Effects of olive oil bioactive extracts on immune response in lipopolysaccharide-challenged weaned heifers

Olive oil has bioactive properties (anti-inflammatory, and anti-oxidant), Sofi et al., 2010

Effects attributed to bioactive molecules, mainly triterpenes and polyphenols

• Found in leaves, and fruit
• Can be extracted from pomace oil
Olive oil bioactive extracts (OBE)

- Hydroxytyrosol (HT)
- Oleanolic Acid (OA)
- Malsinic Acid (MA)

- Promising potential to be used as nutraceuticals
- Dietary supplementation could contribute to reducing the negative effects of subclinical chronic inflammation on animal growth and overall performance
OBE ameliorated the negative effects of LPS on DMI, and decreased inflammatory markers on weaned piglets

- C- = saline
- C + = Increasing doses of LPS (60, 66, 72, 78 μg/kg of BW)
- OBE = LPS + supplementation with OBE at 0.05% of diet

Extracted from Liehr et al., 2017
Hypothesis
Feeding olive oil bioactive extracts (OBE) could ameliorate the detrimental effects of LPS challenge through modulation of the immune response and reduction of systemic inflammation

Objective
To evaluate the impact of feeding OBE to newly weaned Angus crossbred heifers injected intravenously with increasing doses of lipopolysaccharide every other day over a 10 d period
Olive oil bioactive extracts (OBE)

- Pomace oil was filtrated, bioactive compounds extracted with purified ethanol, dissolved in methanol and quantified by HPLC.
- OBE was standardized to 10% OA, 4% MA, and 2% HT.
Materials and Methods

• 36 newly weaned heifers (210 ± 19 kg of BW; 6 mo)

4 treatments (Trt)

1. **CTL -** = Negative control, only saline (n=9)
2. **CTL +** = Positive control, LPS (n=9)
3. **OBE-L** = OBE 0.04% of diet, LPS (n=9)
4. **OBE-H** = OBE 0.16% of diet, LPS (n=9)

• 21 d adaptation prior to LPS challenge
Materials and Methods

• LPS, 0111:B4, Sigma # L2630
• Beginning on d 0, LPS was injected intravenously every other day for 10 d (Fernandes et al., 2017)
• Increasing doses of LPS: 0.10, 0.25, 0.50, 0.75, 1.00, 1.25 μg/kg of BW
• LPS was infused with a winged butterfly needle
Materials and Methods

• Randomized block (period) design with repeated measures

• Mixed Procedure of SAS

• Model included fixed effect Trt, and random effect of period and ID(Trt)

• In addition, for repeated measures: fixed effect of time and Trt × time

• Orthogonal contrasts were performed:
  - CTLPve vs. OBE
  - OBE1 vs. OBE4
  - CTLNve vs. CTLPve

• Significance declared at $P < 0.05$, and tendency at $P < 0.10$
Serial blood collection

Daily blood sampling
On days of challenge, right before LPS infusion

Intravaginal temperature, recorded every 5 min

OBE supplementation

Days -21 - 0: adaptation

-21

Serial blood collection

0.10 µg/kg BW
0.25 µg/kg BW
0.50 µg/kg BW
0.75 µg/kg BW
1.00 µg/kg BW
1.25 µg/kg BW

LPS challenge
No differences observed on DMI pre-challenge

OBE supplementation improved DMI on animals exposed to LPS

Trt, $P = 0.84$

Trt × day, $P = 0.05$
Changes on intravaginal temperature throughout the LPS protocol

Temperature, °C

h relative to the 1st challenge

LPS challenge

CTL -  CTL +  OBE -L  OBE -H
OBE-H supplementation decreased the rise on intravaginal temperature induced by LPS on d 0

*CTLpve vs OBE4 (h 2-4)

Trt × time, $P < 0.01$
Heifers supplemented with OBE ameliorated the increased in IL-6 induced by LPS.

Trt × time, $P < 0.01$
Heifers supplemented with OBE-H recovered normal glycemia faster on d 0 but not on d 10.
OBE recovered normal neutrophils cell counts faster than CTL +
OBE supplementation downregulated the expression of CD14 and CD11b on monocytes cell surface.
Heifers supplemented with OBE had reduced expression of CD11b in neutrophils.
Conclusions

• Supplementation with OBE
  • Ameliorated some of the negative effects of LPS on:
    • Dry matter intake
    • Intravaginal temperature °C
    • Inflammatory marker concentration
  • Recover normal glycemia faster on the first day of challenge
  • Modulated the immune response by ameliorating the drop on immune cell counts, and reducing expression of cell surface receptors involved in LPS recognition and cell migration
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