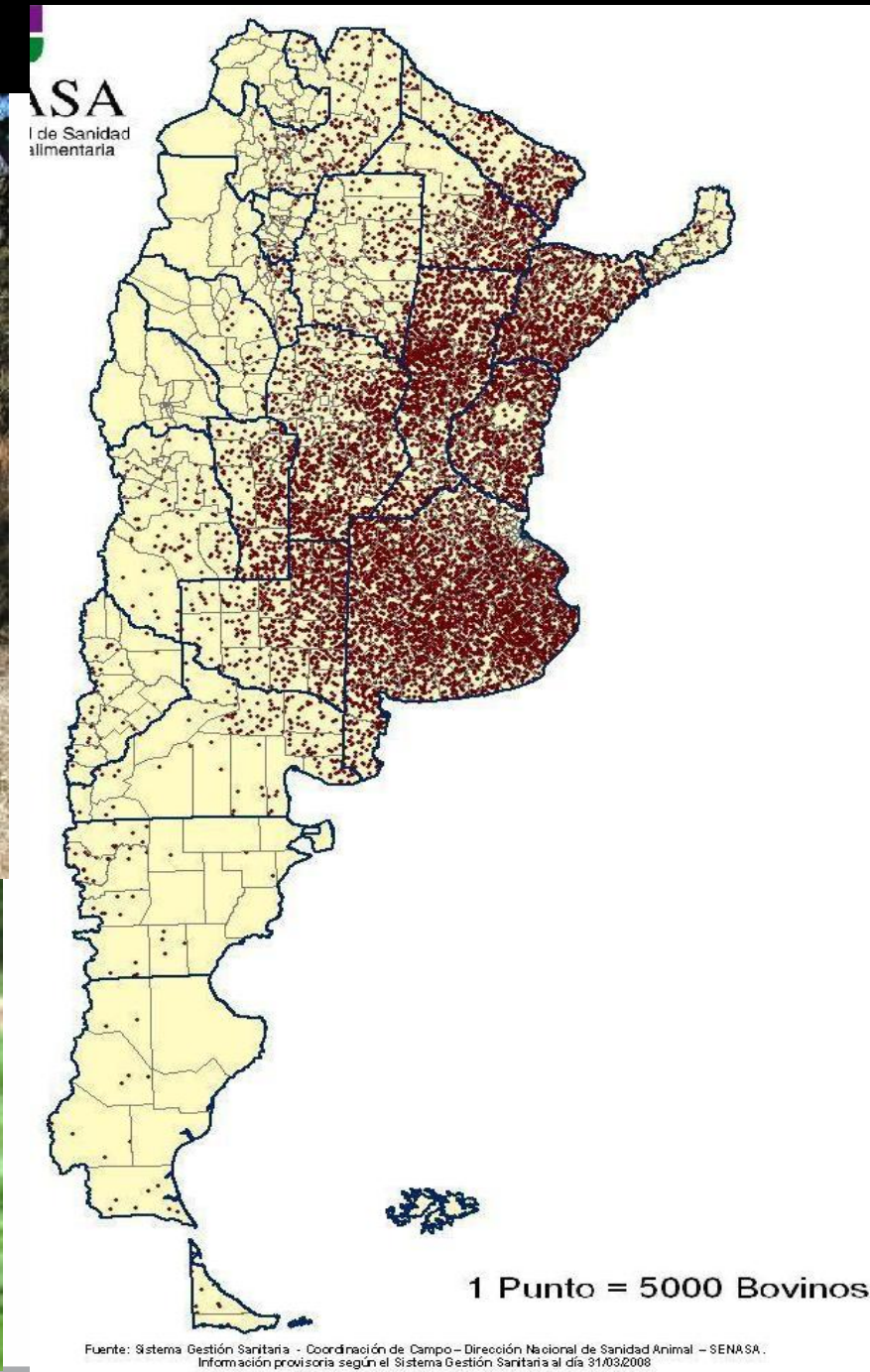


Rumen acidosis in feedlot animals in Argentina: Risks and mitigation

Anibal Pordomingo
Agr., PhD



Cow-calf





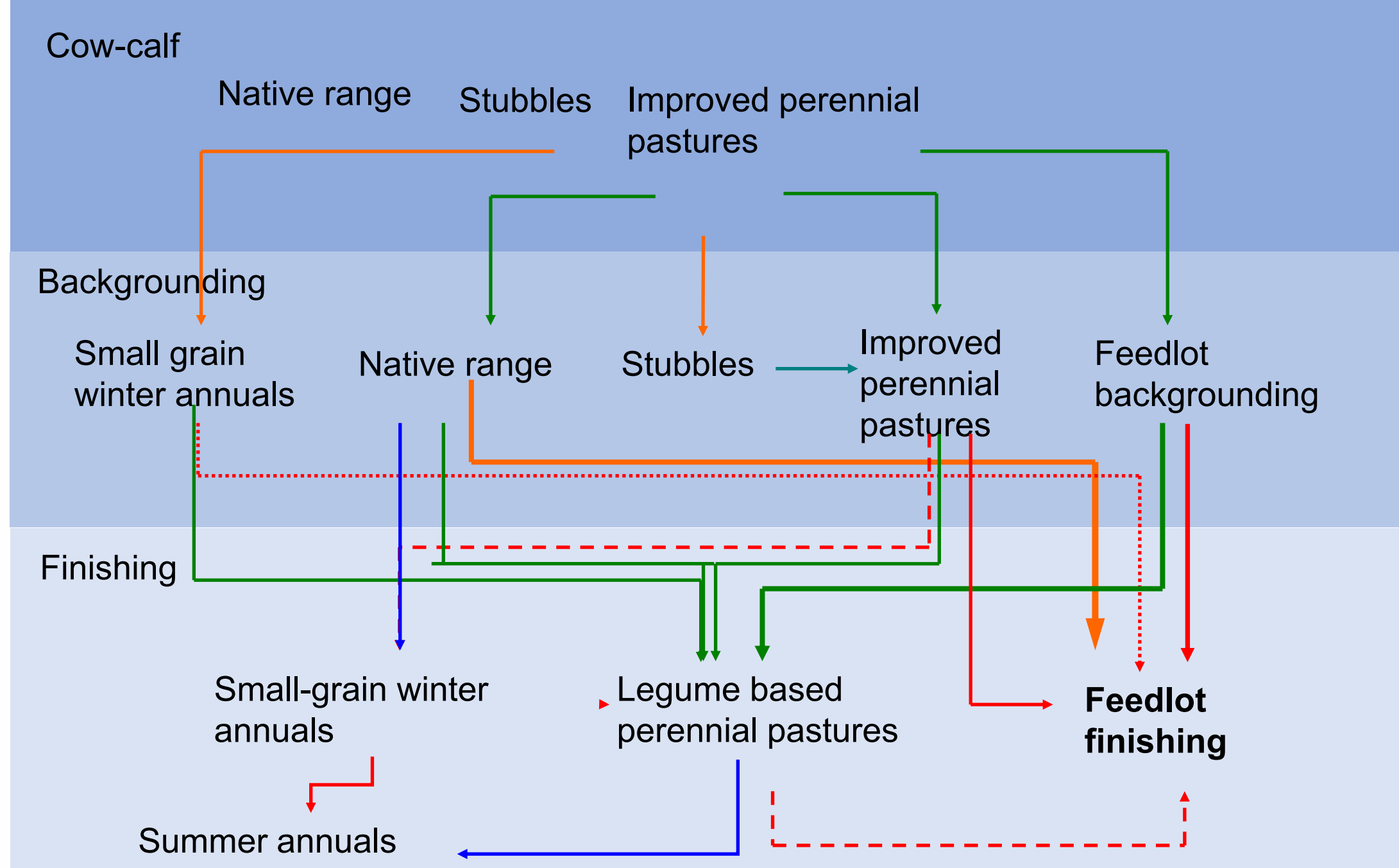
65% Angus
9% Hereford
15% Brangus
6% Braford
5% Other (Shorthorn,
Limangus,
Brahman,
Limousin,
Charolais,
Bonsmara)



Fattening systems



*Argentina beef
growing-finishing
systems*



From Cow-calf to slaughter: 44%

Stoker trade: 1,1

Calving rate: 62% country (50 to 90% across regions, best rates on the pampas area)

Age at harvest: 1.5 to 2.5 year old

Finishing: 1/3 inch to ½ inch BFT

Steers: 800 lto 1300 lb/live weight

Heifers: 700 to 1100 lb/live weight

Tenderness: Expected and appreciated (biotype, slaughter age and finishing)

Marbling: marbling preferred but no signif. effect on price yet. Valued at high-end restaurants. Domestic market does not relate marbl with tenderness

- Domestic market: 70% (50 kg/person yr)
- Exports:
China 63%), USA (11%), Israel (6%), Chile (2%), Brazil (3%), Germany (7%), England (3%), France (2%), Netherlands, Hong Kong, Saudi Arabia (3%)

Finishing:

- **Steers and heifers**
- **75% feedlot fed;**
15% pasture + supplement finished
10% pasture only
- Feedlot Days on feed: **70 thru 120 (150... 180 ?)**
- Days on finishing pasture + supplements (0.75 to 1.5% DM LW basis): 90 to 120
- Days on 100% pasture: 90 to 180



Efecto de la edad/peso sobre el peso, el aumento de peso, el consumo y la conversión de novillos Angus terminados en **123** días de corral

Pordomingo et al., 2021 (Meat Science)

Edad faena, meses	15	18	24	30
PV inicial, kg	258	300	360	407
PV final. kg	420	472	537	584
APV, g/d	1318	1393	1441	1442
CMS, %PV	2.6	2.5	2.4	2.3
CMS	9.0	9.7	10.7	11.6
CMS/APV	6.8	6.9	7.4	8.1
Rto res, %	58.2	58.7	59.5	60.7
Peso res, kg	245	277	320	355
CMS/APres	11.7	11.8	12.5	13.2

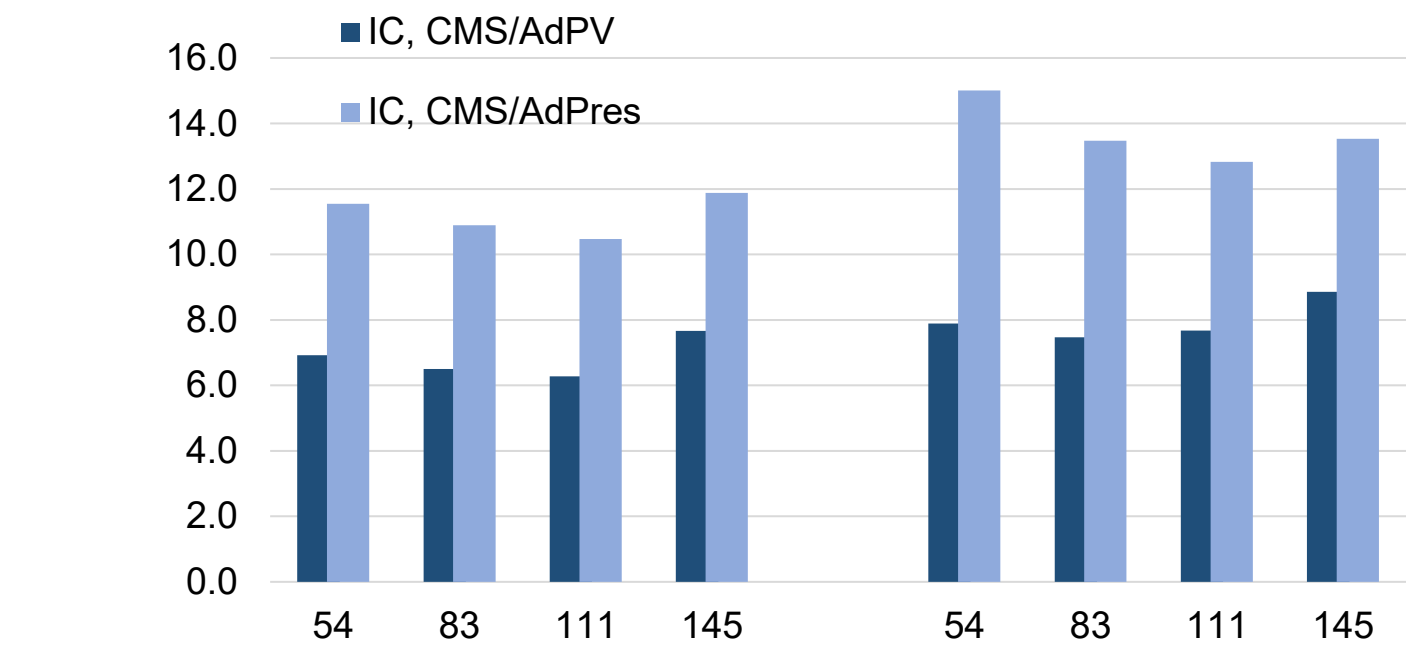
n = 12 corrales (4 animals por corral)

Efecto de la edad/peso vivo a faena sobre las características de la res y la carne de novillos terminados en **123** días de corral

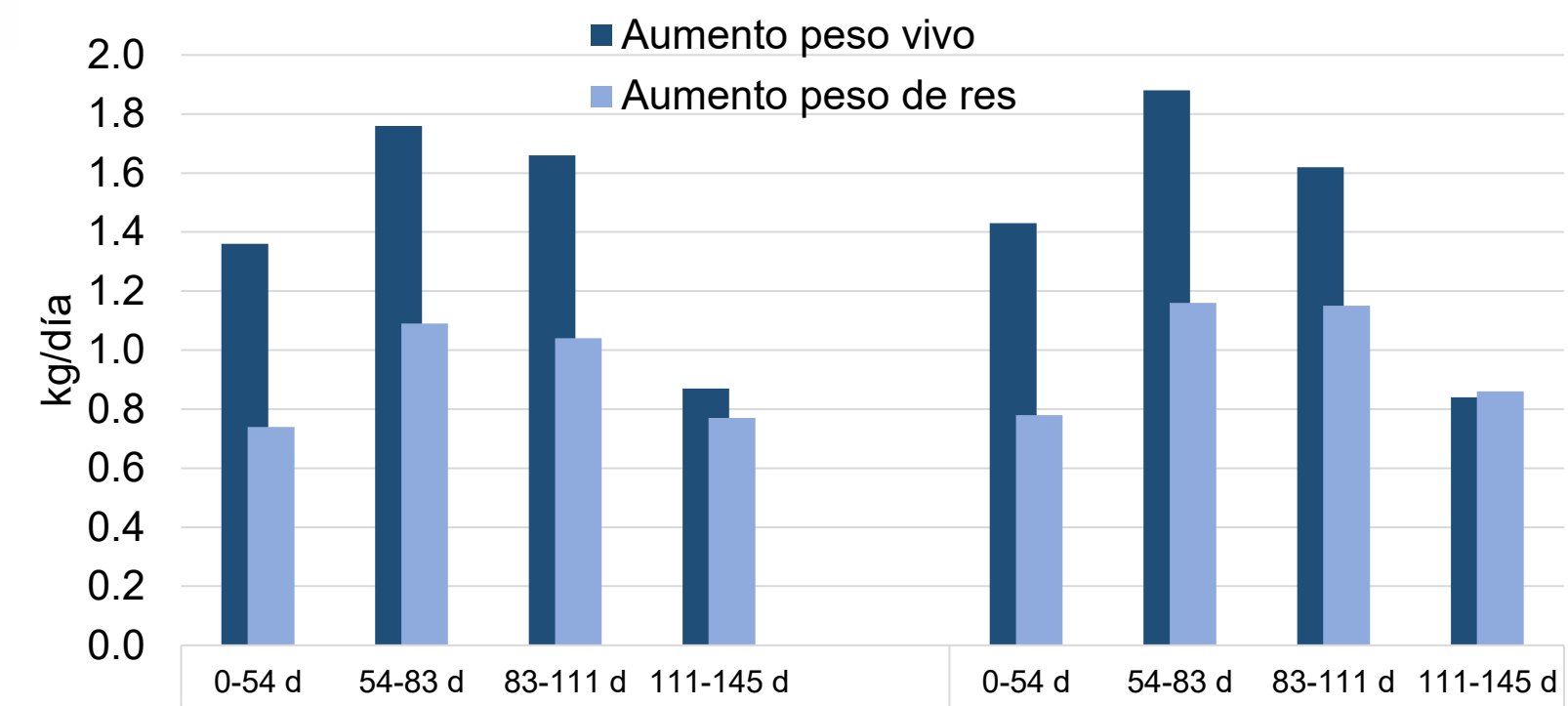
Pordomingo et al., 2021 (Meat Science)

Edad faena, meses	15	18	24	30
PV inicial, kg	258	300	360	407
PV final, kg	420	472	537	584
Grasa Intramusc, %	3.7	4.8	5.1	5.4
EGD, mm	8.5	9.3	10.5	12.6
AOB, cm ²	58	63	69	72
PPC, %	24.1	23.5	23.8	23.1
Fuerza WB, N	28.3	28.7	29.4	33.1
pH	5.6	5.5	5.6	5.5

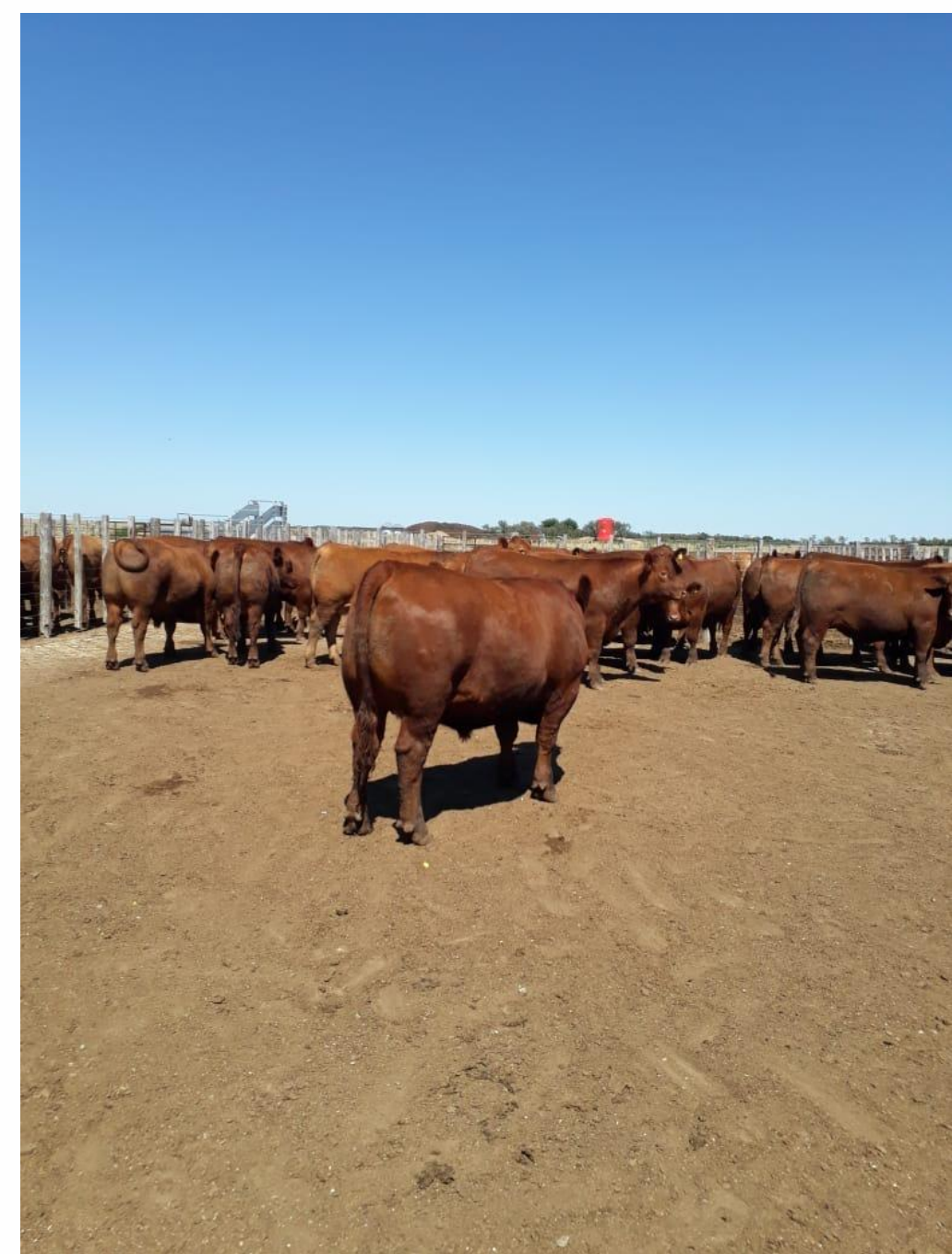
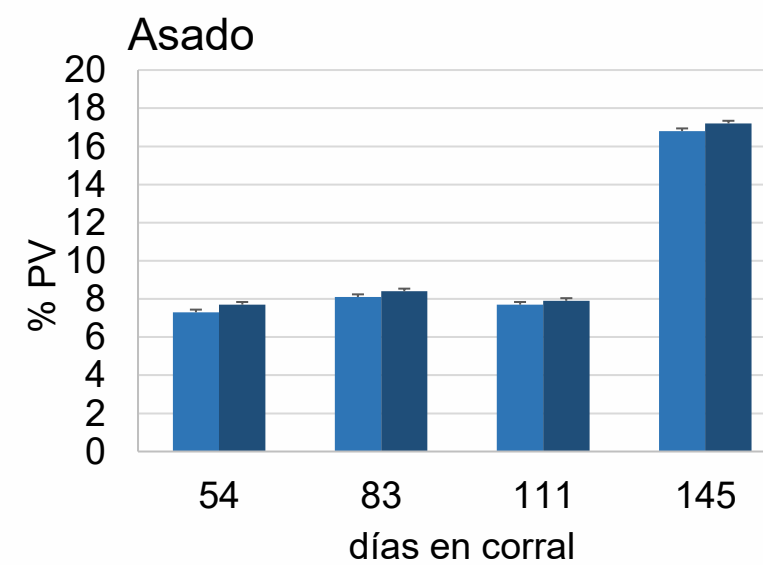
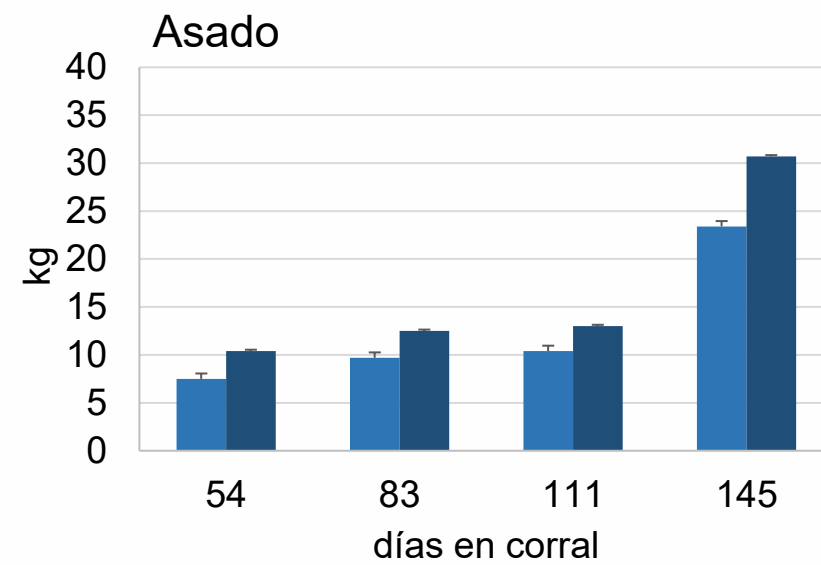
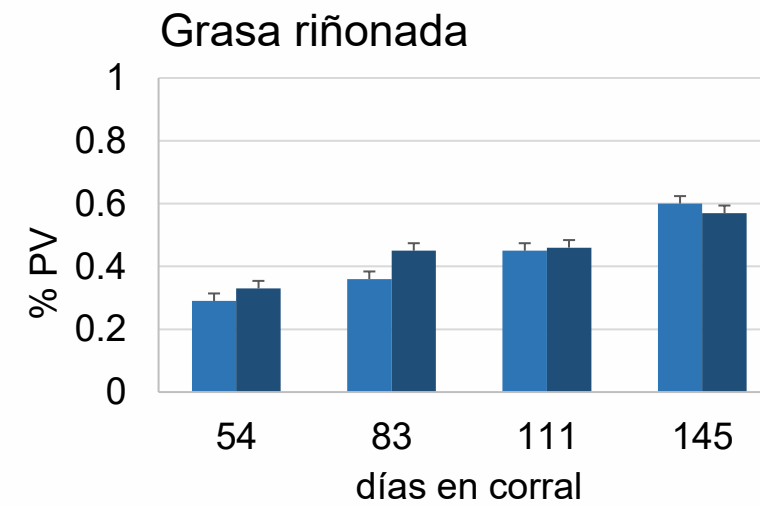
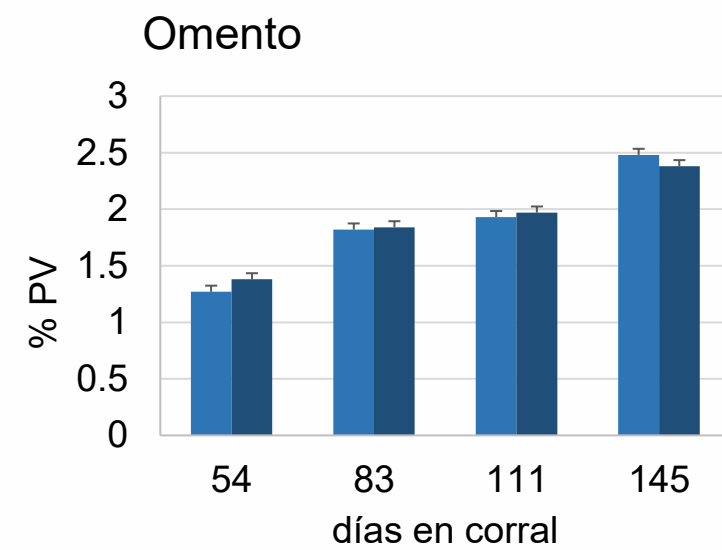
n = 12 corrales (4 animals por corral)

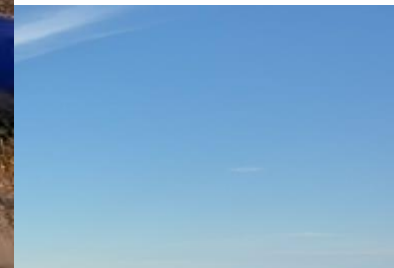


Peso vivo inicio corral:	Livianos (310 kg)				Pesados (415 kg)			
CMS, % PV	9.0	9.6	9.8	10.0	11.1	11.2	11.6	11.9
PV final, kg	374	431	481	497	485	538	584	608
P res cal., kg	207	238	269	288	271	299	332	359



Peso vivo inicio corral:	Livianos (310 kg)				Pesados (415 kg)			
PV final, kg	374	431	481	497	485	538	584	608
P res cal., kg	207	238	269	288	271	299	332	359







As feedlot finishing grows:

Cero effective fiber diets: (grain + pelleted concentrate)

Low effective fiber diets: (grain + pelleted concentrate + hulls)

Split feeding: (grain + pelleted concentrate + hay or silage on the side)

Ad-libitum feeding (full bunk)

Muddy pens

Over processed grains

Inadequate use of high moisture grains

Finely chopped of hay o silage

Inadequate mixing

Crowded pens

Short or no adaptation

Summer feeding (weather)

Coccidiosis

- More days on feed
- Heavier cattle



Compromised animal health ↑

Metabolic acidosis ↑

Chronic rumen acidosis ↑

↑
Virginiamycin solution was explored

Elbio Bressan¹, Danilo Grandini¹, Matt Crouse¹, Kari Saddoris-Clemons¹, Atilio Chiuffolini², Anibal Pordomingo³
¹Phibro Corp, ²Teknal S.A, ³INTA, Argentina

In feedlot cattle, rumen health directly affects animal health and concomitantly performance. Numerous research reports and reviews have pointed out the beneficial effects of adding virginiamycin (VM) in combination with monensin (MO) to feedlot diets on rumen health and liver integrity.

It was suggested that effects could magnify under increased starch exposure in the rumen, or during periods of environmental stress.

But studies of the relationship between rumen health, liver integrity and animal performance under commercial feedlot scenarios are scarce in Argentina.

The objective of this study was to confirm under [commercial feedlot conditions](#) during summer the effects of adding [a combination of VM and MO to a corn-grain-based diet differing in grain particle size](#) on rumen pH and temperature, and consequent effects on the performance of feedlot-finished steers.

It was hypothesized that including VM in a diet with MO in challenging circumstances assist to reduce chronic rumen acidosis, which favors long-term rumen health, and in turn, results in greater efficiency.

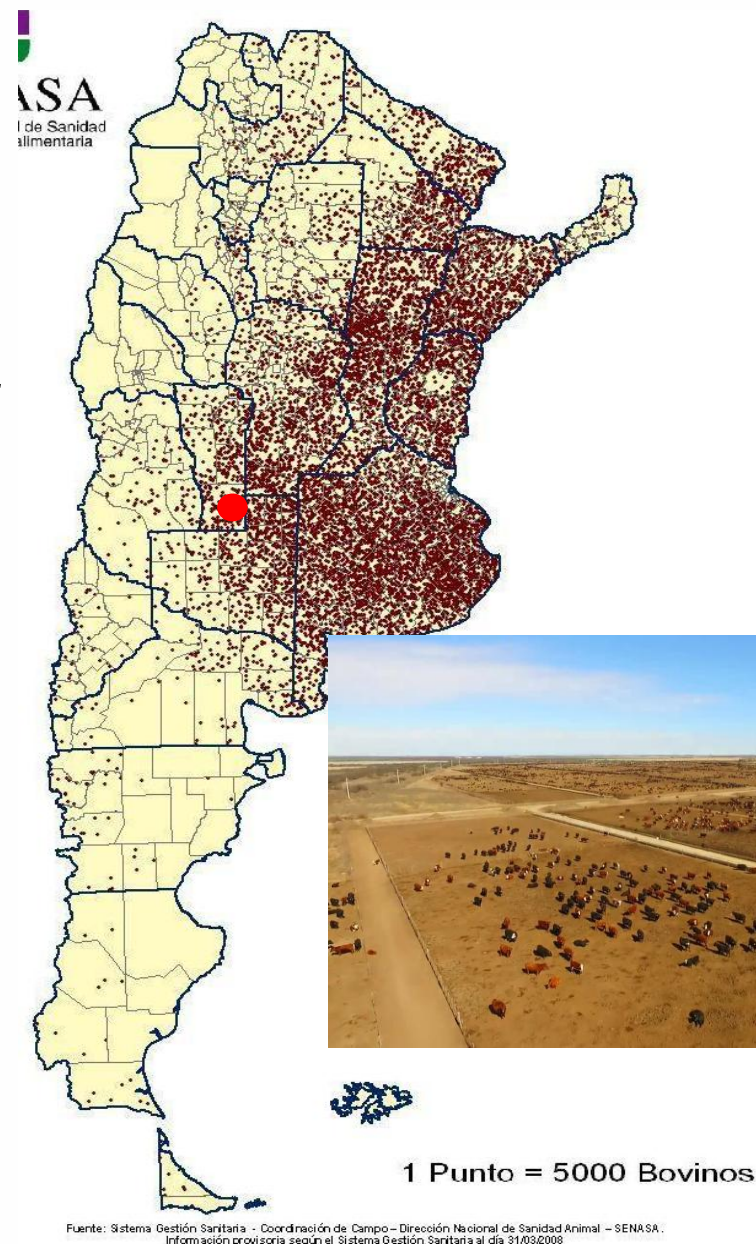
Nagaraja (1995)
Rogers et al. (1995)
Nagaraja et al. (1982)
Russell (1987)
Gottschall et al. (1988)
Corpet (2000)
Ives et al. (2002)
Tedeschi et al. (2003)
Nagaraja and Lechtenberg (2007)
Salinas-Chavira et al. (2009)
Lemos et al. (2016)
Gorocica and Tedeschi (2017)
Tedeschi and Gorocica-Buenfil, (2018)
Dias Batista et al. (2022)

Materials and methods

1. Study site

The study took place at SerBeef feed yards, a commercial feedlot of Southern San Luis Province, Argentina, in summer.

- Phibro Corp., Tecknal S.A.
- SerBeef feedyard (Mercedes, San Luis)
- INTA Anguil Experiment Station (National Institute of Agriculture Technology, Anguil, La Pampa).



2. Animals and treatments

- 896 British-breed steers. Same origin, similar in age and live weight (342 ± 20 kg).
 - Upon arrival, all steers were vaccinated for clostridial and enterotoxemic diseases and dewormed. All animals initiated in healthy conditions and were **backgrounded for 81 days at the same feedyard prior to incorporating VM in the finishing ration.**
 - On day 0, steers were randomly allocated to **8 feeding pens of 112 heads each** and exposed to 4 treatments (trt) with 2 pen reps per trt.
- Treatments were the combination of corn grain processing treatments, single rolled (**Srol**) vs double rolled corn (**Drol**), and additives treatments, Monensin only (**MO**) vs and VM + MO (**VM+MO**), in a factorial 2 x 2 arrangement.

- Virginiamycin was incorporated in mid-December, with summer onset (ambient temperatures on steady rise).
- The study was considered initiated when VM was added.
- It was **concluded 88 days later when the summer was nearly over**, and animals were considered finished by the commercial buyer.
- The **finishing ration was the same used at the commercial feedlot** as the summer finishing ration. It was based on dry corn, DDGS, hominy feed, corn gluten feed, peanut hulls, urea, a mineral and vitamin premix and alfalfa pasture hay.
- The **feeding program of this study mirrored the feedyard commercial program** which consisted of 2 phases with decreasing roughage content. Hay was included to provide at least 7% of the diet in effective fiber.
- Crude protein was always targeted for 14 to 13 % (on DM basis).
- Urea was included at 0.4% of the diet.
- Feed was supplied twice daily, adjusting the amount per pen daily targeting for residual traces of feed at the bunk reading in the morning.
- Feed offered was recorded daily per pen.
- Feed samples (200 g/aliquots) were removed from each pen every 15 days and composited by phase within treatment for laboratory analysis.

Phase 1: 26% roughage/conc diet;
31 d; 2024/12/18 - 2025-01-17;

Phase 2: 10% roughage/conc diet;
57 d; 2025-01-18 - 2025 -03-15

Diet composition on DM basis (%) for
phases 1 and 2 across treatments

	Phase 1	Phase 2
Corn grain	45.0	67.0
DDGS	14.5	14.0
Hominy feed	14.5	4.5
Corn gluten feed	4.5	5.0
Peanut hulls	4.5	0
Alfalfa hay	15.0	7.0
Urea	0.4	0.4
Mineral premix*	2.1	2.1

* Included equal parts of rice bran and oystershell;
1,483 ppm of monensin or 1,482 + 1,244 ppm of
monensin and virginiamycin for MN, or MN + VM,
respectively. And contained: Ca, Na, Zn, Mn, Cu, I,
Co, and Se, and 220,000 IU/kg of vitamin A and
44,000 IU/kg of vitamin D

Diet chemical composition on DM basis for
phases 1 and 2 across treatments

	Phase 1	Phase 2
Chemical composition, %		
CP, %	14,2	13,5
NDF, %	26,4	16,5
ADF, %	17,9	11,3
Statch, %	43,5	56,4
TDN, %	73,8	79,5
Energy concentration, %		
ME*, Mcal/kg DM	2,63	2,81
NEm*, Mcal/kg DM	1,72	1,88
NEg*, Mcal/kg DM	1,11	1,25

* Computed using equations from calculated TDN
according to NASEM (2016).

3. Determinations

3.1. Rumen chronic acidosis

Within the constraints of this study, rumen pH was the indicator of acidosis.

- At initiation of VM feeding, 12 animals of each pen, randomly chosen, were boused orally with active boluses of the Moonsyst Smart Rumen Monitoring System. The system allows for continuous and remote monitoring of rumen temperature and pH.
- Data was generated for each animal every 10 minutes and collected over the 88-day study period.
- Rumen pH ≤ 5.6 was considered acidotic environment.
- Chronic acidosis was defined as the interrupted period of at least 180 min of rumen pH ≤ 5.6 .
- Each period of chronic acidosis was considered a “bout” event (**bout**). The number of bouts was then calculated for each animal over time within each finishing phase (Phase 1 and 2, respectively).
- The proportion of animals with no acidotic bout within phase and treatment was first calculated per pen.
- For the group of animals within pen that expressed at least one bout event (chronic acidosis prone - CAP- animals), number of bouts, average length of bouts (**length, h**) the average number of bouts of the CAP animal per pen (Bout) and the average length per pen (L), were calculated.
- Likewise, the average size of the Bout for each pen and phase was calculated (**Bout x L**).
- Mean, maximum and minimum pH and temperatures for the average Bout/CAP animal and pen within treatment were also calculated.

3.2. Environment

- Since the relationship between performance and animal health was central to the study, the main environmental factors that could elicit stressful events were registered.
- Weather data including daily temperatures, wind, rain, and humidity, was continuously recorded using an automatic weather station on site.
- Heat load index was calculated using the Combat platform. Platform data included breed, hair color, shade, water temperature, mud and days on feed (DOF).

3.3. Animal weighing and performance

- Animals were weighed individually using an electronic scale after a 17-h fast (with access to water), on days -81, 0, 88 and 169 of the study.
- Average daily gain (ADG) for each period and overall were calculated individually dividing the difference between final and initial live weight (LW) into the number of days of the corresponding period.
- Pen averages were calculated for live weight (LW, kg) and ADG (kg/d)
- DMI, DMI/average LW (%) and feed:gain ratio (DMI/penADG) por each pen were calculated

3.4 Slaughter

After final weighing, all animals were fed for 2 extra days and shipped on the morning of the third day. No feeding took place on the shipping day. The slaughter took place at a federally inspected abattoir, 400 km from the feedlot. A minimum of 8-h rest period with access to water was allowed after arrival. At slaughter, steers were stunned, exsanguinated and carcasses handled individually in maintaining individual traceability throughout processing.

3.5 Carcass measurements

Immediately after slaughter, carcasses were individually weighed to determine hot carcass weight (HCW). Hot carcass yield (HCY) was calculated as the proportion (%) of HCW over the final LW after adjusting by a 7% shrink loss (rate regularly accepted in commercially to account for gut fill).

After chilling for 96 hours carcasses were moved to the fabrication facilities within the processing plant. Prior to entering fabrication of primals and before any fat trimming, each left carcass was sectioned at the 11th rib level, from the spine side transversally inwards, including the longissimus lumborum muscle (LM) section. The cut was performed with pneumatic chain saw for the bone vertebrae and a sharp knife to generate a clean cut of the muscle.

Immediately after, the sectioned area of each carcass was cleaned of debris and scanned using the same image scanner used at the plant regularly to estimate rib eye area (REA), subcutaneous back fat thickness (SFT), marbling score and lean proportion.

4. Statistical analysis

- Treatment effects on rumen data, LW, ADG, DMI and FE and carcass and beef traits were analyzed using a CRD with pen as experimental unit.
- Treatment means were separated by LSD (Fisher) if a treatment effect was detected significant ($P < 0.05$) (SAS, 2002).

Results

- The study period was exposed to 317 mm of accumulated rainfall which resulted 18 days of high mud in all pens.
- Humidity and temperatures resulted in 26 days of high HLI for high animal stress.
- Three major and prolonged HLI spikes reaching 250 points took place through February.

Effects of **corn processing** in a finishing diet for summer-finished feedlot steers on expression of chronic acidosis*

	Srol	Drol	SEM	P
Phase 1, %	46	43	7	0.81
Phase 2, %	90	87	3	0.51

n = 4 pens (12 bolused steers/pen);
Phase 1: 26% roughage/conc diet; 31 d; 2024/12/18 - 2025-01-17;
Phase 2: 10% roughage/conc diet; 57 d; 2025-01-18 - 2025 -03-15
Srol = Single-rolled corn; Drol = Double-rolled corn
*Average proportion of steers/pen with at least 1 acidotic bout)
Bout = Period of at least 3 h with rumen pH ≤ 5.6

Effects of **virginiamycin addition** to a finishing diet for summer-finished feedlot steers on expression of chronic acidosis*

	MO	VM+MO	SEM	P
Phase 1, %	54	37	6	0.06
Phase 2, %	91	86	3	0.31

n = 4 pens (12 bolused steers/pen);
Phase 1: 26% roughage/conc diet; 31 d; 2024/12/18 - 2025-01-17;
Phase 2: 10% roughage/conc diet; 57 d; 2025-01-18 - 2025 -03-15
MO = Monensin; VM+MO = Virginiamycin + monensin
*Average proportion of steers per pen with at least one acidotic bout; bout = period of at least 3 h with rumen pH ≤ 5.6

Effects of corn processing in a grain-based diet for summer-finished acidosis-prone feedlot steers on rumen pH

	Phase 1				Phase 2			
	Srol	Drol	SEM	P	Srol	Drol	SEM	P
Bout events*, n/head	6.5	7.5	1.27	0.60	5.9	6.4	0.91	0.58
L**, h/bout	16.6	15.2	2.1	0.66	18.8	18.5	4.6	0.96
Accum. period pH ≤ 5.6, h	98	94	19	0.89	111	99	24	0.75
Period pH ≤ 5.6, %	13.1	12.6	2.6	0.89	8.1	7.2	1.8	0.75
pH***								
Mean	5.27	5.26	0.02	0.58	5.28	5.28	0.02	0.91
Max	5.57	5.56	0.004	0.12	5.57	5.57	0.003	0.62
Min	5.13	5.11	0.02	0.44	5.12	5.11	0.03	0.95
Temperature***, C°								
Mean	39.6	39.5	0.08	0.47	39.4	39.5	0.05	0.71
Max	40.6	40.5	0.13	0.75	40.3	40.5	0.14	0.43
Min	37.3	36.8	0.32	0.24	37.3	37.2	0.25	0.83

Srol = Single-rolled corn; Drol = Double-rolled corn; SEM = Standard error of means; n = pens (12 bolused steers/pen)

Phase 1: 26% roughage/conc diet; **31 d**; 2024/12/18 - 2025-01-17;

Phase 2: 10% roughage/conc diet; **57 d**; 2025-01-18 - 2025 -03-15

*Bout = Period of at least 3 h with rumen pH ≤ 5.6

Average length of bout event in hours ; *pH and rumen temperature of average bout event

Effects of grain processing in a corn-based diet during the final 88 d of summer finishing on performance of feedlot steers

	Srol	Drol	SEM	P
LW day 81, kg	460	463	6.5	0.75
LW day 169, kg	551	552	7.6	0.94
ADG, kg/d	1.147	1.117	0.07	0.76
DMI, kg/d	10.5	10.3	0.25	0.59
DMI/LW, %	2.08	2.03	0.05	0.52
F:G	9.2	9.3	0.31	0.87

n = 4 (pen/trt; 112 steers/pen)
Srol = Single rolling; Drol = Double rolling;
SEM = Standard error of the mean
LW = Live weight;
ADG = Average daily gain;
DMI = Dry matter intake;
F:G = Feed to gain ratio

Effects of virginiamycin inclusion in a corn-based diet for summer-finished chronic-acidosis-prone feedlot steers on rumen pH

	Phase 1 (31 d)				Phase 2 (57 d)			
	MO	VM+MO	SEM	P	MO	VM+MO	SEM	P
Bout events*/steer	7.2	6.8	1.3	0.83	7.3	5.0	0.67	0.05
L**, h/bout	18.8	13.0	1.4	0.03	24.5	12.8	3.2	0.04
Accum. period pH ≤ 5.6, h	122	69	11.5	0.02	144	66	9.9	< 0.01
Period pH ≤ 5.6, %	16.4	9.3	1.5	0.02	10.5	4.8	0.73	< 0.01
pH***								
Mean	5.39	5.48	0.01	0.07	5.27	5.42	0.01	0.06
Max	5.56	5.76	0.009	0.11	5.6	5.77	0.003	0.09
Min	5.04	5.22	0.01	0.06	5.09	5.34	0.02	0.05
Temperature***, C°								
Mean	39.4	39.7	0.04	0.06	39.5	39.4	0.05	0.53
Max	40.4	40.7	0.09	0.07	40.5	40.3	0.13	0.21
Min	36.7	37.4	0.28	0.07	37.2	37.3	0.25	0.87

Phase 1: 26% roughage/conc diet; **31 d**; 2024/12/18 - 2025-01-17;

Phase 2: 10% roughage/conc diet; **57 d**; 2025-01-18 - 2025 -03-15

n = 4 pens (12 bolused steers/pen); SEM = Standard error of means

MO= Monensin; VM+MO = Virginiamycin+monensin

*Bout = Period of at least 3 h with rumen pH ≤ 5.6; **Average length of bout event in hours;

*** pH and rumen temperature of average bout event

Effects of virginiamycin adding to a corn-based diet during the final **88 days** on performance of summer-finished feedlot steers

	MO	VM+MO	SEM	P
LW day 0, kg	460	464	6.4	0.63
LW day 88, kg	541	562	4.6	0.02
ADG, kg/d	1.047	1.236	0.02	0.01
DMI, kg/d	10	10.8	0.14	0.01
DMI/LW, %	2.01	2.11	0.05	0.15
F:G	9.8	8.7	0.09	0.01

n= 4 (pen/trt; 112 steers/pen)
MO = Monensin; VM+MO = Virginiamycin + monensin
SEM = Standard error of means
LW + Live weight;
ADG = Average daily gain;
DMI = Dry matter intake;
DMI/LW = DMI/average live weight
F:G = Feed to gain ratio (DMI/ADG)

Effects of virginiamycin adding to a corn-based diet during the final 88 days on performance of summer-finished feedlot steers over a 169-days

	MO	VM+MO	SEM	P
LW day -81, kg	340	342	9.15	0.89
LW day 88, kg	541	562	4.6	0.02
ADG, kg/d	1.187	1.302	0.03	0.03
DMI, kg/d	10.9	11.2	0.13	0.26
DMI/LW, %	2.48	2.47	0.04	0.74
F:G	9.2	8.6	0.28	0.05

n= 4 (pen/trt; 112 steers/pen)
MO = Monensin; VM+MO = Virginiamycin + monensin
SEM = Standard error of means
LW = Live weight;
ADG = Average daily gain;
DMI = Dry matter intake;
DMI/LW = DMI/average live weight
F:G = Feed to gain ratio

Effects of grain processing in a corn-based diet during the final 88 d of summer finishing on carcass weight and beef traits of feedlot steers

	Srol	Drol	SEM	P
HCW, kg	325	327	3	0.67
Yield grade score*	3.57	3.52	0.03	0.21
Marbling score*	512	489	7.8	0.08
REA, cm ²	72.4	72.3	0.19	0.72
SFT, cm	1.52	1.46	0.04	0.39
Lean score*, %	54	53.6	0.3	0.22

n = 4 (pen/trt; 112 steers/pen)
Srol = Single rolled corn; Drol = Double rolled;
SEM = Standard error of mean
HCW = Hot carcass weight
REA = Rib eye area;
SFT = Subcutaneous fat thickness;
* Estimates according to USDA beef grading system

Effects of virginiamycin inclusion in a corn-based diet during the final 88 d of summer finishing on carcass weight and beef traits of feedlot steers

	MO	VM+MO	SEM	P
HCW, kg	321	331	1.4	< 0.01
Yield grade score*	3.53	3.56	0.021	0.39
Marbling score*	497	504	10.1	0.61
REA, cm ²	71.2	72.6	0.12	0.04
SFT, cm	1.49	1.48	0.030	0.73
Lean score*, %	0.536	0.541	0.002	0.16

n= 4 (pen/trt; 112 steers/pen)
MO = Monensin; VM+MO = Virginiamycin + monensin
SEM = Standard error of means
HCW = Hot carcass weight
REA = Rib eye area;
SFT = Subcutaneous fat thickness;
* Estimates according to USDA beef grading system

Conclusion

- Adding VM to the diet contributed to a less acidotic rumen across the study.
- VM assisted in improving animal performance and efficiency. By controlling the number of chronic acidotic events or reducing the magnitude.
- Positive effects were observed in final LW, ADG, F:G, HCW and REA.

Most likely, effects on performance, carcass size, and REA were directly related with mitigated rumen acidosis and benefits on overall animal wellbeing.



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