Hernández J.
Castillo C.
Pereira V.
Vázquez P.
Suárez A.
López Alonso M.
García Vaquero M.
Benedito J.L.

Animal Patholgy Department, Veterinary Faculty of Lugo, Universidad de Santiago de Compostela, Spain.

Effect of grain processing on serum metabolites in finishing calves.

✘ Processing methods are used to alter certain characteristics of the grain, which improve starch digestion by exerting effects on site and extent of digestion. The predominant grain processing methods used in Spanish feedlots are grinding and pelleting (Acedo-Rico, 2001).

✘ The clinical chemistry profile is a valuable diagnostic tool that can be used in conjunction with clinical examination for establishing and monitoring nutritional protocols and the response to them.

✘ The present study evaluated the effects of grain processing (pelleting and grinding) on different serum metabolic parameters (glucose, NEFA, SUN, TSP, albumin, L-lactate, AST, GGT and amylase of finishing bull calves.

Materials and Methods

✘ A 77-day feedlot study was conducted using 20 double-muscled Belgian Blue steers:

✓ The study ran between 23 and 34 weeks of age and animals averaged 229±3 kg at the beginning of the study. Cattle were housed in a commercial feedlot farm (COREN, SCL, Ourense, Spain).

✓ The animals were adjusted to the fattening diet using an adaptation diet for 7 weeks (from 16 to 23 weeks of age –the growing period in the Spanish feelot system).

✘ Two experimental 10-calves groups: PF: fed a concentrate in a pelleted form; GF: fed a ground concentrate.

✓ All the grains used in the trial came from the same lot and were processed at the same time

✓ To prepare the ground grains, the rollers of the mill were adjusted to crack the grain coarsely (5 mm diameter). The grain used for pelleted feed was first ground to pass a 3-mm sieve and finally was pelleted in a pellet mill at 70ºC. Final pellets had 4 mm diameter.

✘ Dietary composition was typical of diets given commercially to feedlot cattle in Spain (Table 1), with barley straw *ad libitum*.

Table 1. Ingredients and chemical composition of the diets supplied in the present study (both PF and GF[a])

	Growing period	*Finishing period*
Ingredient (%DM)		
Barley	27.0	32.9
Wheat	6.0	----
Corn	25.0	27.5
Molasses	3.3	3.3
Oil palm kernel	----	4.0
Palm oil (98% *by pass*)	1.9	1.6
Soybean meal (44% CP)	16.5	12.9
Corn gluten feed	14.0	14.0
Barley sprouts	2.0	----
Soybean hulls	1.5	1.6
Vitamin/mineral premix[a]	2.8	2.2
Chemical composition (%DM)		
CP	16.5	15.0
CF	4.6	5.0
NDF	17.5	19.3
ADF	6.0	6.8
EE[b]	4.0	4.1
NFC[c]	56.3	56.6
Ashes	5.7	5.0

[a]PF, pelleted-feed group; GF, ground-feed group.

[b]Vitamin and mineral premix contained per kg DM premix: 10.000 IU vitamin A, 2.000 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.

[c]EE: ether extract content

[d]NFC: non-fiber carbohydrates calculated as 100 – (CP + ash + NDF + EE)

✘ Blood samples were collected by jugular puncture on days 0 (just after the adaptation period prior to supplementation), 3, 7, 13, 51 and 77 (the last day of the finishing period, prior to slaughter).

Table 2. Effects of grain processing on productive performance (means±SEMs).of finishing-stage bull calves (Castillo et al., 2006).

	Groups[a]		*P*[b]
Variable	PF	GF	
Initial weight (kg)	237±4.7	232±4.4	>0.1
Final weight (kg)	430±2.9	420±2.7	>0.1
ADG (kg)	1.6±0.07	1.5±0.05	>0.1
Daily intake (kg/day)	8.0	8.1	---
Feed:gain ratio[c]	5.0	5.4	---

[a]PF, pelleted-feed group; GF, ground-feed group.

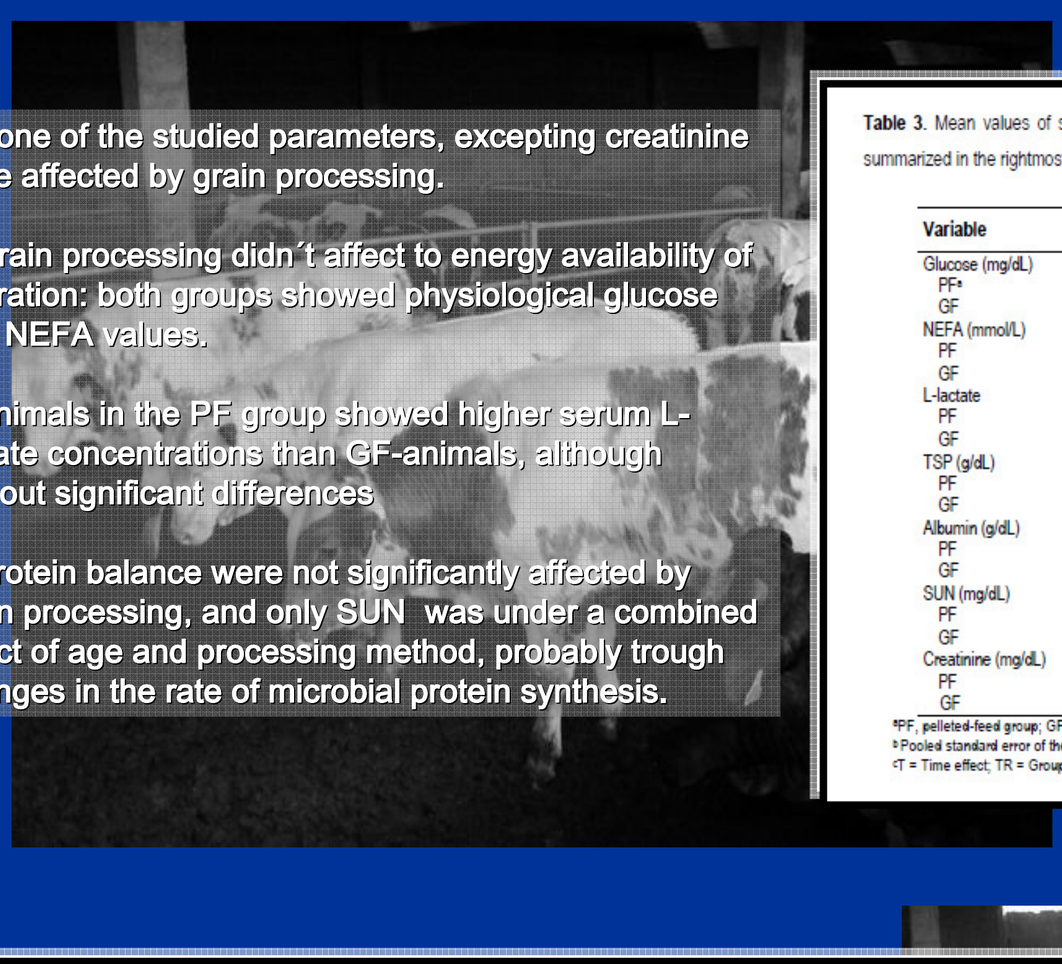
[b]Significance (*P*-value) of variation among groups; within each row, means with the same superscript letter do not differ significantly at the 5% level.

[c]Feed-to-gain ratio was calculated as (kg mean feed consumption per head in the animal's group)/(kg weight gained by the animal).

✘ Production parameters were measured at the end of the finishing period, and can be considered as useful complementary information associated with supplementation (see Table 2).

✘ Data were subjected to analysis of variance (ANOVA) with group as the fixed main effect and sampling date as a repeated-measure effect; the model also included the effects of time (T) and treatment (TR), and the T*TR interaction.

Results and Discussion



✘ None of the studied parameters, excepting creatinine were affected by grain processing.

✘ Grain processing didn´t affect to energy availability of the ration: both groups showed physiological glucose and NEFA values.

✘ Animals in the PF group showed higher serum L-lactate concentrations than GF-animals, although without significant differences

✘ Protein balance were not significantly affected by grain processing, and only SUN was under a combined effect of age and processing method, probably trough changes in the rate of microbial protein synthesis.

Table 3. Mean values of serum glucose, NEFA, L-lactate, TSP, albumin, SUN and creatinine during the study period. Effects of time and treatment are summarized in the rightmost columns.

	Days							P>F[c]		
Variable	*0*	*3*	*7*	*13*	*51*	*77*	**Mean ± Pooled SEM[b]**	T	TR	T×TR
Glucose (mg/dL)							1.44	0.05	0.90	0.3
PF[a]	101.4	100.0	106.4	99.0	95.6	93.2	99.27			
GF	96.6	101.4	101.6	97.8	103.5	93.2	99.2			
NEFA (mmol/L)							0.11	0.01	0.42	0.65
PF	0.53	0.46	0.43	0.43	0.49	0.46	0.46			
GF	0.56	0.41	0.42	0.43	0.48	0.41	0.45			
L-lactate							0.06	0.42	0.13	0.31
PF	0.97	0.50	0.84	0.46	0.68	0.60	0.68			
GF	0.65	0.42	0.56	0.39	0.6	0.46	0.53			
TSP (g/dL)							0.13	0.001	0.91	0.81
PF	6.42	6.77	6.49	6.9	7.71	7.46	6.96			
GF	6.53	6.53	6.83	6.94	7.34	7.7	6.98			
Albumin (g/dL)							0.02	<0.001	0.87	0.94
PF	3.88	3.88	4.02	4.11	4.04	4.14	4.01			
GF	3.88	3.84	4.02	4.10	4.04	4.15	4.01			
SUN (mg/dL)							2.13	0.41	0.69	0.01
PF	26.6	25.8	24.8	26.6	21.6	23.8	24.87			
GF	24.4	19.2	24.6	23.2	26.7	23.6	23.62			
Creatinine (mg/dL)							0.02	<0.001	0.001	0.06
PF	1.22	1.39	1.51	1.34	1.36	1.11	1.32			
GF	1.04	1.21	1.29	1.11	1.29	1.05	1.17			

[a]PF, pelleted-feed group; GF, ground-feed group

[b]Pooled standard error of the mean

[c]T = Time effect; TR = Group effect; T×TR = Time×group interaction

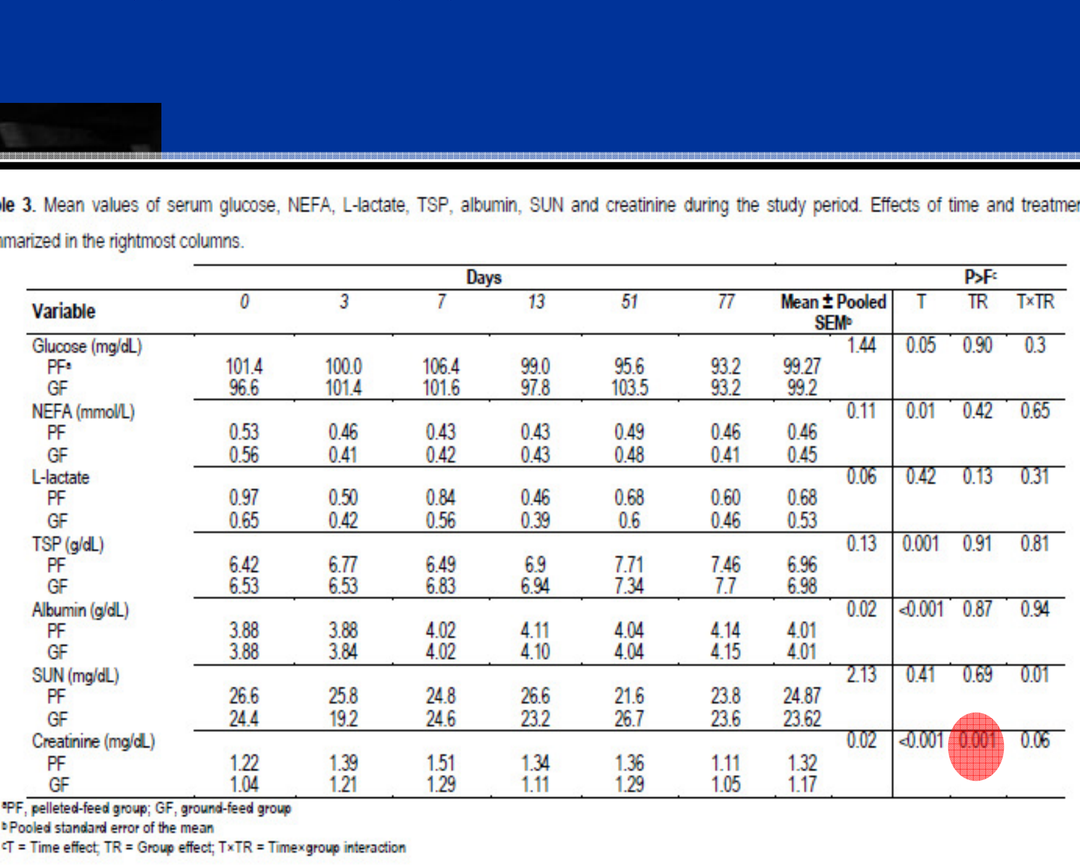
Table 4. Mean values of serum AST, GGT and amylase activities during the study period. Effects of time and treatment are summarized in the rightmost columns.

	Days							P>F[c]		
Variable	*0*	*3*	*7*	*13*	*51*	*77*	**Mean ± Pooled SEM[b]**	T	TR	T×TR
AST (IU/L)							1.67	0.085	0.794	0.542
PF	28.61	19.07	23.85	23.03	21.17	37.34	25.51			
GF	27.68	22.08	23.73	27.68	24.42	30.59	26.15			
GGT (IU/L)							0.22	<0.001	0.132	0.701
PF	5.79	6.34	5.39	4.56	5.07	4.20	5.23			
GF	6.42	7.14	5.83	5.04	4.91	5.15	5.75			
Amylase (IU/L)								0.053	0.230	0.163
PF	82.64	71.96	85.8	76.31	87.3	93.97	83.01	6.86		
GF	76.31	85.4	89.75	98.85	129.7	95.68	95.95			

[a]PF, pelleted-feed group; GF, ground-feed group

[b]Pooled standard error of the mean

[c]T = Time effect; TR = Group effect; T×TR = Time×group interaction



✘ Processing method had no effects on those enzymes related with hepatic function.

✘ No effect of processing were observed in serum amylase

Conclusion

Under the conditions of our study, and excepting SUN and creatinine, none of the studied parameters were affected directly by grain processing, and only serum creatinine could be considered as a valuable biomarker of pelleted high-grain consumption in bull calves.

Taking into account the previous discussed metabolic parameters and the absence of clinical signs of disease over-time, it is obvious that diet itself, or the processing method considered in this study, had no detrimental effects on animal health.

More information in: Castillo C., Hernández J., Pereira V., Suárez A., Sotillo J., Méndez J. and Benedito J.L. (2009). Use of serum metabolites and enzymes in the evaluation of grain processing in finishing bull calves.

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