

Supplementary Materials

Corn Stover Replacement with *Quercus rugosa* Woody Biomass: Growth Performance, Carcass Characteristics, and Meat Quality of Finishing Lambs

Table S1. Mean differences from CTWB-0 with 95% confidence intervals for growth performance and feed efficiency in finishing lambs.

Item	CTWB-8 – CTWB-0	CTWB-16 – CTWB-0	CTWB-24 – CTWB-0
Initial body weight, kg	–0.48 (–2.06, 1.11)	–0.27 (–1.85, 1.32)	–0.23 (–2.00, 1.55)
Final body weight, kg	0.28 (–1.64, 2.21)	–0.76 (–2.68, 1.15)	1.33 (–0.80, 3.46)
ADG, g/d	8.73 (–35.68, 53.14)	–17.06 (–61.47, 27.35)	32.64 (–17.01, 82.29)
Cumulative body weight change, kg	0.37 (–1.50, 2.23)	–0.72 (–2.58, 1.15)	1.37 (–0.71, 3.46)
DMI, kg DM/d	0.02 (–0.07, 0.12)	0.01 (–0.09, 0.11)	0.17 (0.06, 0.28)
G:F	0.006 (–0.022, 0.034)	–0.014 (–0.042, 0.015)	0.004 (–0.027, 0.036)

¹ Values are model-based mean differences (diet – CTWB-0), with individual 95% confidence intervals in parentheses. Confidence intervals are not adjusted for multiple comparisons and do not replace the Tukey comparisons reported in the main tables. Intervals use model-based standard errors and residual degrees of freedom. CTWB = condensed tannin-containing woody biomass. Final body weight was adjusted for initial body weight. ADG = average daily gain; DMI = dry matter intake; DM = dry matter; G:F = gain-to-feed ratio.

Table S2. Mean differences from CTWB-0 with 95% confidence intervals for blood metabolites in finishing lambs.

Item	CTWB-8 – CTWB-0	CTWB-16 – CTWB-0	CTWB-24 – CTWB-0
LDL, mg/dL	1.83 (-4.49, 8.15)	1.16 (-5.17, 7.50)	1.91 (-4.50, 8.33)
VLDL, mg/dL	4.49 (-1.39, 10.38)	-2.04 (-8.56, 4.48)	-1.79 (-9.85, 6.28)
HDL, mg/dL	-2.38 (-23.11, 18.36)	-1.08 (-17.37, 15.20)	-4.81 (-23.66, 14.05)
GLU, mg/dL	0.79 (-14.70, 16.28)	10.20 (-4.79, 25.19)	6.67 (-8.33, 21.67)
TG, mg/dL	-1.40 (-39.74, 36.94)	8.98 (-26.85, 44.82)	31.97 (-3.64, 67.59)
TC, mg/dL	6.86 (-23.69, 37.42)	4.67 (-25.11, 34.46)	18.84 (-10.90, 48.58)
BUN, mg/dL	2.91 (-1.47, 7.29)	0.22 (-3.95, 4.40)	-5.21 (-9.37, -1.04)
BUN/CREA	5.90 (-8.70, 20.49)	-3.31 (-17.23, 10.60)	-8.42 (-22.92, 6.08)
CREA, mg/dL	-0.08 (-0.87, 0.70)	0.39 (-0.44, 1.22)	0.08 (-0.92, 1.08)
UA, mg/dL	-0.29 (-0.98, 0.39)	-0.03 (-0.80, 0.73)	0.58 (-0.20, 1.36)

Values are model-based mean differences (diet – CTWB-0), with individual 95% confidence intervals in parentheses. Confidence intervals are not adjusted for multiple comparisons and do not replace the Tukey comparisons reported in the main tables. Intervals use model-based standard errors and residual degrees of freedom. CTWB = condensed tannin-containing woody biomass. Differences were adjusted for the corresponding baseline metabolite measurement. BUN = blood urea nitrogen; CREA = creatinine; GLU = glucose; TG = triglycerides; TC = total cholesterol; UA = uric acid; LDL, VLDL, and HDL = low-, very-low-, and high-density lipoprotein cholesterol.

Table S3. Mean differences from CTWB-0 with 95% confidence intervals for empty body weight and non-carass components in finishing lambs.

Item	CTWB-8 – CTWB-0	CTWB-16 – CTWB-0	CTWB-24 – CTWB-0
Empty body weight, kg	–0.72 (–2.50, 1.06)	–1.14 (–2.92, 0.64)	0.18 (–1.60, 1.97)
Stomach complex, g/kg EBW	2.50 (–0.57, 5.58)	0.03 (–3.04, 3.11)	3.10 (0.02, 6.18)
Large intestine, g/kg EBW	1.28 (–2.07, 4.63)	1.30 (–2.05, 4.66)	3.38 (0.02, 6.73)
Small intestine, g/kg EBW	0.93 (–3.96, 5.82)	2.59 (–2.29, 7.48)	0.79 (–4.09, 5.68)
Skin, g/kg EBW	1.75 (–17.05, 20.56)	8.37 (–10.43, 27.18)	8.33 (–10.48, 27.13)
Limbs, g/kg EBW	–0.17 (–1.67, 1.33)	–0.21 (–1.71, 1.29)	–0.07 (–1.57, 1.42)
Head, g/kg EBW	2.93 (–1.34, 7.19)	2.42 (–1.85, 6.68)	–0.20 (–4.46, 4.06)
Heart, g/kg EBW	–0.93 (–3.12, 1.25)	–1.35 (–3.53, 0.83)	–1.20 (–3.39, 0.98)
Lungs, g/kg EBW	–0.98 (–6.45, 4.49)	–1.62 (–7.10, 3.85)	–0.72 (–6.19, 4.76)
Liver, g/kg EBW	–0.08 (–1.83, 1.67)	–1.47 (–3.22, 0.27)	–0.03 (–1.78, 1.71)
Spleen, g/kg EBW	–0.37 (–0.74, 0.01)	–0.17 (–0.54, 0.20)	–0.47 (–0.84, –0.10)
Kidneys, g/kg EBW	0.14 (–0.17, 0.45)	0.24 (–0.07, 0.55)	0.22 (–0.09, 0.53)
Testicles, g/kg EBW	–0.29 (–3.08, 2.51)	0.45 (–2.35, 3.25)	1.50 (–1.30, 4.30)
Omental fat, g/kg EBW	–0.97 (–6.77, 4.84)	3.40 (–2.41, 9.21)	3.83 (–1.98, 9.63)
Mesenteric fat, g/kg EBW	–0.88 (–2.89, 1.13)	–0.26 (–2.27, 1.75)	1.22 (–0.79, 3.23)
Visceral fat, g/kg EBW	–1.85 (–9.21, 5.51)	3.14 (–4.22, 10.50)	5.05 (–2.31, 12.41)
Perirenal fat, g/kg EBW	0.70 (–3.59, 4.99)	2.15 (–2.14, 6.44)	1.77 (–2.52, 6.07)

Values are model-based mean differences (diet – CTWB-0), with individual 95% confidence intervals in parentheses. Confidence intervals are not adjusted for multiple comparisons and do not replace the Tukey comparisons reported in the main tables. Intervals use model-based standard errors and residual degrees of freedom. CTWB = condensed tannin-containing woody biomass. EBW = empty body weight.

Table S4. Mean differences from CTWB-0 with 95% confidence intervals for ultrasound traits, carcass characteristics, wholesale cuts, and shoulder tissue composition in finishing lambs.

Item	CTWB-8 – CTWB-0	CTWB-16 – CTWB-0	CTWB-24 – CTWB-0
FAT, mm	0.08 (-0.30, 0.45)	0.00 (-0.37, 0.37)	0.01 (-0.41, 0.42)
LMA, cm ²	-0.38 (-1.51, 0.76)	-0.24 (-1.37, 0.90)	-0.75 (-2.01, 0.52)
Hot carcass weight, kg	-0.62 (-1.92, 0.68)	-0.40 (-1.70, 0.91)	-0.18 (-1.48, 1.12)
Cold carcass weight, kg	-0.43 (-1.62, 0.77)	-0.21 (-1.41, 0.99)	-0.03 (-1.23, 1.16)
Dressing percentage, %	-0.33 (-1.99, 1.33)	0.72 (-0.94, 2.38)	-1.57 (-3.23, 0.09)
Cooling loss, %	-0.81 (-2.02, 0.40)	-0.82 (-2.03, 0.39)	-0.66 (-1.87, 0.55)
Forequarter ³ , %	-1.88 (-5.70, 1.93)	-0.73 (-4.55, 3.08)	-0.03 (-4.11, 4.04)
Hindquarter ³ , %	1.88 (-1.93, 5.70)	0.73 (-3.08, 4.55)	0.03 (-4.04, 4.11)
Neck ¹ , %	-0.56 (-1.97, 0.86)	-0.20 (-1.61, 1.22)	0.00 (-1.51, 1.51)
Shoulder IMPS 206 ¹ , %	0.00 (-0.80, 0.79)	-0.20 (-0.99, 0.59)	-0.40 (-1.25, 0.45)
Shoulder IMPS 207 ¹ , %	0.07 (-1.09, 1.23)	-0.19 (-1.35, 0.97)	-0.17 (-1.41, 1.07)
Rack IMPS 204 ¹ , %	0.24 (-0.34, 0.82)	-0.31 (-0.89, 0.27)	-0.05 (-0.67, 0.57)
Breast IMPS 209 ¹ , %	-0.03 (-0.62, 0.56)	-0.24 (-0.83, 0.35)	0.18 (-0.45, 0.81)
Ribs IMPS 209A ¹ , %	-0.63 (-1.16, -0.10)	-0.14 (-0.67, 0.39)	-0.13 (-0.70, 0.44)
Loin IMPS 231 ¹ , %	-0.05 (-2.41, 2.31)	-0.18 (-2.54, 2.18)	-0.88 (-3.40, 1.64)
Flank IMPS 232 ¹ , %	-0.44 (-1.22, 0.34)	-0.11 (-0.89, 0.67)	-0.04 (-0.87, 0.79)
Leg IMPS 233 ¹ , %	1.44 (0.23, 2.64)	-0.05 (-1.26, 1.16)	0.54 (-0.75, 1.83)
Shoulder muscle ² , %	-0.01 (-3.59, 3.57)	1.53 (-1.62, 4.67)	1.46 (-2.12, 5.03)
Shoulder fat ² , %	-0.83 (-5.23, 3.57)	-1.74 (-5.60, 2.13)	-3.31 (-7.71, 1.09)
Shoulder muscle:fat ratio	0.47 (-1.49, 2.42)	0.80 (-0.91, 2.52)	1.57 (-0.39, 3.52)

Values are model-based mean differences (diet – CTWB-0), with individual 95% confidence intervals in parentheses. Confidence intervals are not adjusted for multiple comparisons and do not replace the Tukey comparisons reported in the main tables. Intervals use model-based standard errors and residual degrees of freedom. CTWB = condensed tannin-containing woody biomass. FAT = rib fat thickness; LMA = longissimus muscle area. Final FAT and LMA were analyzed without a covariate. ¹ Left-side wholesale cuts expressed as percentages of whole-carcass cold carcass weight. ² Tissue proportions expressed as percentages of shoulder weight. IMPS = Institutional Meat Purchase Specifications. ³ Forequarter and hindquarter were expressed as percentages of their combined weight for each lamb and then averaged by pen.

Table S5. Mean differences from CTWB-0 with 95% confidence intervals for meat quality and muscle and fat color in finishing lambs.

Item	CTWB-8 – CTWB-0	CTWB-16 – CTWB-0	CTWB-24 – CTWB-0
DL _{24h} ¹ , %	0.39 (-1.63, 2.41)	1.29 (-0.73, 3.31)	0.04 (-2.09, 2.17)
Cooking loss, %	-0.10 (-4.19, 4.00)	2.71 (-1.38, 6.81)	4.00 (-0.66, 8.66)
Expressible water, %	0.14 (-2.09, 2.38)	-1.76 (-4.00, 0.47)	-2.09 (-4.44, 0.27)
Warner–Bratzler shear force, kgf	0.39 (-0.69, 1.48)	0.01 (-1.08, 1.09)	0.25 (-0.84, 1.33)
pH at 24 h postmortem	0.02 (-0.12, 0.15)	0.08 (-0.06, 0.21)	0.00 (-0.13, 0.13)
Muscle L*	2.80 (0.06, 5.54)	-0.23 (-2.97, 2.51)	1.36 (-1.38, 4.10)
Muscle a*	-2.45 (-4.47, -0.43)	-0.01 (-2.03, 2.00)	-0.11 (-2.13, 1.91)
Muscle b*	-1.11 (-2.71, 0.48)	0.78 (-0.81, 2.38)	0.15 (-1.44, 1.75)
Kidney fat L*	1.04 (-2.24, 4.32)	1.05 (-2.23, 4.32)	0.20 (-3.07, 3.48)
Kidney fat a*	-0.84 (-3.03, 1.35)	0.82 (-1.37, 3.01)	1.43 (-0.76, 3.62)
Kidney fat b*	-0.86 (-2.38, 0.67)	0.77 (-0.75, 2.30)	0.77 (-0.76, 2.30)
Dorsal fat L*	-2.36 (-5.13, 0.42)	-1.28 (-4.06, 1.49)	-1.75 (-4.53, 1.02)
Dorsal fat a*	-0.38 (-2.51, 1.76)	0.11 (-2.02, 2.25)	1.61 (-0.52, 3.75)
Dorsal fat b*	-1.21 (-2.94, 0.52)	0.33 (-1.40, 2.07)	1.29 (-0.45, 3.02)

Values are model-based mean differences (diet – CTWB-0), with individual 95% confidence intervals in parentheses. Confidence intervals are not adjusted for multiple comparisons and do not replace the Tukey comparisons reported in the main tables. Intervals use model-based standard errors and residual degrees of freedom. CTWB = condensed tannin-containing woody biomass. ¹ DL_{24h} = drip loss over 24 h, measured during 24 h of suspension at 4 °C in previously frozen and thawed samples. L*, a*, and b* represent lightness, redness, and yellowness, respectively.

Table S6. Mean differences from CTWB-0 with 95% confidence intervals for economic outcomes in finishing lambs.

Item	CTWB-8 – CTWB-0	CTWB-16 – CTWB-0	CTWB-24 – CTWB-0
Total feed cost, USD/lamb	0.01 (-1.20, 1.23)	-0.52 (-1.73, 0.70)	1.06 (-0.30, 2.42)
Carcass income, USD/lamb	-4.68 (-18.54, 9.19)	-2.29 (-16.15, 11.57)	-2.29 (-17.79, 13.21)
IOFC, USD/lamb	-4.69 (-17.94, 8.57)	-1.78 (-15.03, 11.48)	-3.35 (-18.17, 11.47)
Cost of gain, USD/kg BW gained	-0.21 (-0.58, 0.17)	-0.06 (-0.43, 0.31)	-0.22 (-0.64, 0.20)

Values are model-based mean differences (diet – CTWB-0), with individual 95% confidence intervals in parentheses. Confidence intervals are not adjusted for multiple comparisons and do not replace the Tukey comparisons reported in the main tables. Intervals use model-based standard errors and residual degrees of freedom. CTWB = condensed tannin-containing woody biomass. Diet costs were fixed at 0.301, 0.295, 0.288, and 0.282 USD/kg DM for CTWB-0, CTWB-8, CTWB-16, and CTWB-24, respectively; carcass value was 11.00 USD/kg cold carcass weight. Outcomes were calculated for each lamb and averaged by pen; the same pen records were used for all four economic outcomes. IOFC = income over feed cost; USD = United States dollar; BW = body weight; DM = dry matter.