

### Calf Nutrition


Dairy Outlook Meeting 22<sup>nd</sup> February 2017



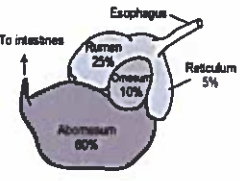

Lorna MacPherson  
Dairy Consultant



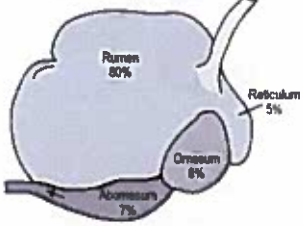
### Rumen Development



Preruminant calf at birth





Heifer after weaning




- The rumen is underdeveloped and nonfunctional, milk by-passes the rumen and is digested in the abomasum and the intestines
- Intake of dry feed, especially a grain or concentrate mix (starter) stimulates rumen growth
- Heifer ruminates and obtains most of its energy and protein from rumen fermentation


### Rumen Papillae

- These finger like projections absorb VFA's
- Acetic Acid
- Propionic Acid
- Butyric Acid



### Rumen Development








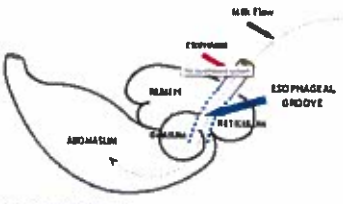




Fig. 1. Milk only Penn State Extension  
 Fig. 2. Milk and hay Penn State Extension  
 Fig. 3. Milk and grain. Penn State Extension


Rumen development in calves 6 weeks of age




### Milk Digestion in Abomasum


- Clot forms in abomasum within 10 minutes by coagulation of milk protein (casein)
- Whey proteins, lactose and minerals separate from curd and rapidly pass into small intestine
- Clot is slowly absorbed into blood stream over 12-18 hours




### Why Use Milk Replacer?




- **Consistent quality** – protein, fat, vitamins & minerals
- **Infectious disease control** – MAP (Johne's) and scours
- **Waste milk** – higher bacterial loads, contribute to disease
- **Waste milk-antibiotic milk** linked to antimicrobial resistance
- **Improved starter intake and performance**
- **Cost?**



### Why Use Milk Replacer?




**Whole milk**




- Protein
- Fat
- Lactose

**Milk replacer**




- Protein
- Fat
- Lactose


- Milk is 35% fat versus 18-20% oil in CMR
- Proportion of energy supplied by fat and lactose is similar
- More lactose and less fat stimulates starter feed intake




### Cost of Milk Powder vs Milk



Price of Milk Powder /T	Cost/Litre @ 12.5% Inclusion	Cost/Litre @ 15% Inclusion
£1200	15p	18p
£1400	17.5p	21p
£1600	20p	24p
£1800	22.5p	27p
£2000	25p	30p




### Milk vs Milk Replacer




MILK FEEDING REGIME	Whole milk	Milk replacer
Total feed cost to 56 days (£)	75.9	60.9
Cost/kg liveweight gain to 56 days (£)	1.59	1.10
Ave 56 day weaning weight (kg)	75.5	81.5
Ave 70 day weight (kg)	86.8	95.1
Ave overall weight gain (kg)	47.7	55.4

Source: Teagasc Moorepark Research Centre / Vol


Research has shown that calves reared on milk replacer vs whole milk tend to be heavier at weaning and consume more starter feed




### Skimmed Milk Powder




- Dairy protein – 80% casein & 20% whey proteins
- Forms effect clot in abomasum
- Allows casein digestion – “reduces spill over” causing nutritional scours
- Low casein milk powder can cause a weak clot to form and increase the risk of nutritional scours
- Minimum 50% as a proportion of milk protein content
- Check skim content!




### Whey Milk Powder




- By-product of cheese manufacture
- Does not form a clot in abomasum
- Whey protein readily digested in the duodenum and small intestine
- Better amino acid profile than skim
- Processing of whey (temperature) can damage the whey protein causing lower digestibility - use a trusted supplier!



### Non-Milk Proteins in CMR



- Egg based proteins – highly digestible
- Plant based protein – less digestible e.g. soya, hydrolysed wheat gluten & pea protein
- Soya – Anti-nutritional factors if fed to excess, amino acids do not match calf requirements (soy flour least digestible)
- Hydrolysed Wheat Gluten – highly digestible (95%), no anti-nutritional factors. Most commonly used
- Pea Protein highly digestible, no anti-nutritional factors but sediments out rapidly (look at buckets after feeding)



### Protein Sources

**SR DP FARM ADVISORY SERVICE**

**Table 1. Milk replacer protein sources categorized by their acceptability**

Preferred	Acceptable*	Not good
Dried whey protein concentrate	Soy protein isolate	Soy flour
Dried skim milk	Protein modified soy flour	Modified potato protein
Casein	Soy protein concentrate	
Dried whey	Animal plasma	
Dried whey product	Egg protein	
	Modified wheat protein	

Adapted from A Guide to Modern Milk Replacer, Bovine Alliance on Management and Nutrition, 2002  
\*Acceptable when used as a partial substitute for milk protein.

### Choosing a Milk Replacer

**SR DP FARM ADVISORY SERVICE**

- Minimum 20% protein (high levels of milk protein)
- Oil level 16-20%
- High ash content (>8%) should be avoided – risk of scours
- Calcium minimum 0.8%
- Fibre content of <0.2%, the lower the better
- Additives: Probiotics, prebiotics, MOS, plant extracts
- Assess by previous calf performance and coat condition

SR DP FARM ADVISORY SERVICE

### Complete Milk Replacer Feed for Calves

**SR DP FARM ADVISORY SERVICE**

Analytical Constituents	Composition
Crude Protein 28 %	Whey Protein
Crude Fibre 10 %	Vegetable Oil (Palm & Coconut)
Crude Oil and Fat 18 %	Hydrolysed Wheat Gluten
Crude Ash 7 %	Calcium Carbonate
Calcium 0.9 %	Magnesium Oxide
Sodium 0.5 %	Galactose (GalBc) @ 225 mg per kg
Phosphorus 0.7 %	

Additives (per kg)		
<b>Vitamins</b>		
E072	Vitamin A	25 000 IU
E071	Vitamin D3	6 000 IU
71189	Vitamin E	250 IU
<b>Trace elements (elemental)</b>		
E3	Cobalt (Cobalt acetate)	0.2 mg
E1	Copper (Copper sulphate pentahydrate)	10 mg
E2	Iodine (Potassium iodide)	0.25 mg
E1	Iron (Iron(II) sulphate monohydrate)	80 mg
E1	Manganese (Manganese sulphate monohydrate)	30 mg
E1	Selenium (Selenium sulphide)	0.4 mg
E6	Zinc (Zinc sulphate monohydrate)	90 mg
<b>Minerals</b>		
E29	Biotin	190 mg
E29	Choline Acid	1000 mg

SR DP FARM ADVISORY SERVICE

### Mixing CMR

**SR DP FARM ADVISORY SERVICE**

- Dilution rates 100-150 grams/litre fed at ~15% BW
- Mix at 40-45°C and feed at 37-39°C
- Normal Feeding 125 g/litre – 6 litres = 750 grams
- Winter Feeding 150 g/litre – 6 litres = 900 grams

SR DP FARM ADVISORY SERVICE

### Mixing CMR

**SR DP FARM ADVISORY SERVICE**

**Step 1** Add half the water to bucket

**Step 2** Weigh powder

**Step 3** Add powder to bucket and mix thoroughly

**Step 4** Top up to required volume and mix thoroughly

SR DP FARM ADVISORY SERVICE

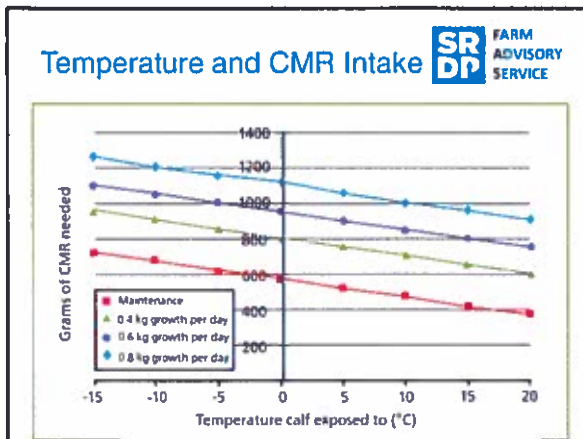
### Increasing Energy Supply

**SR DP FARM ADVISORY SERVICE**

Energy supplied to calf/day MJ	16% Oil, 22% Protein	20% Oil, 22% Protein
4 litres 12.5%	7.5	7.8
4 litres 15%	11.2	11.7
5 litres 12.5%	11.7	12.2

**Energy intake depending on oil content, quality and concentration**

SR DP FARM ADVISORY SERVICE



### Lower Critical Temperature

The lower critical temperature (LCT) is the temperature at which animals require additional energy to maintain their core body temperature

Age Group	LCT Range (°C)	Additional Requirement
Newborn - 3 weeks	10-15 °C	Feed extra 50g MR or 0.33l of whole milk/day for each 5°C drop below 15°C
Calves > 3 weeks	6-10 °C	Feed extra 50g MR or 0.33l of whole milk/day for each 5°C drop below 10°C

Source: AHDB Dairy, SAC, Scottish Government

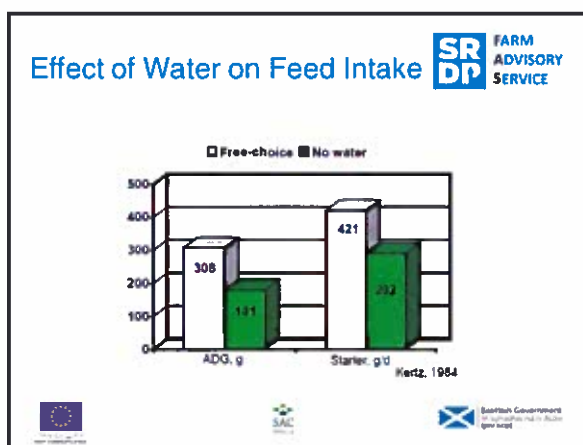
### Growth Targets for Calves

- Double birth weight at weaning (80kg by 56 days)
- Target 120kg by 3 months
- ADG 0.75-0.8kg/day  
800g milk powder for 800g/day growth
- About 225 kg of additional milk in the first lactation could be expected for each additional 100 g/d of growth during the first 2 months of life
- If you can't measure it, you can't manage it!!!
  - Weigh scales or band
  - Measuring stick for wither height

93cm H, 88cm F, 82cm R

### Water Requirement

- Water available from day 4 (eat more starter, better rumen development)
- Required to support the rumen microbial population and promote good rumen development and function
- 4:1 rule!
- Providing water in addition to milk replacer can increase growth by 38% and starter intake by 31%
- Calves will drink 1 litre of water per day during the first week of life, increasing to nearly 3 litres by 3-4 weeks of age



### Calf Starter Feeds

- Concentrates provided fresh daily from day 4
- Palatability important and protein quality
- Minimal dust or finely ground feeds
- Little and often. Keep fresh



### Starter Feed – What to Look For

**SR DP FARM ADVISORY SERVICE**

**Specification:**

- 17-18% CP (fresh weight)
- High energy >12 MJ/kgDM
- Low fibre (6-8%)/ash (5-7%)

**Ingredients**

- Cereals (barley, wheat, maize)
- Soyabean meal, distillers dark grains
- Digestible fibre (SBP, soya hulls)
- Avoid Palm Kernel, Sunflowers, Oatfeed, Oat-Byproduct, Urea




Scottish Government  
Food and Rural Affairs  
gov.scot

### Effect of Pellet Size

**SR DP FARM ADVISORY SERVICE**

	3mm pellet	6mm pellet	3mm	6mm
<b>Live Weight (kg)</b>				
Start weight	51.6	51.4		
Weaning weight	68.0	68.4		
12 week weight	110.9	117.4		
<b>Feed intake (kg/head)</b>				
8 days - weaning	22.3	31.2		
Weaning - 12 weeks	125	138		
MRK replacer	21.4	21.4		
<b>Feed Conversion</b>				
FCR (kg feed: kg gain)	2.84	2.89		



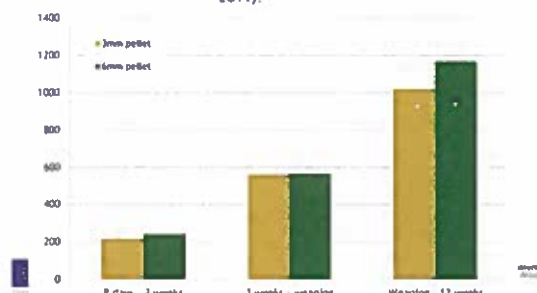
*Effect of pellet size on the weaner, feed intake and live conversion efficiency (Smith and English, 2011)*

Scottish Government  
Food and Rural Affairs  
gov.scot

### Effect of Pellet Size

**SR DP FARM ADVISORY SERVICE**

Effect of pellet size on average daily gain in calves (from Marsh and Linham, 2011).



Stage	3mm pellet (g/day)	6mm pellet (g/day)
8 days	~200	~250
3 weeks	~550	~550
Weaning - 12 weeks	~1000	~1150

Scottish Government  
Food and Rural Affairs  
gov.scot

### Calf Starter Feed Label

**SR DP FARM ADVISORY SERVICE**

A complementary compound feeding stuff for calves up to 12 weeks of age

**ANALYTICAL CONSTITUENTS**

Crude fibre 5.70%, Crude protein 17%, Crude ash 7.70%, Calcium 1.10%, Phosphorus 0.50%, Magnesium 0.20%, Sodium 0.2%

**COMPOSITION**

Distillers Dark Grains (Maize), Wheatfeed, Whole Maize, Wheat, Hi Pro Soyabean Ext.(GM\*2), Sugar Beet Pulp, Molasses, Calcium Carbonate, Sodium Chloride, Megalac a calcium salt of palm fatty acids, Trace Elements, Vitamins + Salmannan (GM\*2) Produced from genetically modified Soya.

**ADDITIVES (PER KG)**

**Vitamins:**  
E872 Vitamin A 12500u/kg, E871 Vitamin D3 3000u/kg, E3a70C Vitamin E (all-rac-alpha-tocopheryl acetate) 150u/kg, Vitamin B12 30mcg, Vitamin B1 10mg.

**Compounds of Trace Elements:**  
E1 Ferrous sulphate monohydrate (iron) 250mg, E2 Calcium iodate anhydrous (iodine) 6.35mg, E3 Cobaltous carbonate monohydrate (cobalt) 0.90mg, E4 cupric sulphate pentahydrate (copper) 80mg, E5 Manganous Oxide (manganese) 96.78mg, E6 Zinc Oxide (zinc) 111.11mg, E8 sodium selenite (selenium) 0.67mg/kg

Scottish Government  
Food and Rural Affairs  
gov.scot

### Beef Feed Label

**SR DP FARM ADVISORY SERVICE**

**Super XL Beef Nuts**

A complementary compound feeding stuff for beef cattle

Directions for use:- To be fed with silage or grass or other roughage. All raw materials used in this feed are from a non-genetically modified source (max 1%)

OS (B) 3.7% Protein 17% Fibre 9.4% Ash 7.4%  
Vt A 8000u/kg Vt D3 2000u/kg Vt E 40u/kg  
Copper 35mg/kg (From Copper Sulphate) Selenium 0.25mg/kg

Ingredients used in descending order by weight are:- Wheatfeed Barley, Distillers Dark Grains (barley), Palm Kernel, Sunflowers, Rapemeal, Oatfeed, Molasses, Calcium Carbonate, Sugar Beet Pulp, Trace Elements + Vitamin Supplements, Sodium Chloride

~~~~~  
This feedstuff contains added Copper DO NOT FEED TO SHEEP  
~~~~~


Best Before/Vitamins present until 09/11/2012 Manufactured 92days before the "best before" date indicated. Berry Farm Feeds Ltd. 1000kg net weight Store in cool dry place. UFAS cert end 30.04.13

Scottish Government  
Food and Rural Affairs  
gov.scot

### Creep Feed for Beef Calves


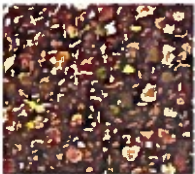
**SR DP FARM ADVISORY SERVICE**

- Minimum 15% protein and 12.5ME
- Start with higher level (18-20%)
- Digestible fibre sources (soya hulls/SBP)
- Build up cereal content gradually - max 50% (lightly processed)



Ingredient	16% Creep Feed Example 1 %	16% Creep Feed Example 2 %
Barley	32.5	57.5
Sugar beet pulp	32.5	25
Wheat dark grains	32.5	-
Soya	-	15
Minerals	2.5	2.5

## Coarse Mixes







**Benefits**


- Very palatable/molassed
- Cooked flaked cereals – better digestion
- Less fillers/lower energy straights (e.g. malt culms, palm kernel)
- "Look nice"
- Better physical quality than blends

**Disadvantages**

- Not necessarily better nutritional quality
- Calves can select out raw materials
- Cost

## Coarse Mix or Pellets?






**Harper Adams Trial (Jan 2008)**


- 40 Holstein and Holstein x Continental bull calves
- Reared on 23:20 milk replacer and weaned at 6 weeks
- Half on 18% 3mm pellet, half on 18% protein coarse mix until 12 weeks

**Pellet Composition**  
wheat, wheatfeed, barley, rapeseed meal, sunflower, molasses, distillers, soya bean meal, citrus pulp, full fat soya & minerals

**Coarse Mix Composition**  
flaked barley, wheatfeed, sunflower, flaked soya, flaked maize, molasses blend, rapeseed meal, flaked peas, hi pro soya, palm kernel, linseed meal, oatfeed & minerals








## Results




Liveweight (kg)	Pellets	Coarse mix
Start	44.7	45.0
3 weeks	54.1	51.0
Weaning	64.1	61.5
12 weeks	114.8	107.3

DLWG (kg)	Pellets	Coarse mix
Start - 21 days	0.45	0.28
Start - Weaning	0.46	0.39
Weaning - 12 weeks	1.20	1.09
Start - 12 weeks	0.83	0.74








## Results




Feed Intakes (kg) & FCR	Pellets	Coarse mix
Milk Replacer	21.6	21.6
Concs Start - Wean	18.3	16.1
Concs Wean - 12 weeks	109.7	105.6
Concs Start - 12 weeks	128.0	121.7
Total Intake	149.6	143.3
FCR (kg feed: kg gain)	2.14	2.30




Feed Costs (£/calf) - Jan 2008	Pellets	Coarse mix
21.6kg CMR @ £1,300/t	28.08	28.08
128.0kg Pellets @ £261/t	33.43	
121.7kg Coarse mix @ £346/t		42.11
Total Feed Costs	61.51	70.19
Feed Cost/kg gain	0.88	1.13

## Conclusions



- The pellet fed calves had significantly higher ( $P < 0.05$ ) DLWG's from start to 3 weeks and from weaning to 12 weeks
- Concentrate intakes were higher for the pellets (+6.3kg) and the calves had a better FCR
- The pellet fed calves gained an extra 7.8kg to 12 weeks of age and had an improved coat bloom score at 12 weeks old ( $P < 0.01$ )
- Feeding pellets compared to coarse mix reduced feed costs to 12 weeks old by £8.68 per calf and feed costs per kg gain by 25p

## Mineral Supplements



- Various powder minerals, buckets and blocks on the market
- Labour saving & convenience
- Useful if feeding low level of creep feed
- Care not to over supply mins and vits
- They are a supplement not a cure all
- Don't just go by price/T, look at spec and ask about intakes
  - £850/T at 100g intake = 6p/head/day
  - £700/T at 150g intake = 10.5p/head/day



Thank You



SRDP FARM ADVISORY SERVICE

European Union

SAC

Scottish Government  
Rural Payments and Agri-Environment

