Cornell University

Practical Solutions for Year-Round Sheep Milk Production

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Overview

Sheep dairy production systems

Dietary fiber levels

Results

Sheep dairy systems

- Dairy sheep breeds (Lacaune, East Friesian) are seasonally polyestrous
- Low conception rates in off seasons

- Seasonal production systems with 1 annual lactation (160 – 200 days)
- Breeding in Fall, lambing (milking) in Spring

- Weaning systems

  DY1: Lambs are taken away within 24 h and reared artificially
  MIX: Lambs remain with dam 12 h of day until weaning
  DY30: Lambs raised by dam, machine milking starts after weaning

(Berger et al., 2004)

Limitations and challenges

- No fresh product available for marketing year-round
- Limited access to hired labor
- Farm financial viability is low
- Difficulties getting started

- Milk production and processing in on-farm creameries

- Approaches to year-round sheep milk production in US include:

  Light treatment (ewes and rams) for better conception rates out of season
  Hormonal treatment for aseasonal breeding ability

  Freezing milk for year-round availability

Research questions

- Meat breed sheep

  Often aseasonal polyestrous (Dorset, Finnsheep X Dorset)
  Higher peak lactation yields
  Less lactation persistency (90 days)

→Can some meat sheep breeds be used for dual-purpose year-round dairy production? How?

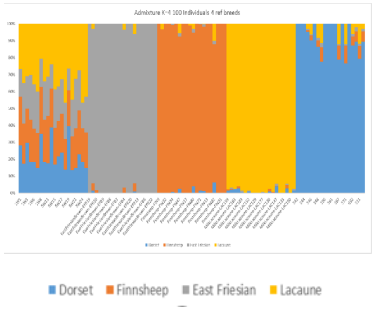
→How do diets have to be formulated to maintain ewe health and condition while ensuring high productivity?

Farm study

- 25 ewes (DIMs 0-2) were randomly selected
- Milk samples on DIM 2, 7, 14, 21, and every 2-weeks until DIM 164
- GWAS with 4 reference breeds

  (East-Friesian, Lacaune, Finnsheep, Dorset)
  ADMIXTURE, n=20

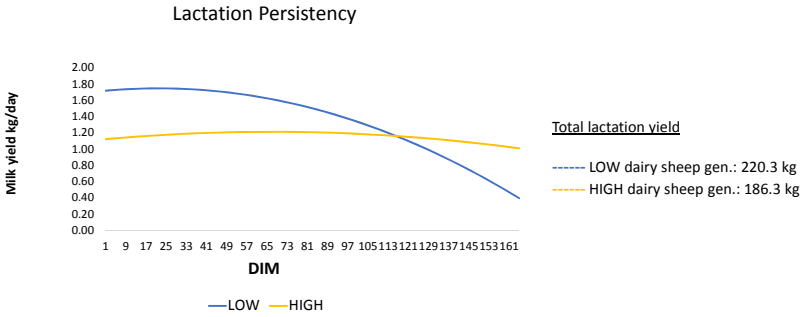
- Categorized in
  - HIGH (57% - 68% dairy breed genetics)
  - LOW (37% - 57% dairy breed genetics)



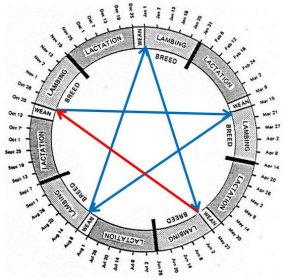
(Posbergh, 2017)

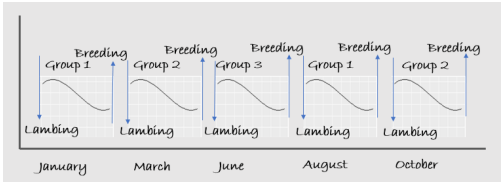
Milk yields milk vs dairy sheep

- Significant interaction between Category and DIM ($P < 0.001$)



Sheep dairying on the STAR accelerated lambing system





- *5 lambing periods (every 73 days) per year*

- Re-breeding on day 73 of each lactation
- 219 day (7.3 months) lambing interval
- 1.67 lambings per ewe in 1 year
- 5 lambings per ewe in 3 years

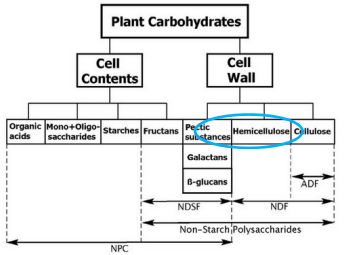
Why potentially fermentable fiber?

- Conceived by Dr. Doug Hogue and Dr. Mike Thonney as tool for formulation of sheep diets
- Successfully tested in commercial, as well as research settings

pfNDF = NDF - indigestible NDF (INDF) at 1 X maintenance

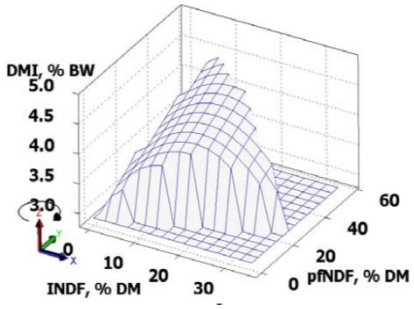
(1 X maintenance INDF = indigestible dry matter at 1 X maintenance - 15% metabolic fecal loss)

(Thonney, 2017)



(Hall, 2003)

Previous experiments



(Thonney, 2013)

Previous experiments

Growth and DM intake of ewes and individual lambs for ewes fed increasing levels of potentially fermentable NDF (pfNDF)

	Diet pfNDF				*P* value	
Item	15%	25%	35%	SE	15% vs 25 & 35%	25% vs 35%
Ewes						
n	7	7	7			
Daily DMI, g	2,148	2,971	3,456	186.5	<0.001	0.082
DMI, % BW	3.7	4.6	5.3	0.23	<0.001	0.042
ADG, g/d	-30	93	105	50.7	0.052	0.874
Lambs[1]						
Lambs/ewe[2]	1.7	2.3	2.4	0.32	0.114	0.753
ADG, g/d	174	167	229	18.0	0.246	0.007

(Adapted from Schotthofer, 2007)

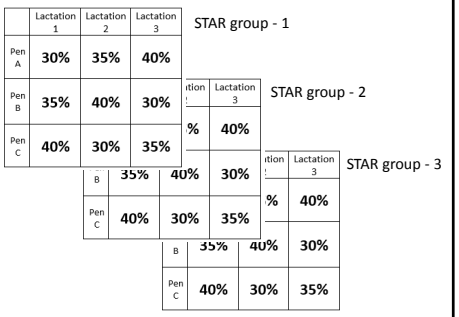
Experimental diets

Composition of experimental diets (% of DM). These diets were offered ad libitum with 350 to 500 g (varied with lactation) of hay per ewe per day.

Ingredient	30% pfNDF	35% pfNDF	40% pfNDF
Soy hulls	34.4	42.4	50.9
Wheat midds	20.1	20.1	20.1
Corn	31.5	24.1	16.2
Soybean meal	8.9	8.6	8.2
Molasses	1.7	1.7	1.7
Cornell sheep premix	1.06	1.06	1.06
Ammonium chloride	0.78	0.78	1.68
Calcium carbonate	1.34	1.12	0.89
Pellet binder	0.26	0.26	0.26
Estimated components			
DM (% of feed)	89.6	89.5	89.4
DDM	81.0	80.6	80.3
CP	17.0	17.0	17.1
NDF	36.1	41.1	46.5
pfNDF	30.5	35.1	40.1
INDF	5.6	6.0	6.4
NSCHO	38.9	34.0	28.7
EE	2.7	2.6	2.4
Ash	5.3	5.3	5.3

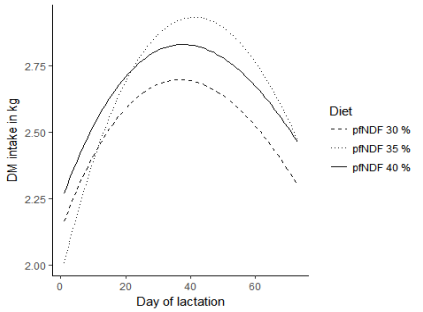
Experimental design (October 2016 – September 2018)

- 3 x 3, triply replicated Latin square design
- Three management groups, n=59
  - STAR group -1, n=45
  - STAR group -2, n=38
  - STAR group -3, n=46
- Lambs taken away after 12 h, raised artificially
- Collected samples
  - Milk yields AM and PM (individual)
  - Diet fed and refused AM and PM (pen)
  - Feed and fecal samples
  - Weights weekly (ewes and lambs)
  - Milk samples (weekly) for NIRS milk component analysis
  - Ruminal fluid and rumen pH
  - Blood samples (energy balance, NEFA)
  - Chewing activity (video recordings)



Feed intake

- Significant difference among diets (P < 0.001)



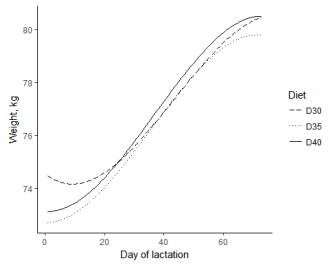
Diet	Feed intake DM/day	Feed intake % BW	Milk/DM	Ruminal fluid pH
pfNDF 30%	2.5 kg/d	3.3%	0.5	6.8
pfNDF 35%	2.7 kg/d	3.5%	0.6	7.0
pfNDF 40%	2.7 kg/d	3.5%	0.5	6.8

Milk production

- Significant difference among diets (P < 0.001)

Diet	Milk yield per day
pfNDF 30%	1.3 kg
pfNDF 35%	1.5 kg
pfNDF 40%	1.4 kg

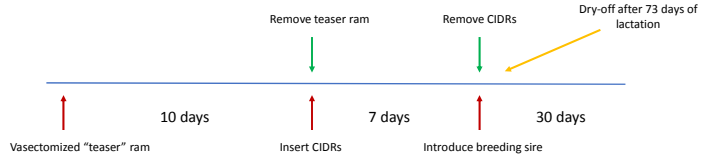
Weight gains



- No biological differences in weight gains due to diets can be observed
- Overall average weight gain between lactations 1 and 3 for all ewes: ~6 kg
- Rebreeding on day 73 after birth → good condition needed
- Do sheep with high BCS have problems reproducing?

Reproductive efficiency

Item	Lactation 1	Lactation 2	Lactation 3
Conception rate, %	84	86	91
Conception in first cycle, %	85	79	93
Lambs born per lambing	2.3	2.2	2.7
Lambs raised per lambing	2.1	2.1	2.6
Lambs born per ewe per year	3.6	3.4	4.2
Lambs raised per ewe per year	3.3	3.3	4.1



(Inskeep, 2012)

Health incidences

Age category	Diagnosis	Number	Age	Deaths	Comments
Ewe	Johne's Disease	1	4 years	1	Euthanized.
	Mastitis	9	15 months to 6 years	0	All in lactation 1 of experiment; completely recovered.
	Metritis	2	5 & 6 years	0	Due to dystocias
	Pregnancy toxemia	3	5 years	2	Not fed concentrate before lambing.
Lamb	Enterotoxaemia	1	25 days	1	No colostrum.
	Septicemia	1	35 days	1	Treated successfully, but failed to ambulate.
	Tail dock infection	9	7 to 16 days	2	Hot tail docker problems.
	Urinary calculi	2	7 weeks	2	Euthanized.
Replacement	Unknown	1	7 months	1	Jaundice, not Cu toxicity.

Behavior during milking

1 – No kicking, no skittishness, ease of entering and leaving the platforms, teat cups stay on
2 – Slightly skittish, needs parlor bait to easily enter platform, nervous, kicks off teat cups occasionally
3 – Very skittish, kicking, teat cups need to be held in place, no ease of entering the platform and head gate, very nervous

Milking behavior	Lactation 1 (n=40)	Lactation 2 (n=47)	Lactation 3 (n=42)
Beginning of lactation	2.0	1.6	1.6
End of lactation	1.4	1.3	1.2

Conclusions

- Sheep dairying on the STAR system may be A solution
- Due to higher conception rates and litter sizes these systems can be classified as dual-purpose
- Levels of pfNDF in diets for high producing, lactating ewes should be 35%

Future directions

- Complete sample analysis (Milk composition, NEFA, VFA concentration in rumen fluid, chewing activity, diet digestibility), and data analysis
- New experiment with 25% dairy genetics will begin in February 2019 → increase persistency to 120 days and lamb 3 times in 2 years?

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USDA United States Department of Agriculture
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NORTHEAST SARE Sustainable Agriculture Research & Education — Grants and Education to Advance Innovations in Sustainable Agriculture

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