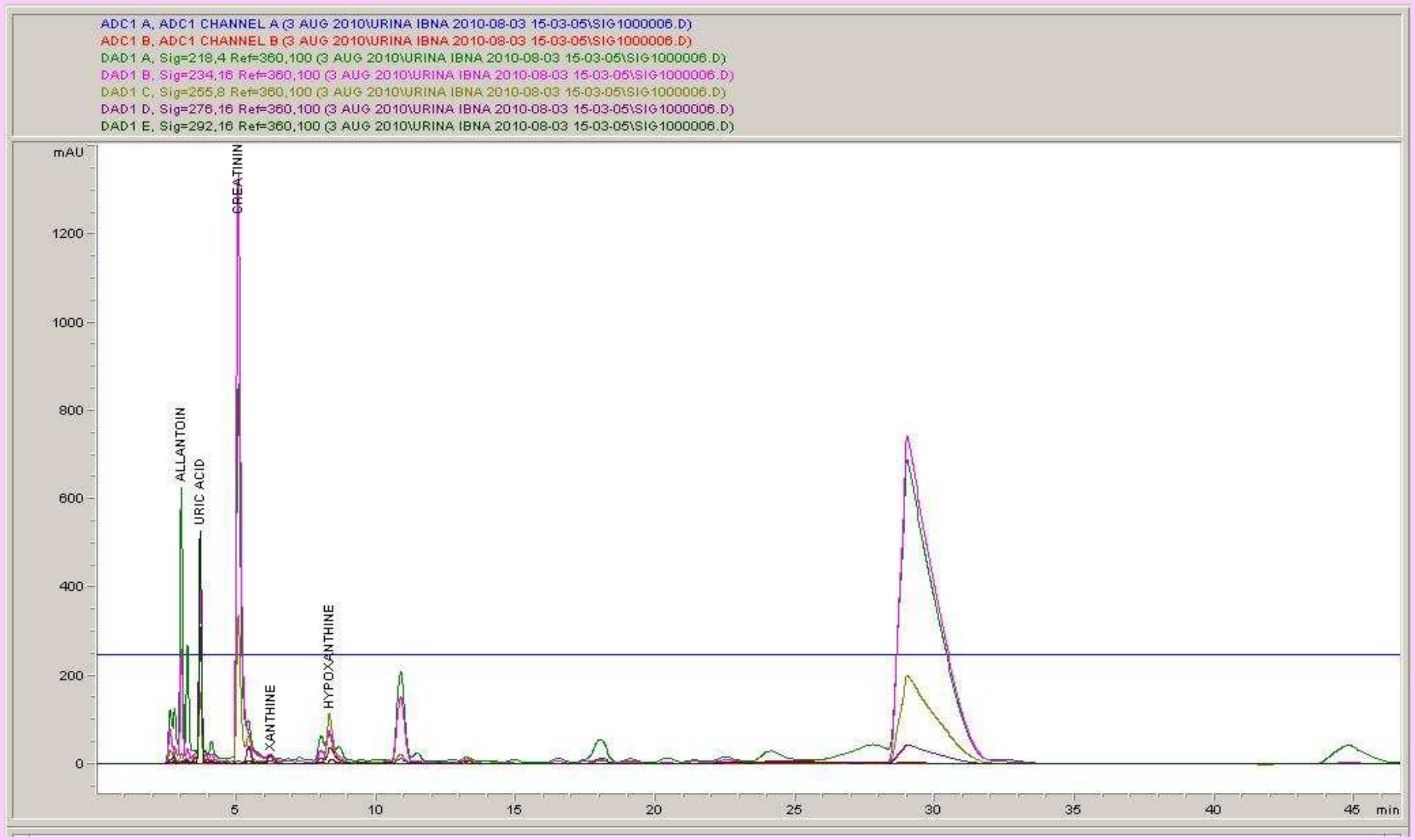
y = 82441,50268 X – 43,76200



Chromatogram of an urine sample

Daily output of urine and purine derivatives

Specification	**Control group (grains)**	**Experimental group (molasses)**
Urine volume, (ml)	524.6 ± 99.7	556.0 ± 198.3
Total allantoin, mmols/d	4.536 ± 1.585	4.489 ± 1.759
Total uric acid, mmols/d	0.584 ± 0.265	0.680 ± 0.275
Total xanthine, mmols/d	0.054 ± 0.031	0.039 ± 0.024
Total hipoxanthine, mmols/d	0.471 ± 0.174	0.499 ± 0.181
Total purine derivatives, mmols/d	**5.645 ± 2.020**	**5.707 ± 2.193**

~ +1% = no effect

!! high data variability (usual in such trials)

Daily production of rumen microbial protein

Specification	**Control group (grains)**	**Experimental group (molasses)**
BW, Kg	58.33 ± 2.98	62.08 ± 0.48
Purine derivatives in urine, mmols/d	5.645 ± 2.02	5.707 ± 2.193
Purine derivatives in microbes, mmols/d	5.275 ± 3.354	5.53 ± 3.431
Microbial N, g/d	3.835 ± 2.439	4.02 ± 2.494
Microbial CP, g/d	23.97 ± 15.24	25.13 ± 15.59
IDMP, g/d	**15.34 ± 9.75**	**16.08 ± 9.98**

~ +4.8%* = no effect either

•in few cases, PD levels were out of range of the equation of Chen, these results were disregarded

results (PD concentrations) are in the range of literature data – at the lower limit (possibly related to hay quality)

use of purine derivatives : creatinine ratio – PDC (which would avoid total collection of urine = on-farm applicability) did not lead to consistent results (biased results)

possible explanation for the lack of response (beside complexity of factors involved in the ruminal ecosystem) the fact that, although the quality of the Sudangrass hay was low, it still accounted for a large part of the dietary nitrogen and SG is a source of slowly degradable nitrogen

peak of availability was probably shifted comparing to availability of sugars.

increase in readily available carbohydrates was beneficial only when matched the protein from sunflower meal, which accounted for only a quarter of dietary protein.

Conclusions & Future work

Partial replacement of grains (wheat, barley, corn) with molasses in diets of growing rams based on low quality Sudangrass hay **did not increase the outputs of purine derivatives in urine** or **the levels of microbial protein synthesis in rumen**

Still, **molasses replaced large part of the energy** ingredients of the diet, **without adversely influence** microbial proteosynthesis via **rumen pH** or **other ruminal parameters** – decision upon molasses **price** (variable & not related to nutritive value) & **availability**

Future work (within the same project):

- replacement of corn with molasses in a low protein diet

- test of a protein-vitamin-mineral premix inclusing molasses + some growth factors for rumen microbes

- test the synchroniceity of energy and protein supply (in dynamics)

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