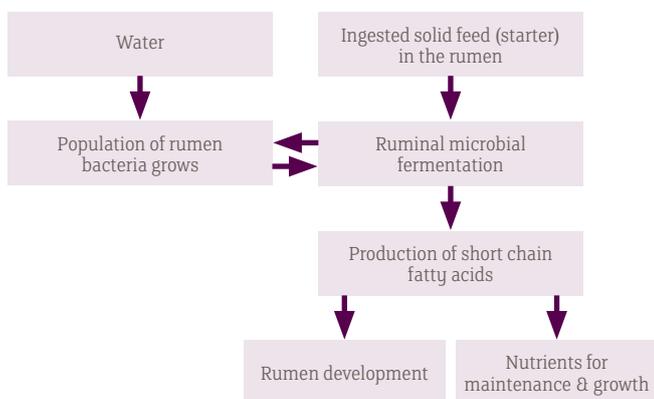


## Weaning the High Milk Fed Calf

Feeding calves high volumes of milk helps them to achieve their early growth potential - and this is beneficial to their lifetime milk production. Calves fed more milk will not be driven by hunger to eat solid feed, since their hunger will be satisfied by the milk, and consequently may eat less starter. But high milk fed calves can be encouraged to eat solid feed by implementing management strategies, balancing the intake of nutrients from both milk and solid feed.

**The Role of Solid Feed:** The calf is born with a non-functional rumen – nutrients from milk (milk sugars – glucose) are digested in the abomasum and intestines to supply the calf its energy. The rumen must be sufficiently developed at weaning so that it can digest and utilise solid feed, replacing the nutrients previously supplied by milk, giving the calf its energy to grow. Rumen development is largely driven by the fermentation of calf starter by the rumen bacteria (Fig. 1).

**Figure 1. The role of solid feed & water in rumen development**



**Social Housing:** Housing calves in pairs or groups encourages starter intake during the milk feeding period due to social facilitation – a feeding response elicited by seeing another animal feeding. A recent study has compared feeding calves 5 L milk/d with 9 L/d, and housing calves either individually or as a pair<sup>1</sup>. For calves fed only 5 L/d – the type of housing made no difference to starter intake, since the calves were driven by hunger

to eat starter feed (Table 1). When calves consumed 9 L/d, they were not driven by hunger to eat starter – but pair housed calves ate more than those housed individually due to peer stimulation (Table 1). *Feeding calves more milk, and pair housing them to encourage starter intake, resulted in a higher body weight gain up to weaning.*

**Table 1. Housing high milk fed calves in pairs, improves starter intake & weight gain<sup>1</sup>**

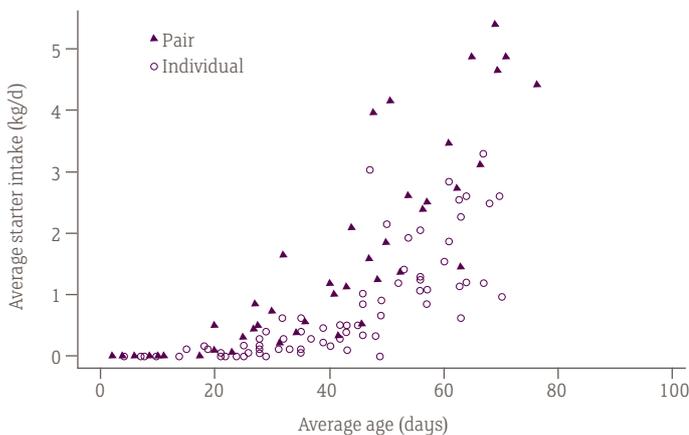
	Standard (5L/d, d3-42)		Enhanced (9L/d, d3-28; 5L/d, d29-42)	
	Individual	Pair	Individual	Pair
Starter intake (d21-43), kg/d	1.09	0.99	0.53	0.84
Body weight gain (d1-44), kg/d	0.84	0.81	0.85	0.99





Another study has compared starter intakes of high milk fed calves housed in hutches, as either an individual or as a pair (by adjoining adjacent hutches)<sup>2</sup>. All calves were fed a high milk allowance and weaned gradually over 3 weeks: 900g milk powder/d to day 7, increasing to 1500g/d from day 8 to 35, then reduced to 900g/d to day 58, with a further reduction and weaning on day 60<sup>2</sup>. Pair housed calves consumed more starter (0.89 kg/d) than individual calves (0.48 kg/d) demonstrating that social housing encourages starter intake (Fig. 2). Cross sucking was rarely observed - over 14 weeks, cross sucking was only observed 5 times (out of a total of 651 scans) in 4 different pairs. *A combination of a high milk allowance, and teat feeding, are thought to help minimise cross sucking in group housed animals<sup>2</sup>.*

**Figure 2. Housing high milk fed calves in hutches, as a pair, improves starter intake<sup>2</sup>**



**Timing of Pairing or Grouping:** Pairing calves soon after birth (on day 6 of life) has been shown to improve starter intake and increase weight gain, compared to pairing calves late during the milk feeding period (on day 43), or keeping calves in individual pens through to weaning (Table 2)<sup>3</sup>. *It is recommended to house calves individually for the first week of life, and then introduce to pair or group housing at 1 week of age (always within the first 3 weeks of life).*

**Table 2. Pairing calves early in life (on day 6) improves starter intake & weight gain<sup>3</sup>**

	Pairing on day 6	Pairing on day 43	Individual
Starter intake (6 wks), kg/d	0.18	0.05	0.07
Starter intake (10 wks), kg/d	2.20	1.09	1.26
Average daily gain (3-10 wks), kg/d	0.89	0.75	0.73

**Forage:** Offering forage alongside starter feed plays a role in rumen development - it helps stabilise the rumen pH, stimulate the muscular layer of the rumen, and maintain the integrity and healthiness of the rumen wall. Furthermore, providing chopped barley straw (separately from starter) during the milk feeding period has been shown to stimulate starter intake, improve weight gain and improve forage intake after weaning due to the calves increased ability to ingest and digest forage (Table 3)<sup>4</sup>.

**Table 3. Providing chopped forage increases starter consumption & weight gain<sup>4</sup>**

	Starter only	Chopped barley straw
Average daily gain, kg/d	0.72	0.88
Intake, kg of DM/d		
Starter	0.88	1.06
Forage	-	0.06



Another study has analysed the results from 27 experiments with dairy calves, and shown that forage provision increases starter feed intake during the milk feeding period, as well as after weaning<sup>5</sup>. Forage provision increased starter feed intake by 0.027 kg/d during the milk feeding period, i.e. calves offered forage ate 0.027 kg/d more starter compared to calves fed only starter with no forage supplementation<sup>5</sup>. After weaning, calves provided with forage ate 0.201 kg/d more starter compared to calves offered no forage, and this greater starter intake resulted in an increase in weight gain after weaning of 50 g/d more<sup>5</sup>. Providing forage is thought to improve the rumen environment which may in turn contribute to the stimulation of starter intake.

Chopped forage (about 3-4 cm chop length) should be provided separately from the starter (i.e. do not mix the forage into the starter). If chopped forage is not available, provide long fibre by offering forage in racks (a separate source from the bedding). If a calf is being fed enough milk and starter, it will naturally limit its forage intake, but as a guide forage intake should be less than 5 to 10% of the total dry feed intake (i.e. about 0.1 kg/d of forage as weaning approaches).

**Weaning Period Length:** Reducing the amount of milk offered gradually over a 3-week period encourages starter intake, helps rumen development and improves the digestibility of nutrients after weaning. Starter intake will rapidly increase at weaning, when milk is removed. But a rapid increase in starter intake at weaning does not allow enough time for the rumen to develop - the amount of starter that has been consumed for 3 weeks before weaning is key for rumen development.

Recent work has shown that feeding calves a high volume of milk (up to 1.1 kg milk powder/d) and weaning over a 3-week period, results in better rumen development compared to calves fed high milk volumes and weaned rapidly over 7 days (Table 4)<sup>6</sup>. Furthermore, weaning high

milk fed calves over 3 weeks resulted in similar levels of digestibility after weaning, as those calves that had been fed less milk (Table 4). Better digestibility means a calf will be able to fully utilise the dry feed after weaning.

*A 3-week period where milk replacer is fed at  $\leq 750$  g milk solids/d is needed to ensure calves eat enough starter to allow for sufficient rumen development. E.g. if weaning on day 56, start to reduce the amount of milk offered (to  $\leq 750$  g milk solids/d) on day 35.*

**Table 4. Weaning high milk fed calves over 3-weeks improves rumen development & post-weaning digestibility<sup>6</sup>**

	Moderate milk	High milk & 3-week weaning	High milk
Milk replacer, kg/d	0.66 for 39d 0.33 for 3d	0.88 for 5d 1.1 for 23d 0.66 for 18d 0.33 for 3d	0.88 for 5d 1.1 for 37d 0.56 for 7d
Weaning period length	3 days	21 days	7 days
Digestibility at 11 weeks, %			
NDF*	37.7	33.5	25.1
ADF*	28.6	24.1	10.4

*\*NDF & ADF are measures of digestibility – lower levels suggest issues with rumen fermentation due to impaired rumen development*



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**Starter Intakes:** Calf starter should be introduced from day 3 to 5 – but calves don't typically begin consuming measurable amounts of solid feed until 2 weeks of age. By 2 to 3 weeks, intakes will begin to increase, and by 5 weeks should increase to 0.5 kg/d. Calves should be eating 0.7 to 1 kg/d by 6 to 7 weeks, and a minimum of 1.5 kg/d at weaning.

Several management steps can be taken to encourage high milk fed calves to also eat enough starter feed to ensure good rumen development. Calves that are fed more milk over the first 5 weeks of life will be bigger and more vigorous – these calves will subsequently eat more starter when milk is gradually reduced from day 35 to 56. Calves fed more milk, coupled with good starter intakes, will be more likely to achieve their early growth potential, and their lifetime milk production.

**Recommended milk feeding plan, with a 3-week weaning period, for calves fed twice daily:**

Week	Age (days)	Twice daily feeding rates (litres)*	
		am	pm
1	0-3	Colostrum	
	4-7	2.5	2.5
2	8-14	3	3
3	15-21	3	3
4	22-28	3	3
5	29-35	3	3
6	36-42	2.5	2.5
7	43-49	2.5	2.5
8	50-56	2.5	0
9	57	0	

\*Milk replacer mixed at either 12.5% or 15%.

**References**

<sup>1</sup>Jensen MB, Duve LR & Weary DM (2015) Pair housing & enhance milk allowance increase play behaviour & improve performance in dairy calves. *J. Dairy Sci.* 98:2568-75  
<sup>2</sup>Whalin L, Weary DM & von Keyserlingk MAG (2018) Short communication: Pair housing dairy calves in modified calf hutches. *J. Dairy Sci.* 101:5428-33  
<sup>3</sup>Costa JHC, Meagher RK, von Keyserlingk AG & Weary DM (2015) Early pair housing increases solid feed intake & weight gains in dairy calves. *J. Dairy Sci.* 98:6381-86  
<sup>4</sup>Castells LI, Bach A, Araujo G, Montoro C & Terre M (2012) Effect of different forage sources on performance & feeding behavior of Holstein calves. *J. Dairy Sci.* 95:286-93  
<sup>5</sup>Imani M, Mirzaei M, Baghbanzadeh-Nobari B & Ghaffari MH (2017) Effects of forage provision to dairy calves on growth performance & rumen fermentation: A meta-analysis & meta-regression. *J. Dairy Sci.* 100:1136-50  
<sup>6</sup>Hill TM, Quigley JD, Batean HG, Suarez-Mena FX, Dennis TS & Schlotterbeck RL (2016) Effects of milk replacer program on calf performance & digestion of nutrients in dairy calves to 4 months of age. *J. Dairy Sci.* 99:8103-10

**Top Tips:**



1. Starter Quality – starter must be clean, fresh & palatable (offer small amounts daily).
2. Starter Type - always use a specific calf starter feed with a crude protein content of at least 18% (do not feed diets designed for mature dairy or beef animals to youngstock).
3. Starter Quantity – calves must be eating at least 1.5 kg/d at weaning.
4. Water - provide clean fresh ad libitum water from day 1.
5. Forage – offer chopped (3-4 cm chop length) forage (e.g. straw) from 1 week of age. Offer chopped forage separately from starter feed.
6. Housing – pair or group house calves from 1 week of age (always within the first 3 weeks of life).
7. Weaning Age – wean calves at 56 days of age (wean by 63 days of age at the latest).
8. Weaning Duration - gradually wean over a 3-week period (feed ≤750g milk powder/d from day 35 to 56).



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