

Effects of a mycotoxins-binder on plasma biochemistry in early lactating dairy cattle

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- **Introduction**
 - Mycotoxins from *Fusarium spp* and their binders
 - The different mycotoxin-binders and their effects
- **Material and Methods**
 - Animals, sampling, analysis
- **Results and Discussion**
 - Plasma minerals
 - Plasma enzymes activity
- **Conclusion**

Mycotoxins from *Fusarium spp.*:

The contamination of feeds with mycotoxins from *Fusarium spp.* is a problem of growing interest for dairy cattle

The main mycotoxins are zearalenone (ZEA) and deoxynivalenol (DON) produced by *F. graminearum* and fumonisins produced by *F. verticilloides*

On-farm:

a widely adopted solution to reduce the toxic effects of Fusarium-mycotoxin in cows is the addition of polymeric glucomannan-based adsorbents (**PGA**)

Many adsorbents: ability to bind one or more mycotoxins, but these feed additives may also have some adverse effects

- interfering in the availability of essential nutrients (generally minerals) to the animal
 - decreased DM and ADF digestibility (Johnson et al., 1988)
 - change in liquid fractional rate of passage (% h) and rate of flow (L/h) (Johnson et al., 1988)
- subtracting “space” for nutrients
- other???

Clay-based (more studied)

Big study in Greece, from -30 d before calving to the end of lactation (monthly sampling)

- 0.00, 1.25, or 2.50 % inclusion of clinoptilolite in dairy cow diet

No adverse effects on: **haematological parameters** (Katsoulos et al., 2005, Vet Med Czech 50, 427-431); serum **Cu, Zn, and Fe** (Katsoulos et al., 2005, Biol Trace Elem Res 108, 137-145); serum **β -carotene, vit A and E** (Katsoulos et al., 2005, J Vet Med A 52, 157-161)

PGA (derived from yeast cell wall): very good results on *Fusarium* mycotoxins, but no data on secondary effects

cell walls: polysaccharides (glucan, mannan), proteins, lipids

⇒ numerous different and easy accessible adsorption centers including different adsorption mechanisms (H-bonding, ionic, or hydrophobic interaction)

Evaluation of possible effects from the introduction of PGA in the diet of early-lactating dairy cow on



- Plasma minerals
- Plasma enzymes activity

2 groups of 16 cows each (homogeneous for age at calving and parity), first 6 wk of lactation

	Control (CON)	Adsorbent (ADS)
Age at calving, mo	40.9 ± 15.6	40.1 ± 15.7
Parity, n	1.67 ± 0.84	1.76 ± 1.09

All the concentrate feeds were bought in the respect of the EU limits for the contamination with undesirable substances in animal feed

Blood samples

- drawn from the jugular vein, in the morning, before feed distribution, using evacuated tubes (10 ml, Li-heparin)
- plasma immediately centrifuged at 3000 g x for 20' at 4°C and stored at -20°C
- 7 d intervals starting 1st wk after calving

Corn silage-based diet supplemented (top dressing method) with 500 g of a barley flour-flaked corn mixture **with or without 20 g/d** per cow of a commercial **PGA**

Ingredients and chemical composition of the TMR

Composition	kg	Parameters	
Corn silage	26.0	DM, % as fed	52.34
Alfalfa hay	4.5	CP, % DM	14.69
Commercial concentrate	4.5	NDF, % DM	34.27
Corn flaked	3.0	ADF, % DM	20.05
Cottonseed	1.0	Fat, % DM	3.74
Barley meal	1.0	Starch, % DM	30.64
Mineral salts	0.4	Ash, % DM	6.05

Minerals

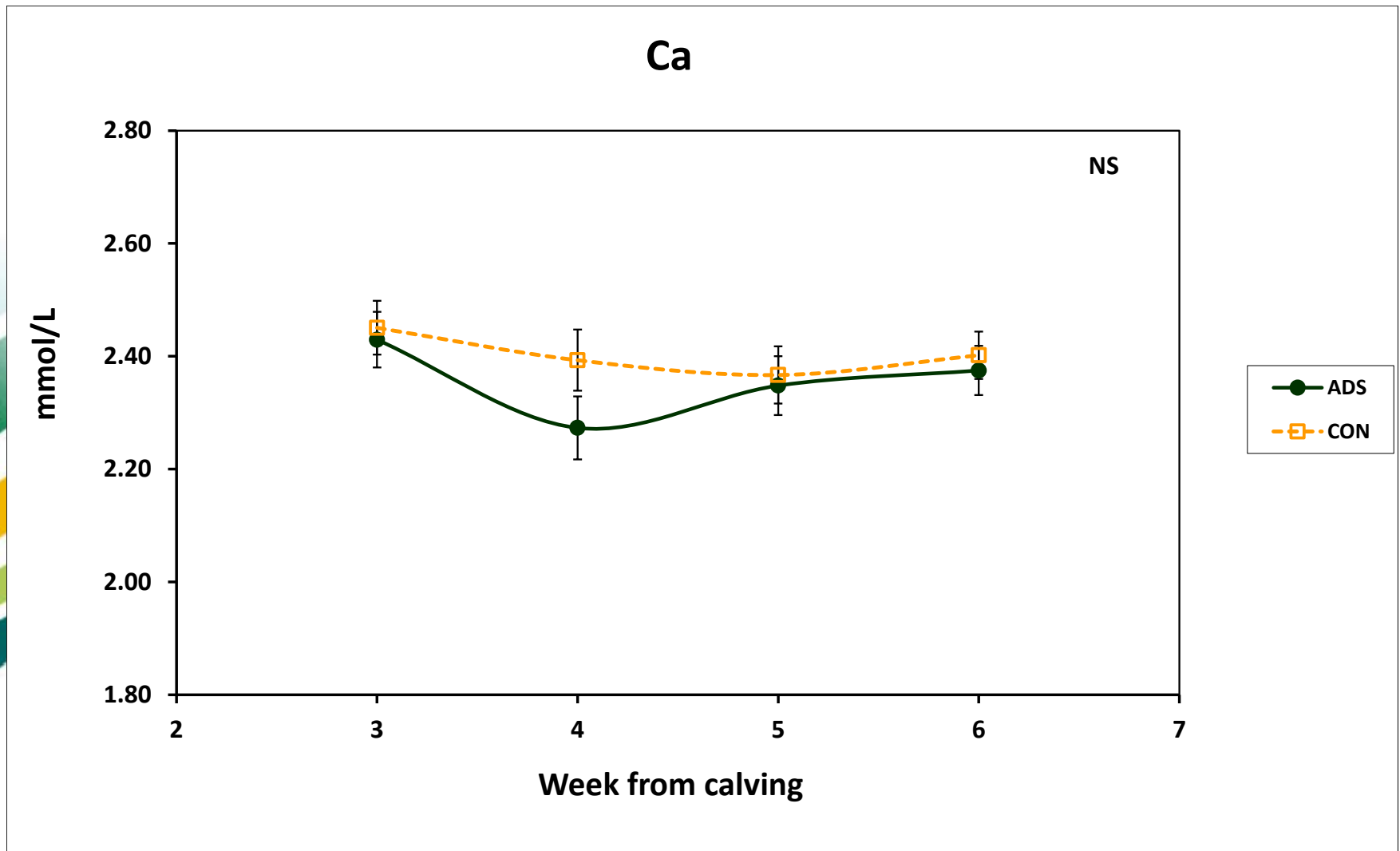
- Calcium (Ca)
- Inorganic phosphorus (iP)
- Magnesium (Mg)
- Sodium (Na)
- Potassium (K)
- Chlorine (Cl)
- Iron (Fe)

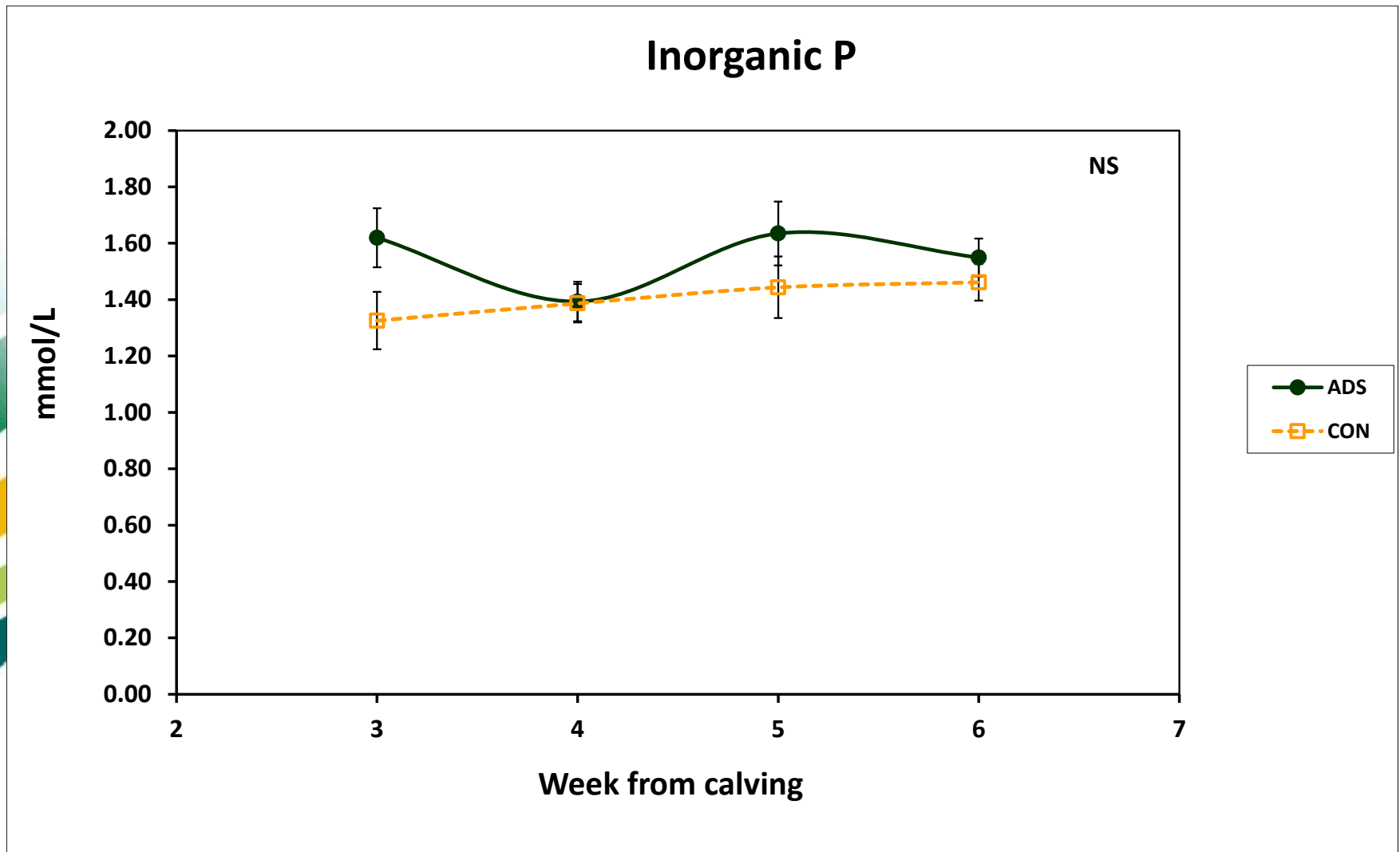
Enzymatic activities

- ❖ alanine aminotransferase (ALT, EC 2.6.1.2)
- ❖ aspartate aminotransferase (AST, EC 2.6.1.1)
- ❖ γ -glutamyltransferase (GGT, EC 2.3.2.2)

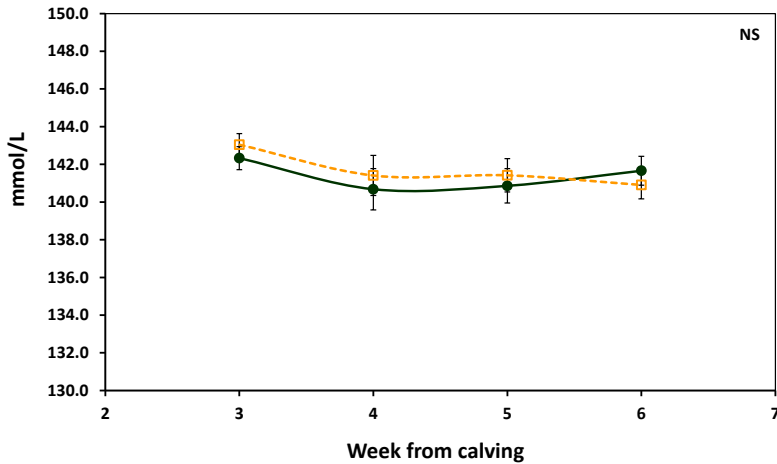
Analyzed at 37°C by an automated clinical analyzer (ILAB Aries, Instrumentation Laboratory, Lexington, MA) using commercial kits (Instrumentation Laboratory, Lexington, MA).

- ❖ **NORMAL DISTRIBUTION TEST: PROC UNIVARIATE (SAS, 2009)** with the Shapiro-Wilk's test
 - The variables that did not fit the normal distribution were re-tested after log-transformation to match the assumption for a parametric analysis; their results are presented in the original scale after re-transformation
- ❖ blood data were analysed as repeated measures by a mixed model, with diet treatment (**D**), week from calving (**T**), and their interaction (**D × T**) as main factors, with cow within diet treatment considered as random
 - COVARIANCE STRUCTURE (according to the AIC) the one which best fitted the data among **SIM, CS, ANTE(1), AR(1), UN**
- ❖ Means ± s.e. (c.i. for re-transformed data); **significant** = $P < 0.05$; **trend**:= $0.05 > P < 0.10$

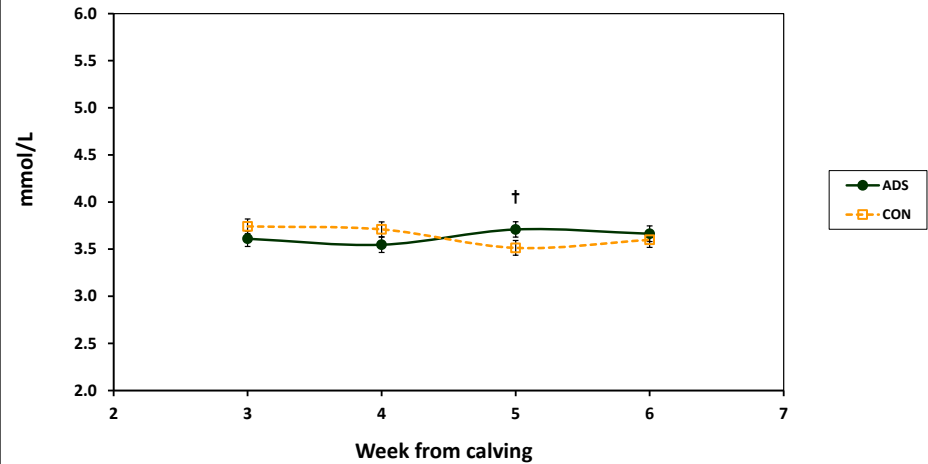




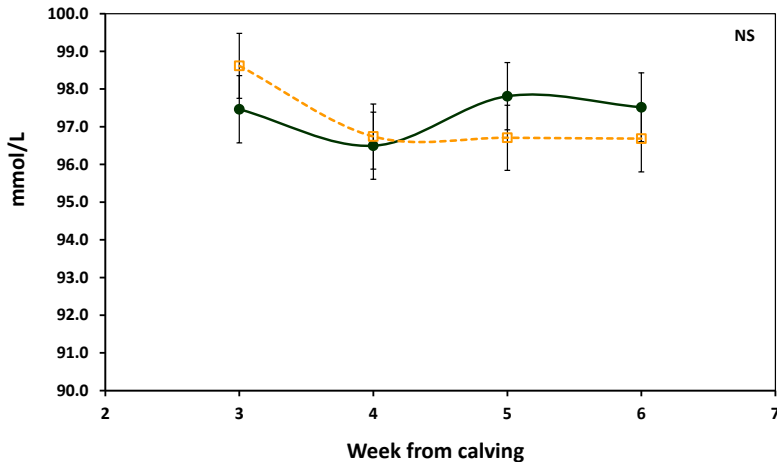
Na



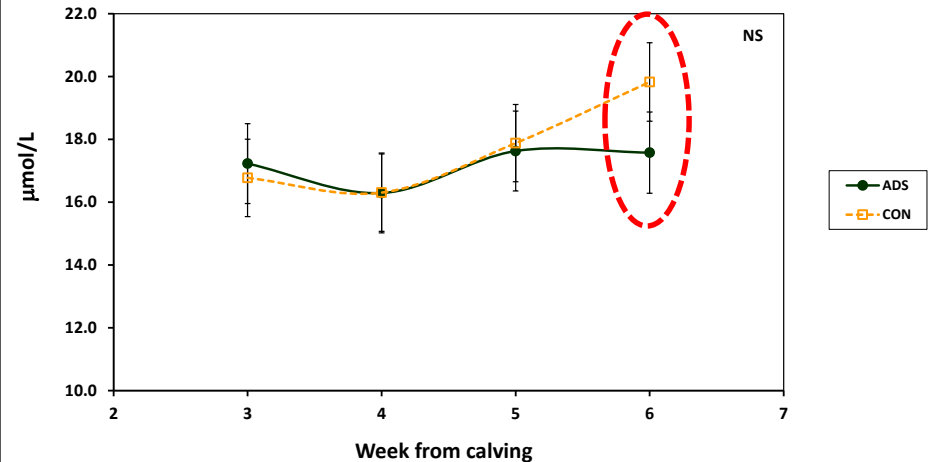
K



Cl



Fe



Macrominerals

No interference with Ca and P in an important phase such the onset of lactation

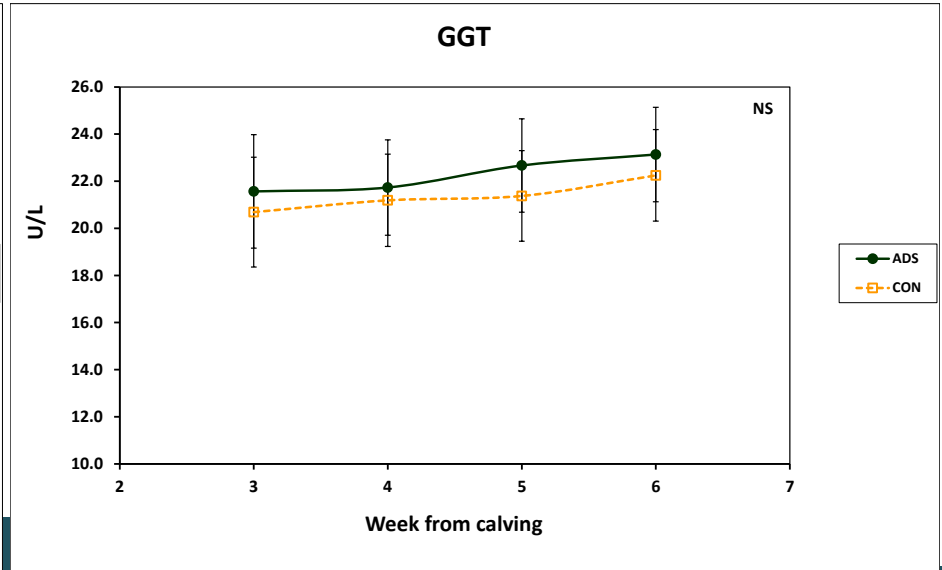
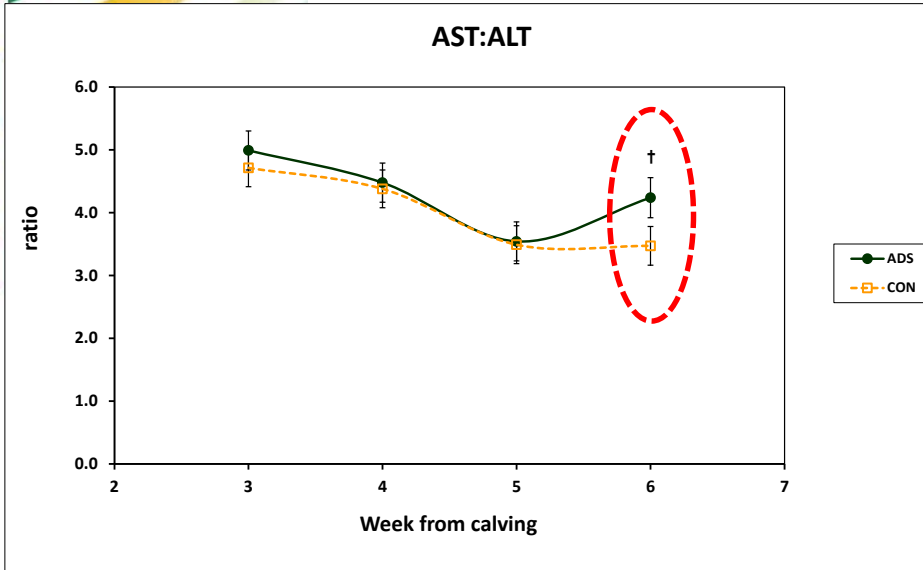
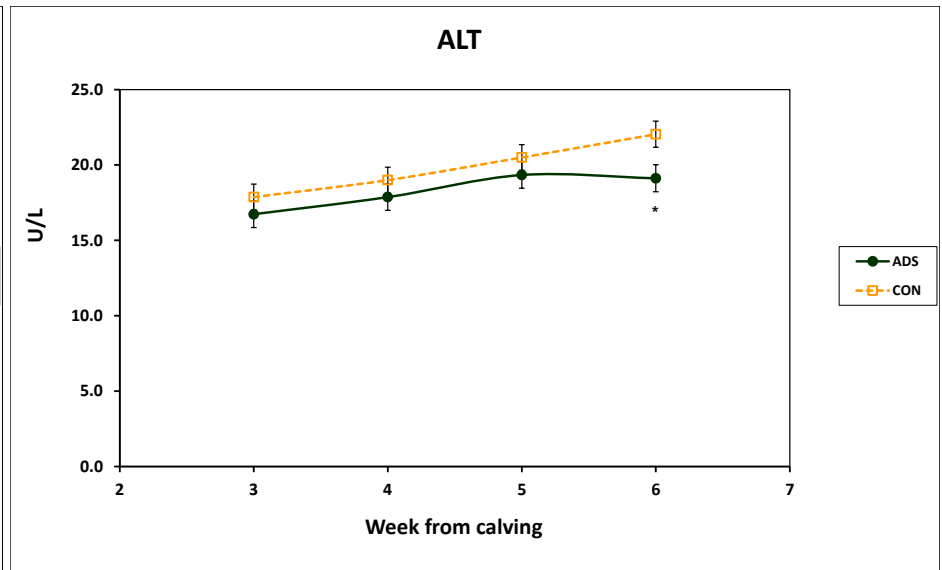
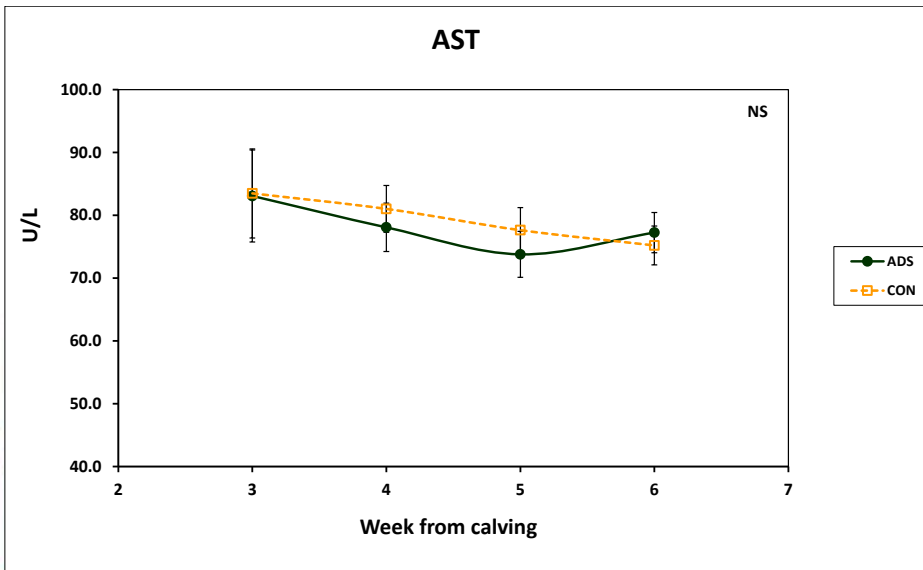
Electrolytes

No negative effects on plasma levels

Iron

No negative effects

Short-term trial, but results seems confirmed by our previous data on red blood cells features (Dal Prà et al., 2013)



AST, ALT, and GGT

No interference from ADS

Data comparable with those reported for this stage of lactation (Boots and Ludwick, 1970; Rico et al., 1977)

AST:ALT ratio

Normal pattern at 3, 4, and 5 wk

Higher value in ADS at 6 wk (the same time when plasma Fe tends to differ between groups) \Rightarrow trend to hemolysis? (no evident in fresh plasma)

PGA ADS did not seem to affect cow plasma mineral in the short period during the first 6 wk of lactation

According with our previous report on hematology, **PGA ADS** did not interfere with Fe availability (in the short period) or liver function

Further research will be necessary in trials lasting 3 mo, which better mirror possible negative effects in the turnover of erythrocytes

Thank...

... you ...

... for ...

... your ...

... attention!



Acknowledgment

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