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Dietary energy source modifies the N utilization and the whole body leucine kinetics in dairy cows

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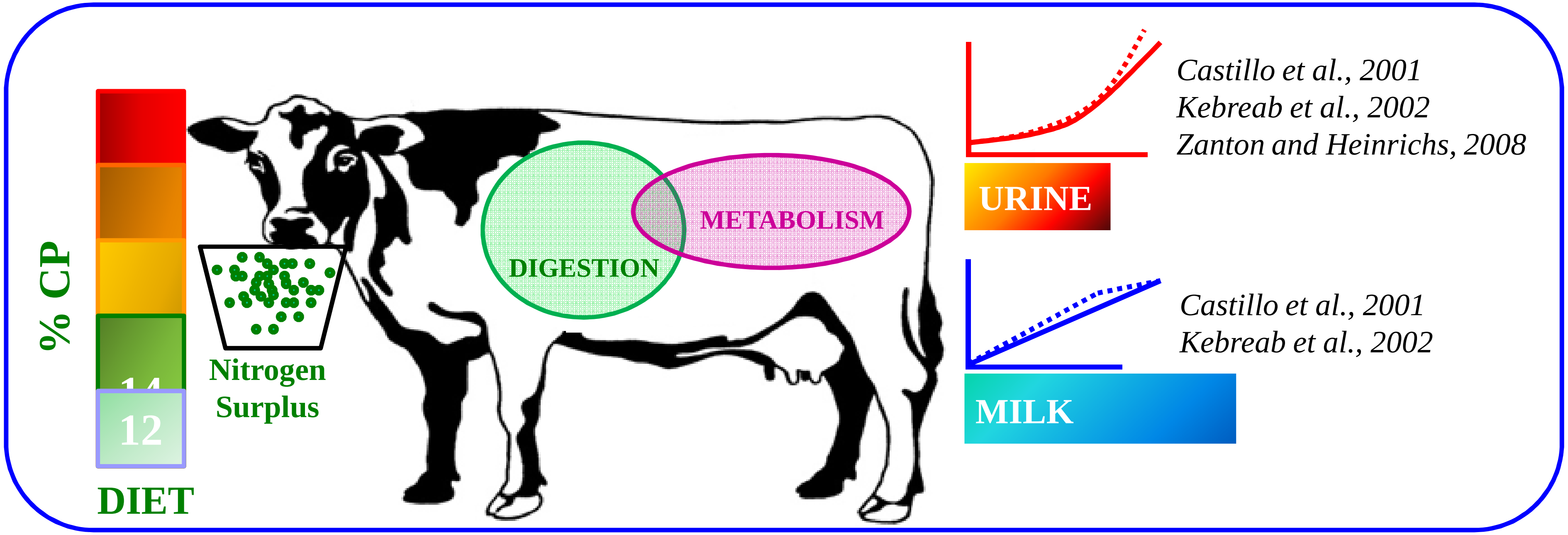
REDNEX

SEVENTH FRAMEWORK PROGRAMME

ALIMENTATION
AGRICULTURE
ENVIRONNEMENT

INRA

INTRODUCTION



REDNEX **Innovative and practical management approaches to reduce N excretion by ruminants**

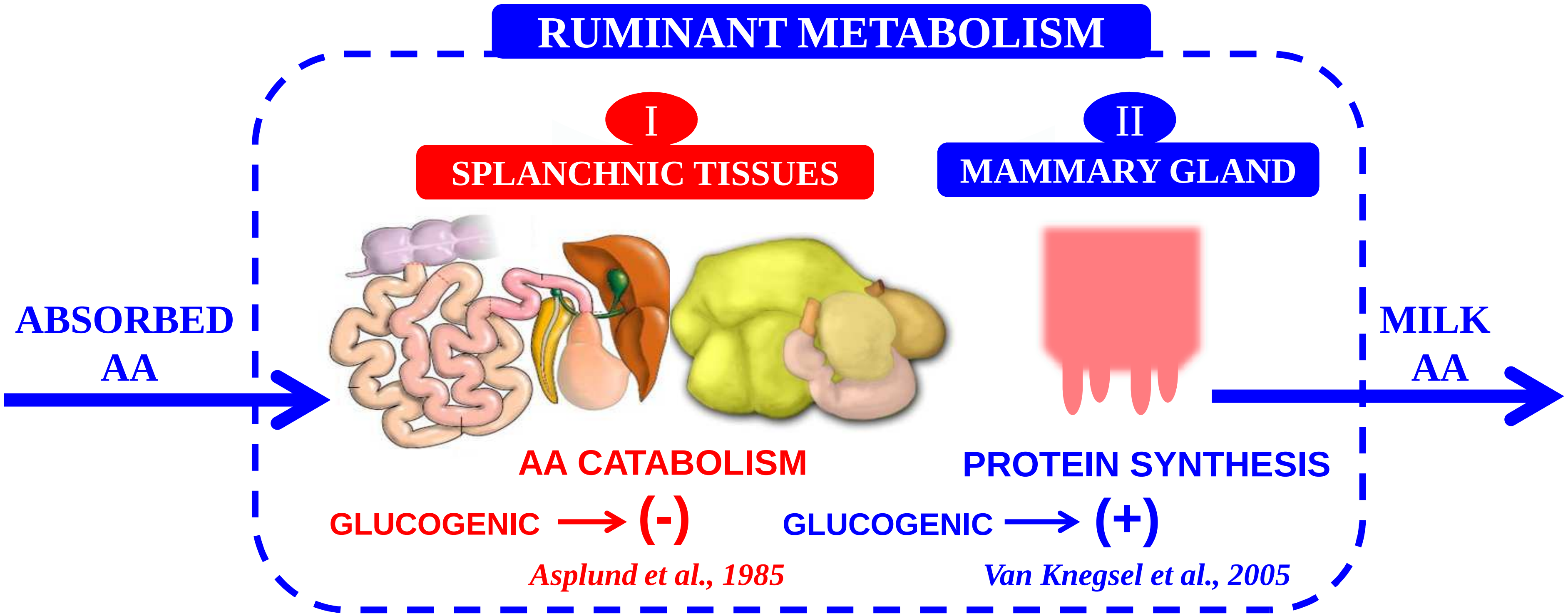
1 DECREASING THE N INTAKE

2 INCREASING THE EFFICIENCY OF N UTILIZATION (ENU)

Huhtanen & Hristov, 2009 (metanalysis)

Dietary CP concentration (most important factor)

Carbohydrate composition (NDF [-], NFC [+] and starch [+])



HYPOTHESIS:

At low N intake **GLUCOGENIC** nutrients absorbed from diets rich in starch could **decrease the AA catabolism** compared to **CETOGENIC** nutrients absorbed from diets rich in fiber, and thus contributing to improve the efficiency of N utilization

OBJECTIVE

To study the effect of the dietary energy source (starch *vs* fiber) on the efficiency of N utilization and whole body leucine kinetics in dairy cows fed diets at two protein content levels (low *vs* normal)

MATERIAL AND METHODS

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- 4 catheterised Jersey cows in mid lactation (85 ± 25 DIM)
- 4 iso-energetic 50:50 F:C diets
- 4 28d-periods: 2 last days for measurements
- Limited and constant allowances
- Distribution every 1h and interval between milking close to 12h
- 4 x 4 Latin Square design
- 2 x 2 Factorial arrangement of treatments

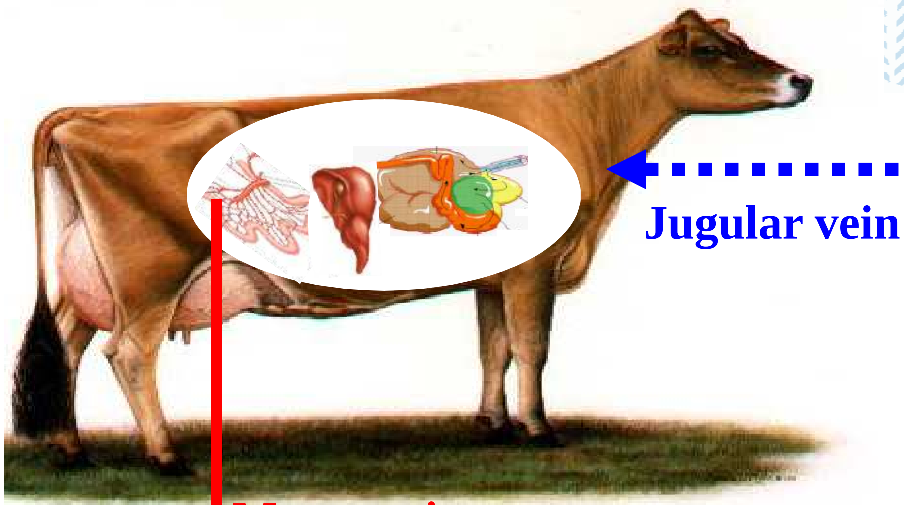
→ **2 energy sources:**

	%NDF	%Starch
Rich in STARCH	31.5	34.5
Rich in FIBER	46.5	5.0

→ **2 CP content levels:**

	%CP	%PDI Requir.
Low CP	12.0	80
Normal CP	16.5	100

MATERIAL AND METHODS

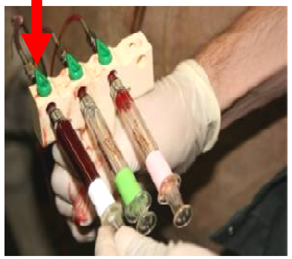


Jugular vein

Mesenteric artery

Tracers infusions

Day 27: ^{13}C-Leu (8h)
Day 28: ^{13}C-Bicarbonate (6h)



Blood sampling

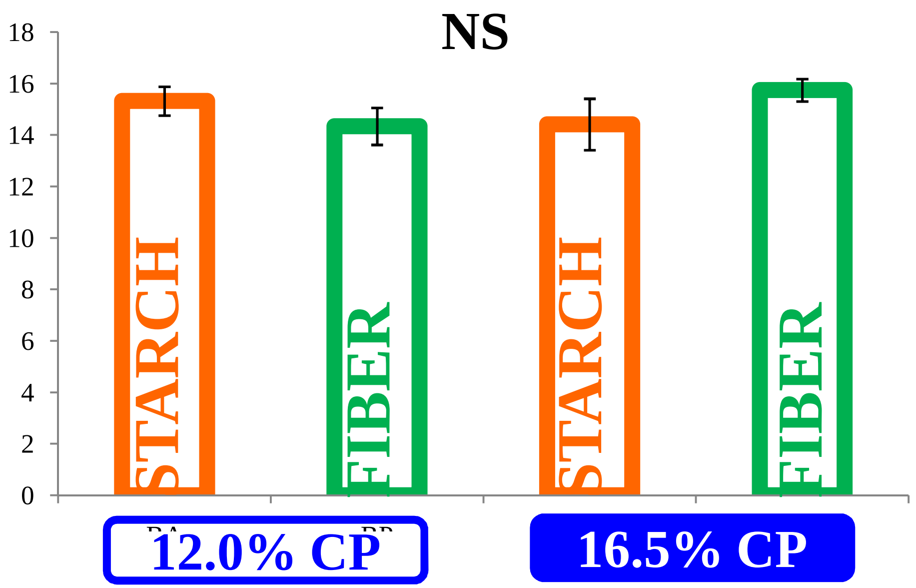
Day 27: 6 hourly sampling
Day 28: 5 hourly sampling

Analysis
Day 27: Isotopic enrichment ^{13}C-Leu/CO_2
Day 28: Isotopic enrichment ^{13}C-CO_2

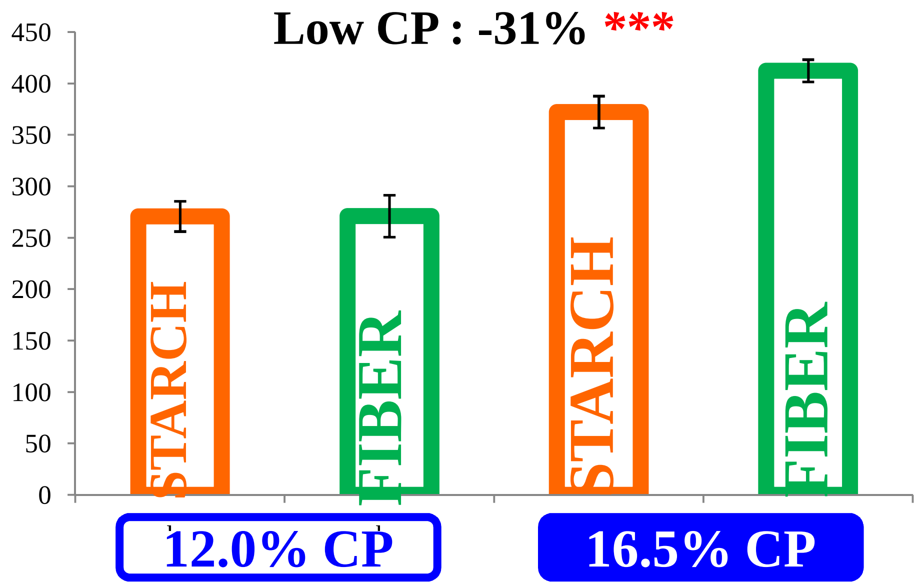
RESULTS

FEED INTAKE

DRY MATTER INTAKE, kg/d



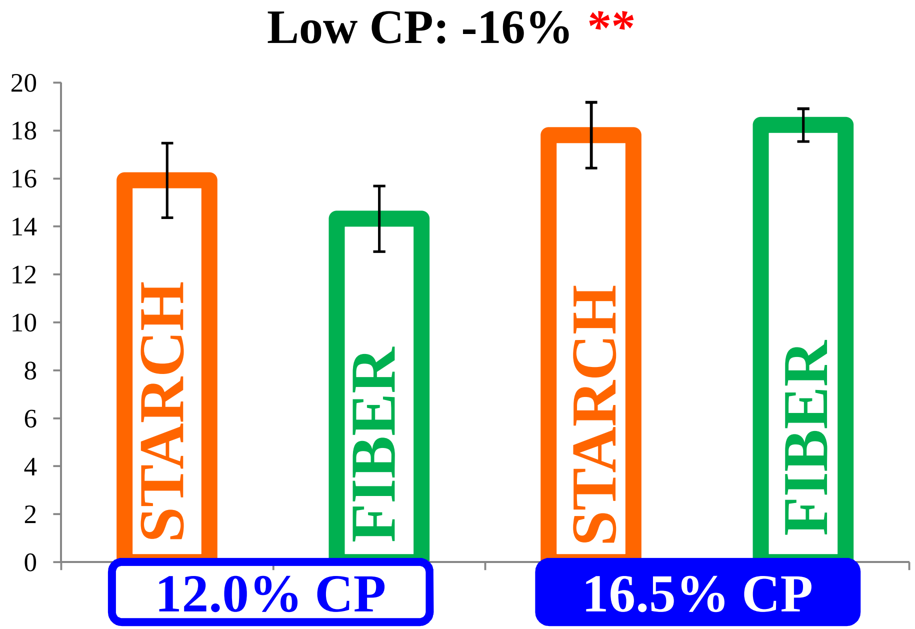
N INTAKE, kg/d



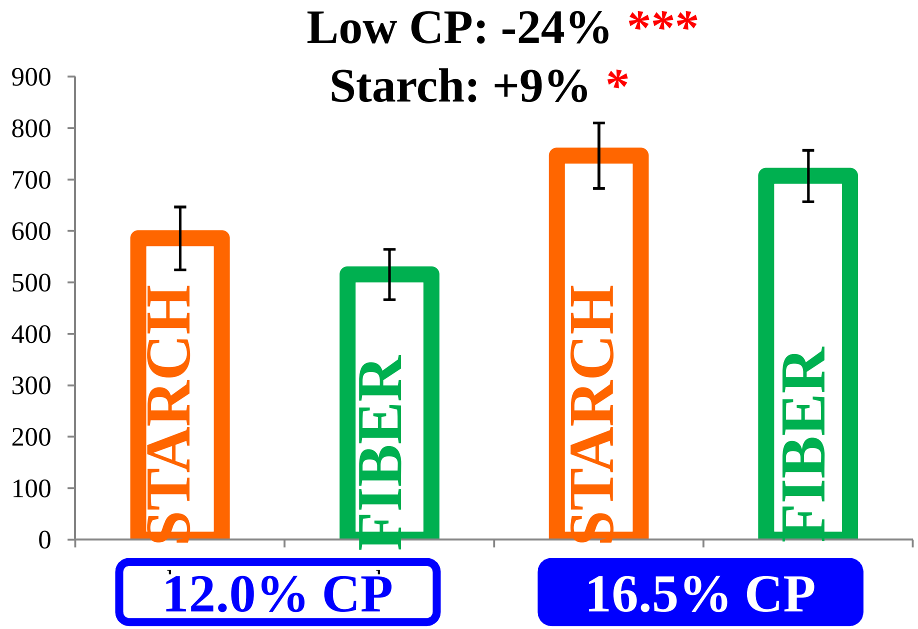
Based on INRA calculated feed values, intakes of energy (UFL) and protein (PDI) were similar between starch and fiber diets

MILK PERFORMANCES

MILK YIELD, kg/d

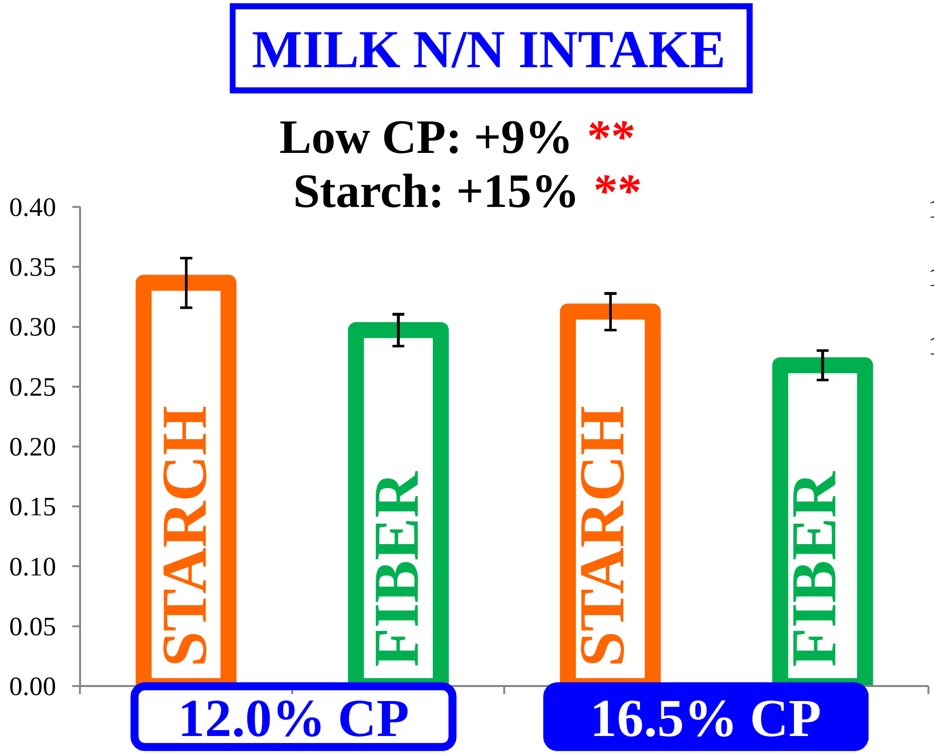


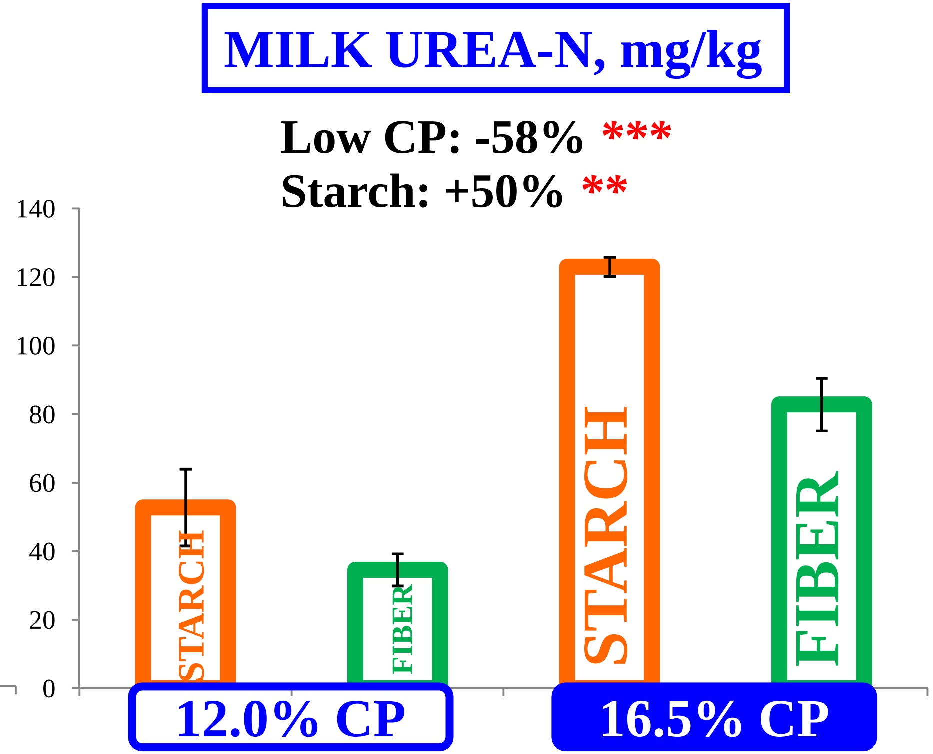
MILK PROTEIN YIELD, g/d



Although milk yield was not affected by the dietary energy source, milk protein yield was 9% higher with starch diets

MILK N EFFICIENCY



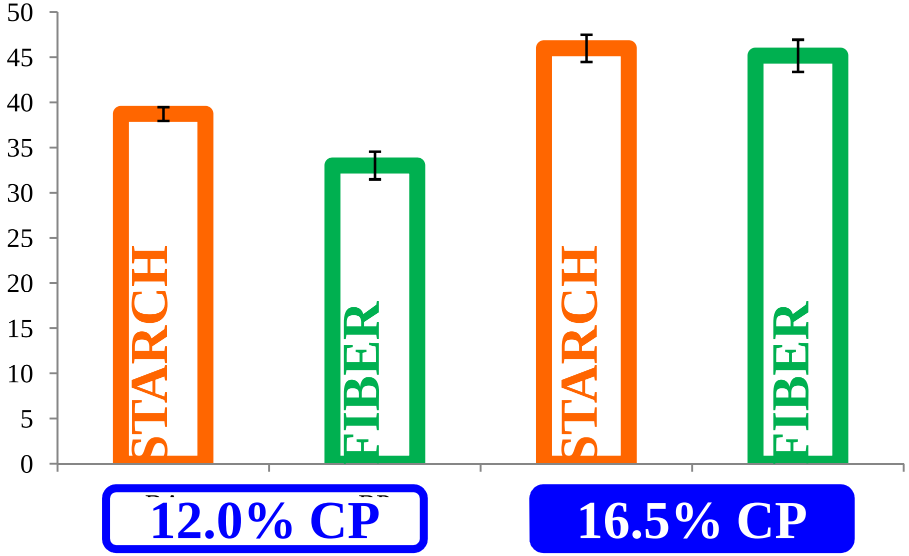


The efficiency of N utilization was improved with starch diets, but was not reflected in the MUN

WHOLE BODY LEU KINETICS

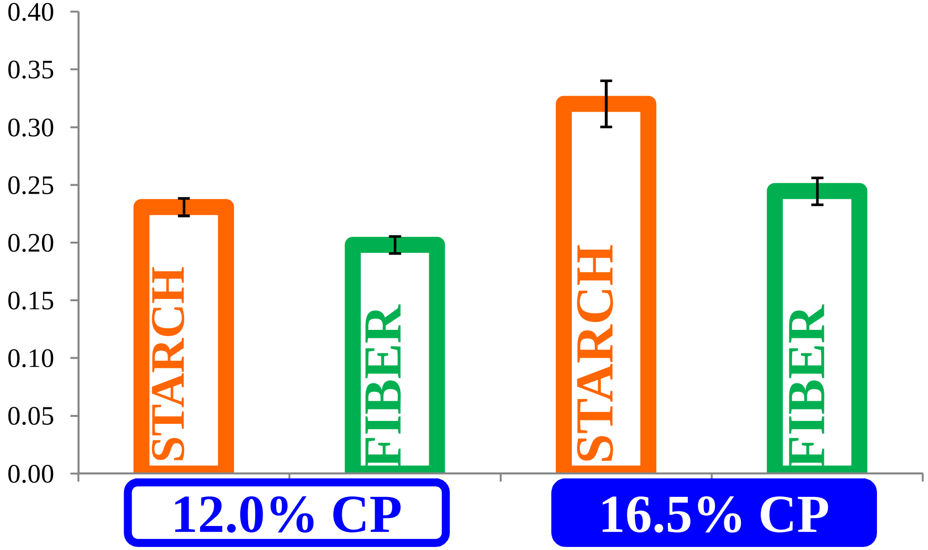
IRREVERSIBLE LOSS RATE, mmol/h

Low CP: -21% **
Starch: +8% *P* < 0.10



FRACTIONAL OXIDATION, mmol/mmol

Low CP: -21% **
Starch: +20% **



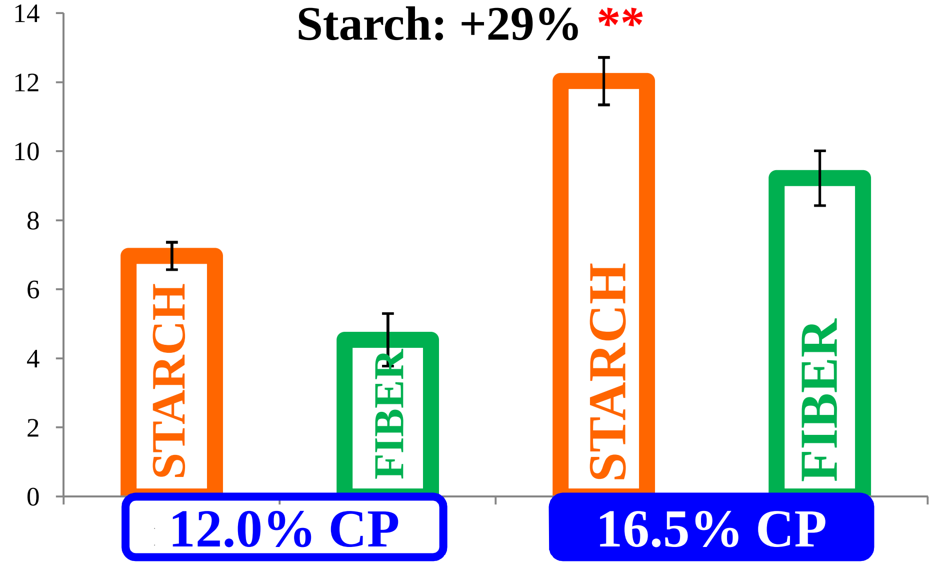
Metabolic Leu utilization tended to be higher with starch diets.
Leu fractional oxidation was significantly higher with starch diets

WHOLE BODY LEU KINETICS

OXIDATION, mmol/h

Low CP: -37% ***

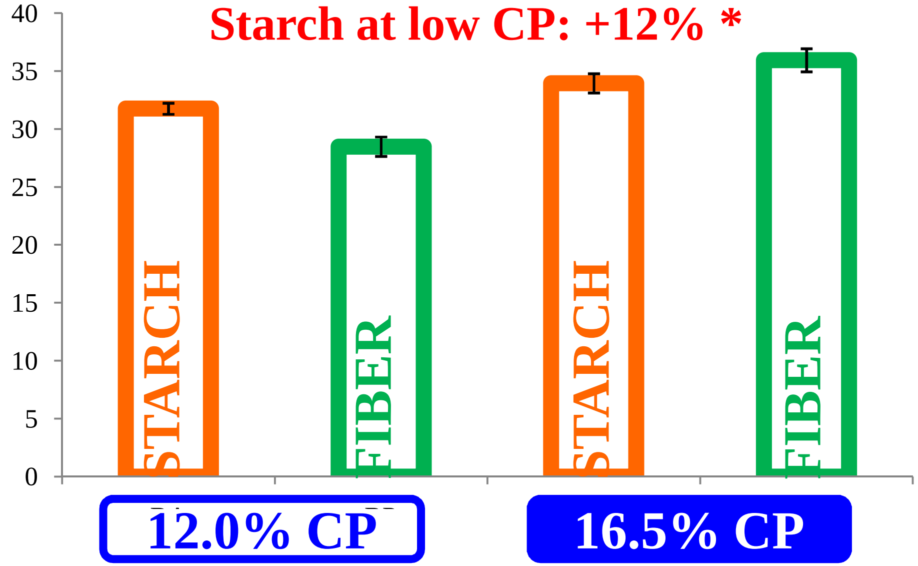
Starch: +29% **



SYNTHESIS, mmol/h

Low CP: -15% **

Starch at low CP: +12% *



Unexpectely Leu oxidation was higher for starch diets.
More Leu was used for protein synthesis with starch diets, at low CP only

CONCLUSIONS

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- **In Jersey cows, fed iso-energetic levels:**

Decreasing protein intakes at 80% of recommendations

- **Reduced milk protein yield by 176 g/d (-24%)**
- **Improved ENU by 10%**
  - **By reducing AA oxidation (Leu)**

Feeding starch (34% on a DM basis):

- **Improved milk protein yield by 55 g/d (+9%)**
- **Improved ENU by 15%**
  - **By increasing the pool of metabolically active Leu (ILR) and thus orienting more Leu towards protein synthesis**

The indicator Milk Urea N reflected differences in Leu oxidation, but not in Leu utilization for protein synthesis

THANK YOU FOR YOUR ATTENTION