RESEARCH BRIEF

KEY RESEARCH STUDY RESULTS & CONCLUSION

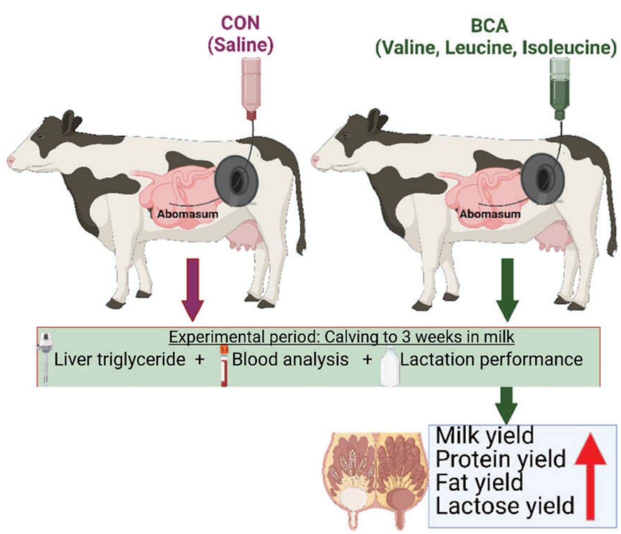
- Overall, BCAA supplementation in this study improved milk production, whereas BCKA supplementation reduced TG accumulation in the liver of fresh cows.
- Infusion of BCA increased milk yield (39.5 vs. 35.3 kg/d, SEM 1.8), milk fat yield (2.10 vs. 1.69 kg/d, SEM 0.08), and lactose yield (2.11 vs. 1.67 kg/d, SEM 0.07) compared with CON.

Paper Title: Abomasal infusion of branched-chain amino acids or branched-chain keto-acids alter lactation performance and liver triglycerides in fresh cows

Gallagher et al. Journal of Animal Science and Biotechnology (2024) 15:13

Cows with fatty liver have lower circulating branched-chain amino acid (BCAA) concentrations whereas cows with high circulating BCAA levels have low liver triglyceride (TG). Our objective was to determine the impact of BCAA and their corresponding ketoacids (branched-chain ketoacids, BCKA) on production performance and liver TG accumulation in Holstein cows in the first 3 weeks postpartum.

DISCUSSION - MILK PRODUCTION AND COMPOSITION



- Abomasal infusion of BCAA at the current dose increased milk yield by 4.2 kg/d compared to CON. Based on NASEM [15] predictions for our diets and assuming that 100% of infused AA were absorbed (Table 2), cows infused with BCAA were predicted to produce 2.5 kg more milk per day based on protein supply if no change was made in user-entered milk yield. It is well-established that milk yield is highly correlated with mammary plasma flow [27]. A recent jugular infusion study demonstrated that Leu (50 g/d) and Ile (22 g/d) supplementation increased mammary plasma flow by 24% and increased milk yield by 2.3 kg/d [14]. In the current study, we infused Leu at the same dose as Yoder et al. [14] and Ile at a higher dose (34 g/d) into the abomasum. Hence, the increased milk yield of BCA cows in this study might have been partly caused by a higher mammary plasma flow.

Table 2
Nutrient composition evaluation (NASEM 2021) of early lactation diet fed to multiparous Holstein fresh cows[a]

COMPONENT[c]	TREATMENTS[b]	
	CON	BCA
NEL, Mcal/kg of DM	1.76	1.75
CP, % of DM	17.6	18.3
RDP, % of DM	12.0	11.9
NEL allowable milk, kg/d	35.2	37.6 (35.7)
MP allowable milk, kg/d	29.1	34.0 (31.7)
Predicted milk protein, kg/d	0.87	0.88
Predicted milk, kg/d	36.9	37.4
MP supplied, kg/d	1.98	2.12
MP from Microbial CP, kg/d	1.11	1.12
MP from RUP, kg/d	0.87	1.00
MP balance, g/d	-333	-278
Absorbed Val, g/d	121	186
Absorbed Leu, g/d	176	224
Absorbed Ile, g/d	118	147

[a] Predicted by Nutrient Requirements of Dairy Cattle (v.8, The National Academies of Sciences, Engineering, and Medicine) [15] based on ingredient composition, with the observed mean DMI, BW, BW loss, milk yield, and milk components for each treatment
[b] CON Control (saline 0.9%), BCA Branched chain amino acids (67 g valine, 50 g leucine, and 34 g isoleucine),
[c] Values were predicted using the NASEM Dairy software V8 R2022.12.08 using actual milk production and diets for each treatment. BCAA were entered as RUP supplements with 100% digestibility. BCKA were entered as a FA supplement with 100% digestibility to provide the same DE supply as BCKA. For BCA treatment, values for NE and MP-allowable milk are dependent upon the cow description. Values in parentheses were predictions using the milk production of CON cows to predict milk without the complicating effects of user-entered milk on urinary N output

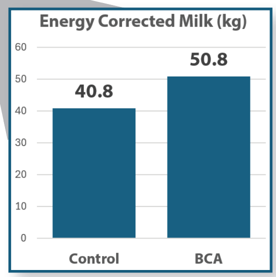
CONTINUED ON BACK

CONT'D RESEARCH

Table 4
Lactation performance in multiparous Holstein fresh cows

PARAMETER	TREATMENTS[1]	
MILK PRODUCTION, kg/d	**CON**	**BCA**
Milk yield	35.3[B]	39.5[A]
Fat yield	1.69[B]	2.10[A]
Protein yield	1.25[b]	1.46[a]
Lactose yield	1.67[B]	2.11[A]
FCM[3]	41.1[B]	52.0[A,a]
ECM[4]	40.8[b]	50.8[a]
Milk:DMI	1.90[ab]	2.11[a]

[A,B] Within a row, means with different capitalized superscripts differ after controlling for pairwise LSM comparisons using Tukey's post-hoc procedure ($P \le 0.05$)
[a,b] Within a row, means with different superscripts (lowercase) tend to differ after controlling for pairwise LSM comparisons using Tukey's post-hoc procedure ($0.05 < P \le 0.10$)
[1] CON Control (saline 0.9%), BCA Branched chain amino acids (67 g valine, 50 g leucine, and 34 g isoleucine)
[3] Fat corrected milk calculated as FCM (kg) = 0.4324 × Milk yield (kg) + 16.216 × Fat yield (kg) [22, 23]
[4] Energy corrected milk calculated as ECM (kg) = 12.82 × fat yield (kg) + 7.13 × protein yield (kg) + 0.323 × milk yield (kg) [22, 23]



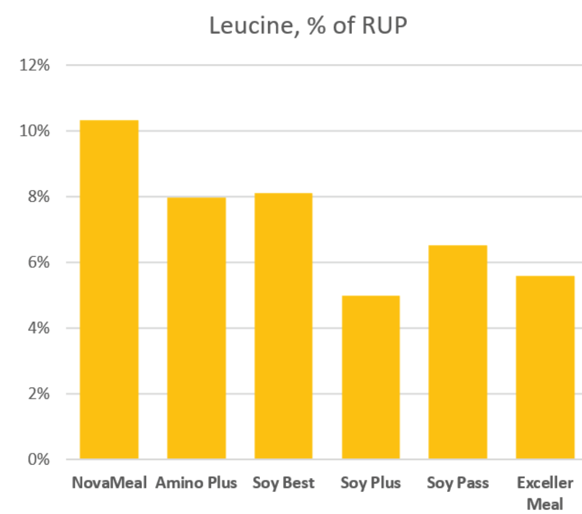
- Abomasal infusion of BCAA at the current dose also increased milk protein yield by 0.21 kg/d compared to CON. This outcome was expected considering fresh cows are in negative MP balance [28], and increasing the amount of AA available may alleviate MP shortage in dairy cows by providing more metabolizable AA available as precursors for milk protein.
- Suggest that supplementing BCAA may also have stimulated milk protein synthesis and milk yield via activation of intracellular signaling pathways, such as the mammalian target of rapamycin (mTOR) pathway, based on work in other species and in cultured mammary cells and tissue [29–31].
- Therefore, we expected BCAA supplementation to upregulate milk protein synthesis.

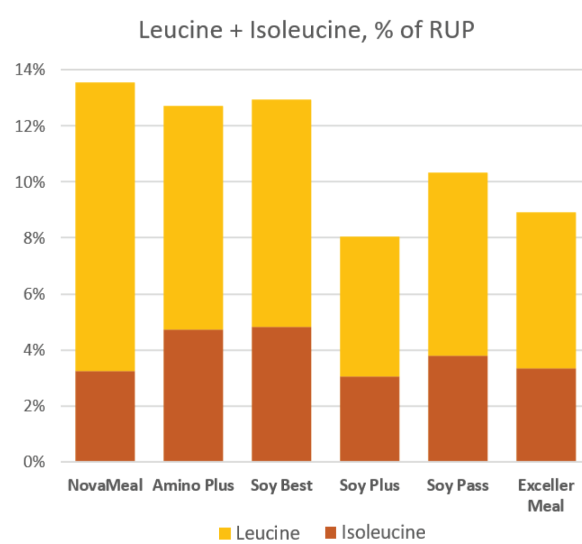
For the full paper and references visit:
https://jasbsci.biomedcentral.com/articles/10.1186/s40104-023-00973-7

HOW DOES NOVAMEAL STACK UP IN BRANCHED CHAIN AMINO ACIDS

- In the Gallagher et al. research brief (highlighted above), the researcher points out the importance of the branch chain amino acids (BCAA) being in the rumen undegraded protein (RUP) fraction as the rumen will break down into branched-chain volatile fatty acids (BCVFAs).
- In the Yoder et al. research shows leucine and isoleucine with an independent and additive response likely from the stimulation of the mTOR (mammalian target of rapamycin) pathway, which plays a crucial role in regulating milk protein synthesis. mTOR is a central regulator of cell growth and proliferation, and its activation by amino acids like leucine and isoleucine is essential for milk protein synthesis in mammary epithelial cells. This response appears to be a dose-dependent, meaning that increasing the amount of these amino acids can enhance the effect.
- The charts (to the right) compare NovaMeal's RUP Leucine and Isoleucine to other bypass products using company published spec sheets as the resource.

Reference: Yoder PS, Huang X, Teixeira IA, Cant JP, Hanigan MD. Effects of jugular infused methionine, lysine, and histidine as a group or leucine and isoleucine as a group on production and metabolism in lactating dairy cows. J Dairy Sci. 2020;103(3):2387–404.





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