



Abstract Summary

Title: Rumen-protected choline (RPC) reduces hepatic triacylglycerol content by increasing hepatic triglyceride-rich lipoprotein secretion

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Objective: Determine the effect of supplementing sources of RPC with a low (28.8%) or high (60.0%) concentration of choline chloride (CC) on hepatic lipid metabolism.

Treatments:

- Holstein cows (n=33) were blocked by body condition and fed the following treatments for 14 days:
 - 0 g/d RPC (**CON**)
 - 25.8 g/d of choline ion from RPC containing 28.8% CC
 - 25.8 g/d of choline ion from RPC containing 60.0% CC
- Feed was restricted to 50% of the net energy for lactation in the last 9 days
- Intake of metabolizable methionine was maintained at 20 g/d for the 14-day experiment

Results:

- Supplementing RPC:
 - a. reduced hepatic TAG content
 - b. increased area under the curve for serum TAG (indicating increased hepatic secretion of TAG-rich lipoproteins)
 - c. increased the mRNA expression of genes associated with autophagy (*ATG3*) and assembly of lipoproteins (*MTTP*)
 - d. decreased the expression of a gene associated with hepatic lipodosis (*PLIN2*)

Take Home Message: This research illustrates the basic science that feeding RPC positively influences liver health through mRNA expression and increased hepatic VLDL secretion.

Full Abstract

Rumen-protected choline (RPC) reduces hepatic triacylglycerol content by increasing hepatic triglyceride-rich lipoprotein secretion

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Objectives were to determine the effect of supplementing sources of RPC with a low (**L**, 28.8%) or high (**H**, 60.0%) concentration of choline chloride on hepatic lipid metabolism. Holstein cows at 234±2.2 d of gestation were blocked by body condition (3.79±0.50) and assigned to receive 0 (**CON**) or 25.8 g/d of choline ion either as **L25.8** or **H25.8** (n=33; 11/treatment). Treatments were fed for 14 d, with cows feed-restricted to 50% of the net energy for lactation required in the last 9 d of the experiment. Intake of metabolizable methionine was maintained at 20 g/d for the 14-d experiment with rumen-protected methionine. Hepatic tissue was collected on d 13 to determine composition and mRNA expression. On d 14, cows received intravenously a 10% solution of tyloxapol at 120 mg/kg of body weight to block very-low density lipoprotein (**VLDL**) catabolism. Blood was sampled sequentially for 720 min and the area under the curve (**AUC**) of triacylglycerol (**TAG**) was calculated. Lymph was sampled 6 h post-infusion. Data were analyzed using mixed-effects models, and orthogonal contrasts were used to evaluate the effect of supplementing RPC (**CON** vs. ½ **L25.8** + ½ **H25.8**) and source of RPC (**L25.8** vs. **H25.8**). Supplementing RPC reduced hepatic TAG content and increased AUC for serum TAG indicating increased hepatic secretion of TAG-rich lipoproteins. Supplementing RPC increased the mRNA expression of genes associated with autophagy (*ATG3*) and assembly of lipoproteins (*MTTP*), whereas it decreased the expression of a gene associated with hepatic lipidosis (*PLIN2*). Reduction in hepatic TAG in cows supplemented with RPC is mediated by increased hepatic TAG secretion.

Responses to treatments during feed restriction

Item	CON	L25.8	H25.8	SE
Liver, as is %				
TAG [*]	8.3	4.0	4.8	0.4
Glycogen ^{*†}	1.77	3.40	3.96	0.15
AUC TAG, [*] mg/dL/min	21,747	32,323	28,699	3,706
Lymph				
NEFA, mM	0.43	0.46	0.53	0.14
BHB, mM	0.87	0.86	0.89	0.08
Glucose, mM	2.90	3.17	2.94	0.15
TAG, [†] mg/dL	16.7	13.8	11.9	1.9
Hepatic mRNA, fold change				
<i>ATG3</i> [†]	1.0	1.10	1.12	-
<i>ATG7</i> [†]	1.0	0.97	1.10	-
<i>DGAT2</i> [†]	1.0	0.85	0.99	-
<i>MTTP</i> ^{†‡}	1.0	0.98	1.58	-
<i>PLIN2</i> [*]	1.0	0.66	0.62	-
<i>TNFα</i> [*]	1.0	1.82	1.83	-

Contrasts: ^{*}RPC ($P<0.05$); [†]RPC ($P=0.07$); [‡]source of RPC ($P<0.05$).

Key Words: choline, lipoprotein, triacylglycerol