Serum metabolite and enzyme activities as biomarkers of high-grain diet consumption in finishing bull calves

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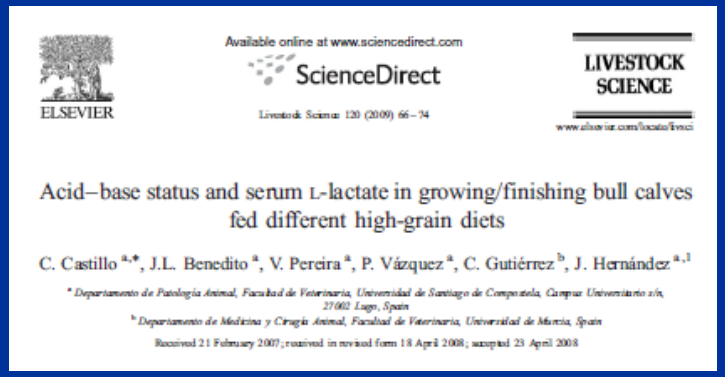
Little is known about whether different grains have different effects on metabolism…




The clinical chemistry profile is a valuable diagnostic tool that can be used to evaluate the internal balance. When used in conjunction with the physical examination, the chemistry panel may be useful for establishing initial baseline parameters, formulating a problem or rule out list, planning nutritional options and monitoring the response to it (Russell and Roussel, 2007).

Introduction



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Acid–base status and serum L-lactate in growing/finishing bull calves fed different high-grain diets

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The acid-base status of growing and finishing bull calves was influenced by grain mix in high-grain diets (Castillo *et ál*., 2009)

- ✔ **How did the same diet influenced on other serum metabolic parameters (glucose, NEFA, L-lactate, SUN, creatinine, TSP, albumin, AST and GGT?**

- ✔ **Can be possible to find metabolic indicators connected with the nutritional protocol received by the animals?**

Materials and Methods

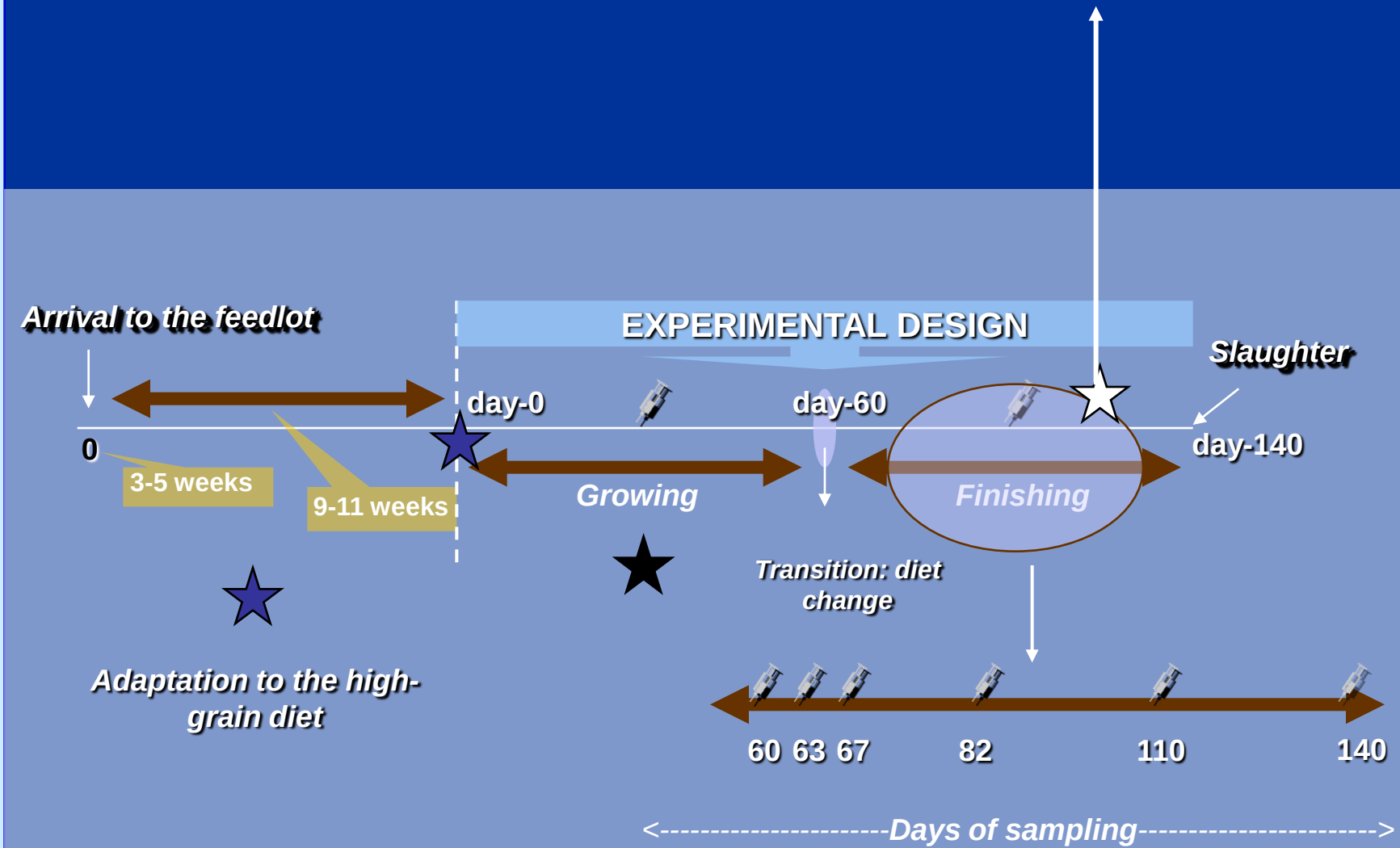
✓ We studied 30 double-muscled Belgian Blue calves brought to the commercial study farm (COREN, SCL, Ourense, Spain) at an age of 3-5 weeks.

✓Animals were adapted progressively to the fattening diet since 14 weeks until 23 (growing period).

✓The study ran between 23 and 35 weeks of age, i.e. the finishing period in the Spanish feedlot system (80 days).

Materials and Methods

This study was focused on the *finishing period…*



Materials and Methods

Calves were allotted randomly to three groups of ten each:

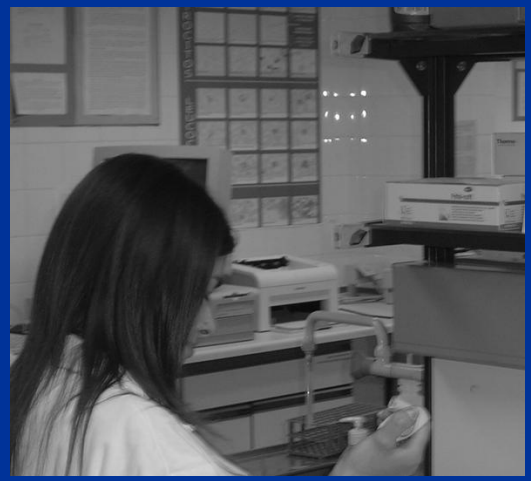
- ✓1) a high-grain diet with corn as the main component (M)
- ✓2) a high-grain diet with similar proportions of corn and barley (MB)
- ✓3) a high-grain diet with barley as the main component (B)

	Growing Groups[a]			Finishing Groups		
	M	MB	B	M	MB	B
Ingredient (%DM)						
Barley	14.5	27.0	32.6	15.8	32.9	30.5
Rye	---	---	5.0	6.0		
Wheat	---	6.0	10.0	---	---	10.0
Maize	30.0	25.0	10.0	30.0	27.5	10.0
Molasses	3.0	3.3	2.5			2.5
Sunflower meal	4.0			---	---	---
Palm oil (98% bypass)	2.0	1.9	1.8	0.5	1.6	2.0
Palm kernel oil	---	---	---	4.0	4.0	4.0
Soybean meal, 44% CP	14.3	16.5	15.1	13.5	12.9	9.6
DDGS[b]	---	---	7.0	---	---	8.0
Barley sprouts	2.0	2.0		---	---	---
Corn gluten feed	10.0	14.0	10.0	10.0	14.0	10.0
Wheat bran	9.0	---	---	5.3	---	4.2
Soybean hulls	8.0	1.5	3.2	10.0	1.6	1.1
Sodium bicarbonate	0.6	---	---	0.3	---	---
Vitamin/mineral premix[c]	3.2	2.8	2.8	2.1	2.2	2.1
Chemical composition (%DM)						
CP	16.6	16.5	16.6	15.0	15.0	15.5
CF	7.6	4.6	5.0	7.3	5.0	5.0
NDF	21.3	17.5	19.0	20.8	19.3	21.6
ADF	10.8	6.0	6.6	11.1	6.8	7.2
EE[d]	4.9	4.0	4.1	3.5	4.1	4.7
NFC[e]	50.9	56.3	54.5	57.2	56.6	53.1
Ash	6.3	5.7	5.8	3.4	5.0	5.1

[a]M=Maize-based diet; B=Barley-based diet; MB=Equal mixture of maize and barley;
[b]Maize distillers' dried grain with solubles.
[c]Vitamin and mineral premix containing (per kg DM premix): 10000 IU vitamin A, 2000 IU vitamin D, 10 IU vitamin E, 0.4 mg Co, 16 mg Cu, 25 mg Fe, 2 mg I, 110 mg Mn, 0.3 mg Se, and 120 mg Zn.
[d]EE: ether extract content.
[e]NFC: non-fibre carbohydrates calculated as 100 – (CP + ash + NDF + EE)



Blood samples were taken on days 60 (the last day of the growing period and beginning of the finishing period), 63, 67, 82, 110 and 140 (the last day of the study, prior to slaughter), in all cases following feed delivery, between 09:00 and 11:00.



Analyses of variance (ANOVAs) were performed with group (M, MB or B) as fixed effect factor and time as repeated-measures factor, and with the time×group interaction included in the model. The criterion for statistical significance was $P \leq 0.05$.

Results and discussion

At no time during the study any of the animals developed clinical signs of acidosis or of other disorders related with high grain consumption:

✓ amount of crude protein (CP) in these diets, greater than recommended.

✔ the forage fibre source employed, barley straw, effective in promoting chewing activity and saliva secretion.

Productive parameters

Variable	Groups[a]			P[b]
	M	MB	B	
Initial weight (kg)	222.0±3.0[b]	232.0±4.4[c]	208.0±3.4[a]	<0.001
Final weight (kg)	405±5.5[a]	420±2.7[a]	416±4.1[a]	>0.1
ADG (kg)	1.5±0.04[a]	1.5±0.05[a]	1.7±0.03[b]	0.019
Daily intake (kg/d)	7.9	8.1	7.5	---
Feed:gain ratio[c]	5.3	5.4	4.4	---

[a]M, maize-based diet; B, barley-based diet; MB, diet with equal proportions of maize and barley.
[b]Significance (*P*-value) of variation among groups; within each row, means with the same superscript letter do not differ significantly at the 5% level.
[c]Feed-to-gain ratio was calculated as (kg feed consumed)/(kg weight gained).

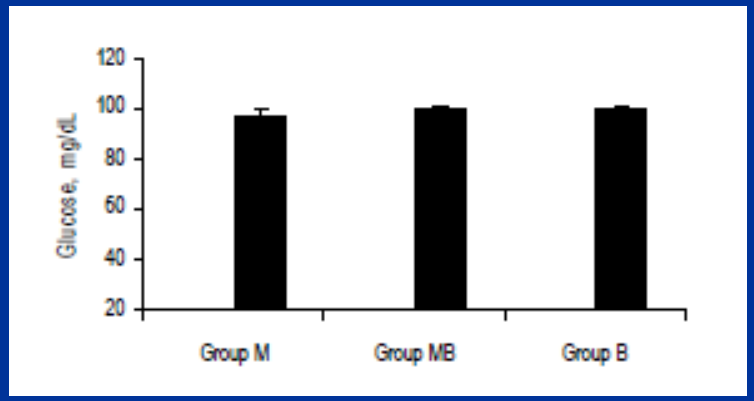
The feed-to-gain ratios of groups M and B corroborate that a barley-based diet can be more efficient than a maize-based diet.

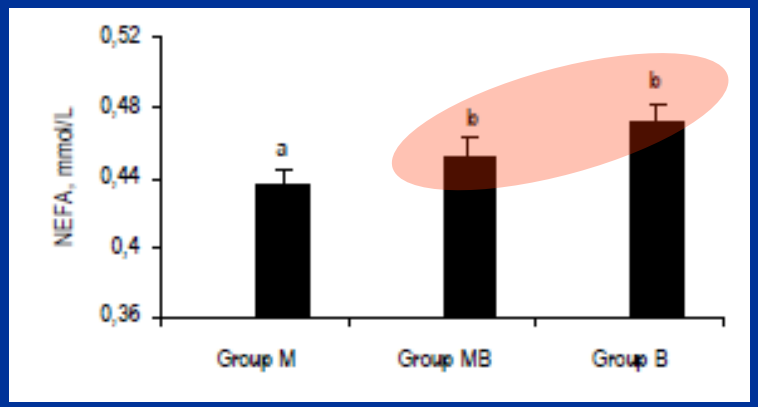
starch provides more energy for the growth of bull calves when digested in the rumen than when digested in the small intestine.

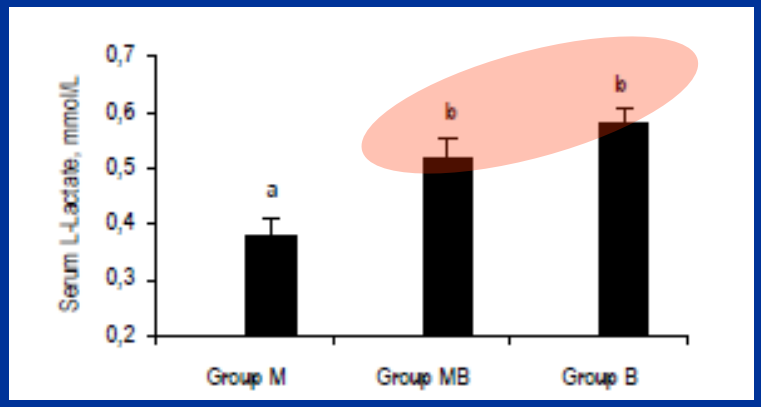
Daily intake, ADG and feed-to-gain ratio of group MB were close to those of group M→ contradicts those findings in which animals fed an equal mixture of barley and maize performed better than animals fed either barley or maize alone.

That the final weight of group MB was as high as that of group B was due mainly to their greater weight at the start of the finishing period.

Results and discussion





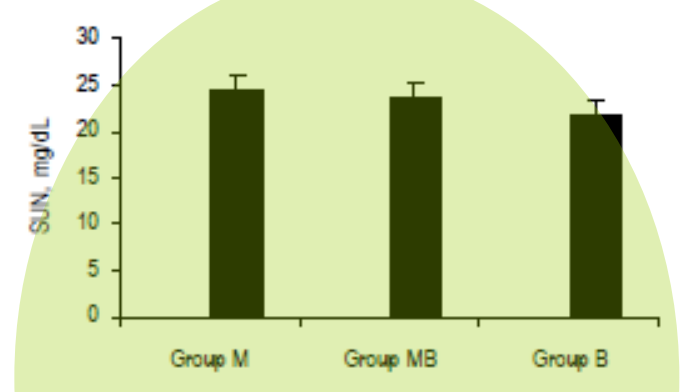


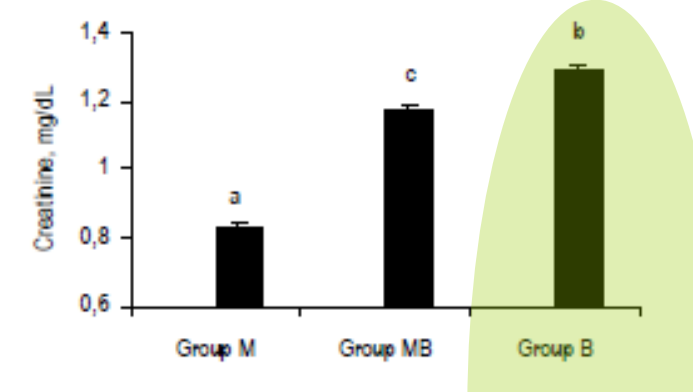
No significant differences were found in serum glucose among the three groups…

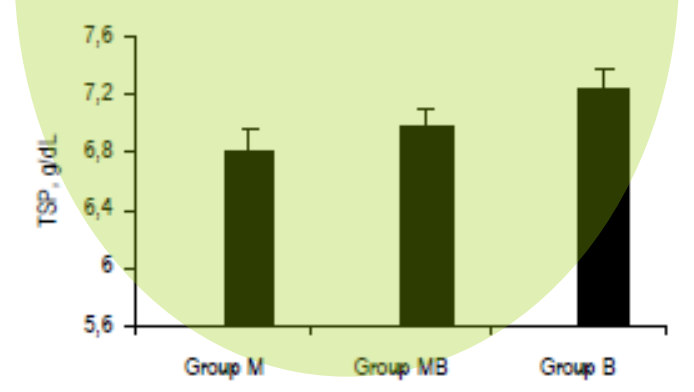
Differences in NEFA values can be attributed to the different ether extract content…

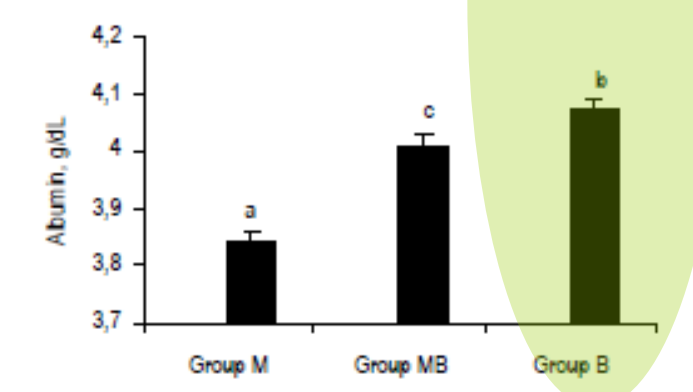
Similar proportions of maize and barley had no beneficial effects, in term of L-lactate production, than a barley-based diet…

Metabolic parameters





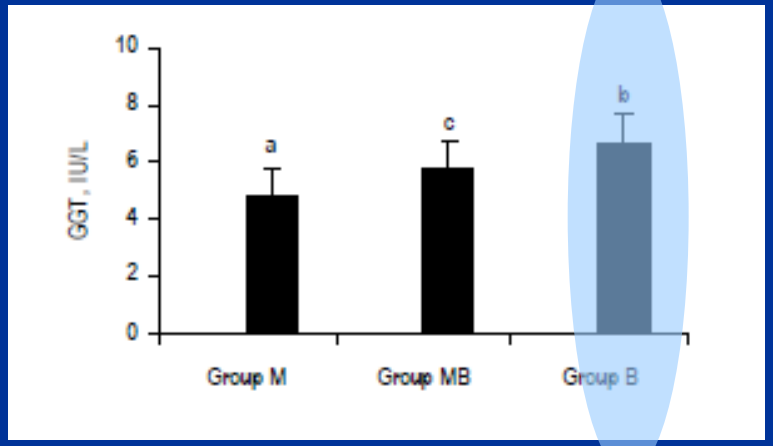


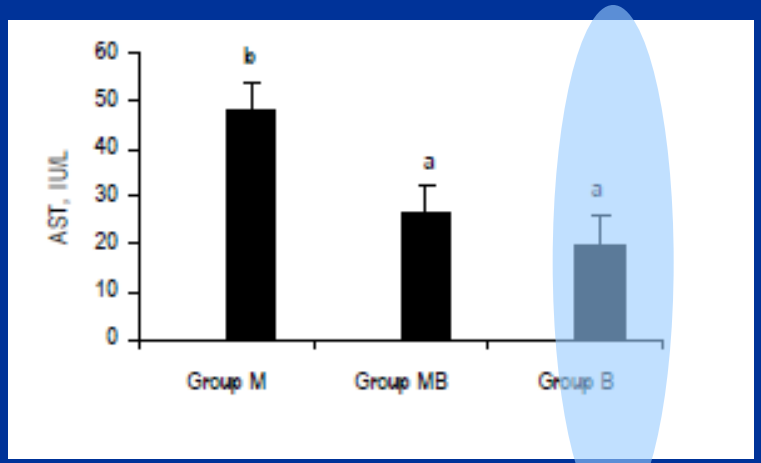


No significant differences were found in SUN and TSP among the three groups…

A barley-based diet seems to be more efficient, in terms of protein catabolism, than a maize-based diet or the mixture…

Results and discussion





The higher L-lactate levels of group B were correlated with the highest levels of GGT, a sensitive indicator of hepatobiliary disorders, though all values were below the pathological range

Nevertheless, the reverse between-group trend was shown by AST, a nonspecific marker of acute liver damage that can be elevated in acidotic animals

Conclusions…

Under the conditions of this study none of the diets employed was associated with either clinical signs of acidosis or pathological alterations in the metabolic parameters studied…

…possibly because of the high CP content of these diets and the high long-fibre NDF content of the forage, barley straw.

Best productive performance was afforded by the barley-based diet.

Although average serum L-lactate, NEFA, creatinine, albumin, AST and GGT levels all differed among groups, only L-lactate and AST can be considered as possible age-independent markers of grain-type-related metabolic alterations, since the other parameters all showed significant time×group interaction.

In terms of these two parameters, animals fed a diet with equal proportions of maize and barley behaved similarly to those fed a diet with barley as its main cereal.

The absence of between-group differences in blood glucose level may reflect a genetic characteristic of this double-muscled breed.

Thank you very much for your attention…