

Understanding lamb finishing systems and their impact on product quality

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Overview:

- Methods of raising market lambs
- Factors that impact growth, feed efficiency and product quality
- Comparison of rearing systems and their economics

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Lamb rearing systems:

- Grain feeding: preweaning to market
- Background: slower rate of growth on pasture for variable period of time followed by grain finishing
- Near exclusive pasture rearing: rearing on pasture for all or majority of rearing period-no grain feeding
- Pasture rearing with grain supplement: rearing on pasture and supplementing with grain during the finishing period

Basic concepts of lamb growth

- Bone> muscle>>> fat
- Body composition is a function of **maturity (degree of mature size), sex, and growth rate**
- Lambs with larger mature size potential are leaner at a given body weight than those of smaller mature size potential
- Overall, body composition is **remarkably** similar between breeds when lambs are compared at the same degree of maturity.

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Lamb growth concepts

- Maturity profoundly influences:
 - ✓ Growth rate
 - ✓ Body composition
 - ✓ Feed efficiency
- Lambs of the same size may also differ in the shape of their growth curve and in carcass traits

Lambs at the same size but not maturity: *Polypay vs. Suffolk lamb at 130 lbs*

	Polypay	Suffolk
Mature size (lbs)	175	230
% of mature size	74%	56%
Muscle (lbs)	33.2	35.4
Bone (lbs)	8.3	9.2
Fat (lbs)	23.4	18.4

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Polypay vs. Suffolk lamb at same degree of mature size (0.70)

	Polypay	Suffolk
Mature size (lbs)	175	230
% of mature size	70%	70%
Liveweight	122	161
Muscle (lbs, [%BW])	33.0 [27.0]	43.3 [26.9]
Bone (lbs, [%BW])	8.0 [6.6]	9.6 [6.6]
Fat (lbs, [%BW])	19.2 [15.8]	24.3 [15.8]

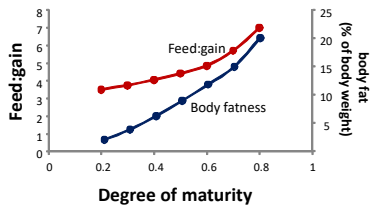
Lamb Feed Efficiency:

- Feed efficiency is influenced by diet, maturity and genetics.
- High efficiency ~3.0 lb feed/lb gain, but may be as poor as 8+ lb feed/lb gain.
- The lean growth phase (accumulation of muscle) is the most efficient. **There is more water and less energy in a pound of muscle than in a pound of fat.**
- Lamb feed efficiency is largely driven by the composition of gain (body composition) and hence hugely influenced by degree of lamb maturity.

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Feed efficiency is driven by body fat gain



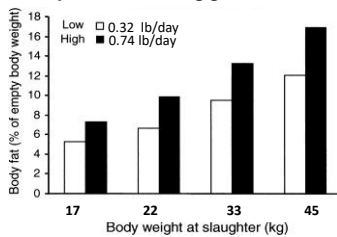
Body composition and rate of growth:

- Fat has lower priority for energy than does muscle so when animals are feed excess energy the relative partition into fat is greater (fattening diets!)
- Therefore, animals grown more slowly are leaner at any given maturity than those grown more quickly
- **Backgrounding** is a term used for a feeding program designed to limit the rate of growth allowing for a leaner animal at a given stage of maturity (% of mature size).

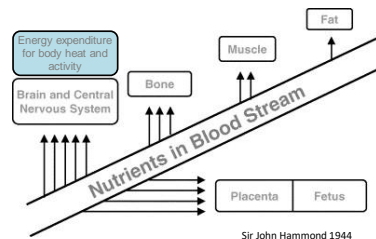
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Plane of nutrition effects how nutrients are partitioned during growth



Ehrhardt R A et al. J. Nutr. 2003;133:4196-4201
 JN THE JOURNAL OF NUTRITION



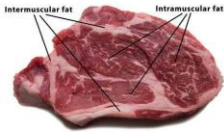
Sir John Hammond 1944

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Lamb finishing concepts:

- Goal is to have adequate fat within muscle (intramuscular fat=marbling) for juiciness and flavor without excessive intermuscular fat (seam fat and subcutaneous fat).
- 4% intermuscular fat content is associated with higher eating quality in lamb
- Can we optimize genetics and feeding strategies to achieve this goal?



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What is reasonable ballpark estimate for lamb size to efficiently create YG 2 (approx. 25% carcass fat)?

- Well fed lambs (wethers and ewes) reach the ideal carcass yield grade at **70%** of the average maternal **mature size** of their sire and dam.

Sire: 330 lb Suffolk ram=**230 lb Suffolk ewe**
 Dam: **175 lb PolypayX ewe**

Average maternal size: **202.5 lbs**
 Ideal market lamb size= .7 x 202.5= **142 lbs**

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Variations on 70% maternal size rule:

1. Ram lambs can be grown to 75-80% maternal mature size.
2. Slowly grown lambs can be grown to 75% maternal mature size.
 - ✓ Grass-fed
 - ✓ Background feeding systems

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Backgrounding feeding programs:

- Background feeding can be used to create larger market animals that are still relatively lean
- Backgrounding can be a good or bad strategy depending on:
 - ✓ Market price fluctuations
 - ✓ Impact of maturity on carcass quality
 - ✓ Yardage cost: cost of maintaining an animal in a feeding facility
 - ✓ Mortality risk
 - ✓ Cost of gain for backgrounding vs. feeding for fast growth

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Comparison of annual crops grazed as part of a background rearing system for lambs

	Corn	Sudan	Brassica
ADG, lb/day	0.32	0.32	0.38
Feed:Gain	11	10	10
DMI, % per day	5	5	5.8
Gain potential per acre	720	700	500
Cost of crop per acre	287	200	165
Cost of gain	0.40	0.39	0.33

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Challenges with grazing lambs:

- Predation
 - ✓ Managed with predator-proof fencing or livestock guard dogs
- Parasite control
 - ✓ Managed with careful infection monitoring, grazing management, use of quality forages and judicious use of anthelmintics in combination
- Dietary energy level
 - ✓ Manage with selective grazing and/or use of high energy forage species
- Pasture availability: Is there quality pasture available when it is needed?
 - ✓ Reserve hay/silage regrowth for grazing
 - ✓ Plant annual pastures or use cover crop grazing



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Grazing management to maximize lamb growth:

- **Maximizing intake is the key** and is managed by controlling pasture allowance
- Do you seek maximum individual lamb gain or maximum gain per acre?
- If finishing lambs on pasture, you may seek maximum individual gain but if backgrounding, then you are seeking maximum gain per acre.
- High intakes are achieved by:
 - ✓ Grazing highly digestible forage
 - ✓ Short grazing bouts
 - ✓ Greater allowance
 - Allows greater selectivity but will decrease quality over time

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Lamb* gain on pasture according to forage quality and month of the year

(Ehrhardt and Cassida, unpublished)

Average daily gain, lbs/d	Forage allowance per day, lb DM/100 lb BW	TDN of forage, % (DM basis)	Month	Pasture specie(s)
0.65	10	66	July-August	Leafy brassica
0.60	10	64	July-August	Red clover, ryegrass
0.45	10	60	July-August	BMR Sudan
0.55	10	62	Sept-Oct	Brassica mix
0.40	10	62	Nov-Dec	Brassica mix
0.86	NA	80	All year**	Unlimited grain

*Dorset-cross wether lambs at 0.5 to 0.6 maturity

** Lamb gain can be lower in summer in feedlot under high heat conditions

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Feedlot and Grazing Management

Feedlot

- Lambs were fed a transition diet from pasture to grain
- Unlimited feed at minimum 20% refusal
- 6 weeks grain feeding for GRN
- 4 weeks grain feeding for BKG

Grazing

- Lambs grazed for 6-8 day periods
- Paddock biomass estimated weekly
- Paddock size was calculated weekly to provide a daily forage DM allowance of 9-10% of the pen's bodyweight



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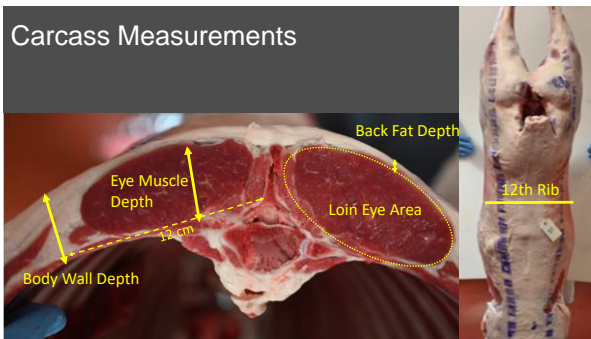
Slaughter

- GRN slaughtered after 6-weeks of treatment
- BKG,BRO, MIX slaughtered after 8-weeks of treatment
- Lambs slaughtered 22 h after last weight measurement
- All carcass data was collected 24 h post slaughter



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Carcass Measurements



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Meat Analyses

Physical Analyses

- Cooking Loss
 - Loins cooked to 158 F
 - George Foreman Grill
- Color
 - 3 chops measured
 - Hunter Miniscan XE Plus
- Shear force
 - 24 hours post cooking
 - Warner Bratzler Shear Force

Chemical Analyses

- Analyzed at Texas Tech with Andrea Krieg
- FOSS Analyzer
 - Protein
 - Moisture
 - Fat
- pH

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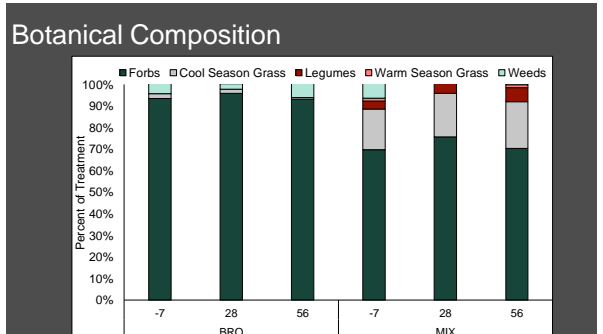
Sensory Analysis

- 100 point continuous scale
 - Liking
 - Flavor
 - Tenderness
 - Acceptability
- Loin chops served in halves in individual containers
- Each panelist tried samples from each treatment



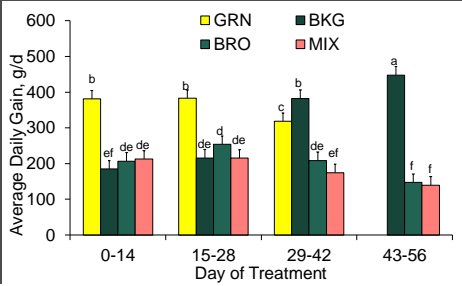
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Botanical Composition



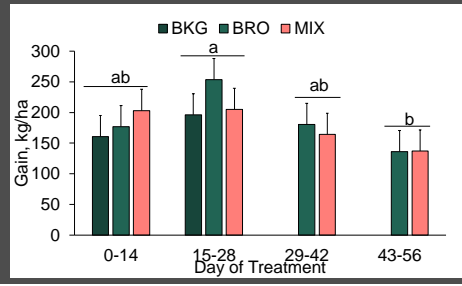
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Average Daily Gain



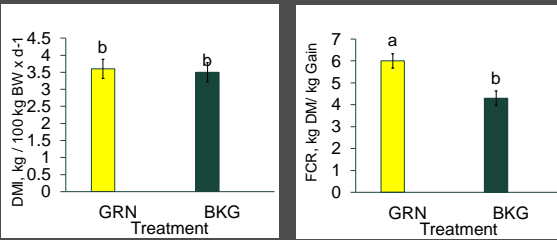
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Gain / unit land



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Intake (DMI) and feed efficiency (FCR) for Grain Diets



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Carcass measurements

Carcass Trait	Treatments				SE
	GRN	BKG	BRO	MIX	
Hot Carcass Weight, kg	29.8 ^a	30.2 ^a	27.9 ^b	27.3 ^b	1.29
Back Fat Depth, cm	0.45 ^{ab}	0.51 ^a	0.40 ^b	0.38 ^c	0.03
Body Wall Fat Depth, cm	2.28 ^a	2.35 ^a	1.95 ^b	1.92 ^b	0.14
Loin Eye Area, cm	20.6 ^a	20.0 ^{ab}	19.1 ^{bc}	18.7 ^c	1.09
Eye Muscle Depth, cm	3.77 ^a	3.52 ^b	3.40 ^c	3.37 ^c	0.04
Yield Grade	2.16 ^{ab}	2.37 ^a	1.98 ^{bc}	1.86 ^c	0.10
Quality Grade	3.00 ^a	2.20 ^b	1.67 ^b	1.83 ^b	0.20
Dressing Percentage, %	51.5	50.6	51.8	51.5	1.29

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Meat physical and chemical analyses

Meat Trait	Treatments				SE
	GRN	BKG	BRO	MIX	
Cooking Loss, %	23.2 ^a	22.0 ^{ab}	20.8 ^b	22.5 ^{ab}	0.9
Shear Force, kg	4.24	4.67	4.21	4.08	0.85
Redness, a*	21.6 ^b	23.3 ^a	24.0 ^a	23.1 ^a	1.5
Yellowness, b*	23.4	23.4	23.1	23.3	0.8
Lightness, L*	30.0 ^a	27.3 ^b	25.2 ^c	26.6 ^{bc}	2.0
Protein, %	23.3 ^b	23.3 ^b	24.0 ^a	24.0 ^a	0.2
Moisture, %	73.1	73.0	72.7	72.7	1.1
Fat, %	4.2	4.2	3.8	4.1	0.5
Collagen, %	2.0	2.0	2.2	2.1	0.5
pH ³	5.64	5.68	5.68	5.67	0.02

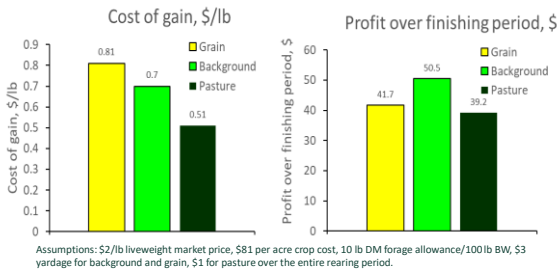
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Sensory Evaluation

Sensory Traits ³	Treatments				SE
	GRN	BKG	BRO	MIX	
Liking	57.2	58.4	64.4	60.9	2.6
Flavor	52.1 ^b	55.7 ^{ab}	60.7 ^a	57.7 ^{ab}	2.8
Juiciness	50.4 ^b	51.4 ^b	60.4 ^a	49.5 ^b	2.7
Tenderness	56.4	54.0	63.2	57.3	2.9
Acceptability, % ⁴	76.2	69.5	83.8	76.2	4.1

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Economics of Lamb Finishing Systems



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Summary

- Lambs on grain diets grew faster and had greater carcass weight and fatness than those grazing
- Lambs on background rearing system exhibited marked compensatory growth and improved feed efficiency over those fed grain exclusively
- All lambs graded choice or better with grain-fed lambs have greater yield grade than those grazing
- Loin chops from grazing CC were darker with a deeper red color
- Intramuscular fat content (marbling) was in the range of 3.8-4.2% and did not differ between treatments
- Consumer sensory analysis revealed a preference for loin chops of lambs reared on brassica cover crop over those fed an exclusive grain diet in terms of juiciness and flavor
- Cost of gain was similar for pasture-reared and background lambs but the total profit over the finishing period was ≈25% greater for background lambs at current prices.

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Thank you

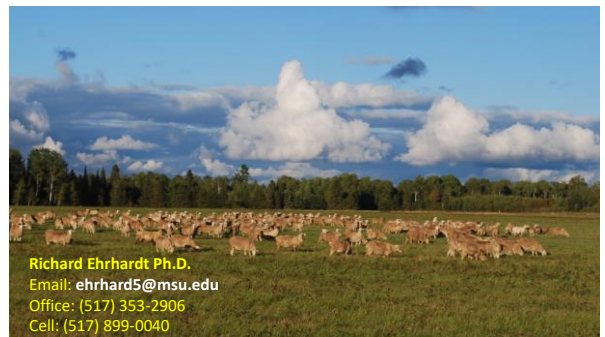
MSU:

- *Project leaders:* Kim Cassida and Richard Ehrhardt
- *Project collaborators:* Erin Recktenwald, Jeannine Schweihofer, Andrea Garmyn
- *Technical staff:* Barbara Makela and Joe Paling
- *Farm and meat lab staff:* Lacey Quail, Tony Boughton, Tristan Foster, Wes Mays, Trenton Cole, and Jennifer Dominguez
- *Students:* Maci Kubiak, Carol Freltas, Danny Schaub, Allison Schafer, Alexis Stachurski, Grace Herkimer

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