Feeding faba bean to dairy cows

Using faba bean to replace soya in dairy rations

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Legumes Translated

More UK dairy farmers are moving away from soya as a protein source for a range of reasons including consumer concerns about the environmental and social consequences of soya production in some exporting countries. This practice note discusses the suitability of faba bean (field bean) for the replacement of soya in dairy rations. The faba bean can be used for the protein enrichment of cereal-based concentrate feeds. The nutritional value of faba bean and whether it can maintain milk output and composition when replacing soya in milking cow rations is examined to support decisions around if and how to use faba bean for feeding dairy cows.

Applicability

Theme: Dairy cow nutrition

For: Dairy farmers, nutritionists, the feed manufacturing industry and crop growers

Where: Throughout the UK

Timing: Most relevant for winter feeding period or all year round for fully housed herds

Impact: Reduced reliance on soya helps reduce the farm's carbon footprint and conforms to some milk buyers' requests. The response to including faba bean will depend on the inclusion rate, cow factors, and the balancing of the ration for protein supply

Outcome

Soya can be substituted using faba bean in dairy cow rations without affecting milk output or compositional quality. Successful use of faba bean depends on the level of substitution and being able to balance rations to maintain rumen bypass protein levels, particularly for higher yielding cows. The use of home-grown or locally produced faba bean opens up opportunities to reduce costs and to exploit markets for soya-free and GM-free dairy products.

A crop of faba bean growing in Scotland. Photograph: Hugh McClymont (SRUC)

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Table 1. Key nutritional data for faba bean and soybean meal

Parameter		Faba bean	Hipro soybean meal
Dry matter (DM)	%	86	90
ME	MJ/kg DM	14	13.6
Crude protein	% DM	29	55
DUP at 8% outflow	% DM	3.9	24.5
Lysine	% DM	1.95	3.1
Methionine	% DM	0.25	0.7
Starch	% DM	40	5

Source: Ewing, 1997

Nutritional value of beans

Faba bean is palatable and an excellent source of protein and energy, with an energy content of at least the same, if not higher than cereals and similar to that of soya (see Table 1). However, the protein content is significantly lower than soya at only 29% on a dry matter basis. This means that nearly twice as much needs to be fed to achieve a similar protein level in the diet. The protein in faba bean is highly rumen degradable. Similar to pea, the methionine content is nearly a third of that in soya, and so use of beans as the main protein source may require supplementary methionine in order to maintain milk yield and milk protein content.

Ensuring the correct balance of rumen degradable protein (RDP) and un-degraded protein (DUP or bypass protein) is important for maintaining milk production in high yielding cows which have a higher requirement for bypass protein.

Beans contain anti-nutritional factors, the most well-studied being tannins. Some tannins protect the protein from degradation in the rumen and reduce energy utilisation. However, this is not a concern for fully developed ruminant animals. At high levels, intakes can be reduced due to the presence of tannins, although the white-flowered cultivars have lower levels than coloured cultivars.

Soya substitution effects

Faba bean can successfully substitute soya in dairy rations provided the diets are appropriately balanced. Similar responses in intake, milk yield and composition can be achieved.

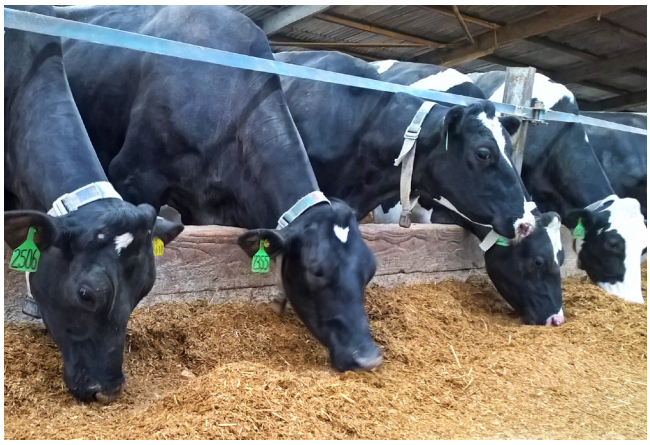
Researchers at the Agri-food and Biosciences Institute (AFBI) in Northern Ireland reported that feeding medium levels (4.7 kg/day) of faba bean to mid-lactation dairy cows had no detrimental effect on performance.

Further research in Northern Ireland looked at feeding various levels of faba bean to freshly calved cows up until 140 days in milk. The concentrate portion of the diet contained either 0%, 35% or 70% field beans (intakes of 0, 4.2 kg and 8.4 kg/cow/day) with constant total protein levels. The diet with 8.4 kg beans replaced all other high-protein ingredients (soybean meal, rapeseed meal and maize gluten). The results show that faba bean can account for up to half of the protein supplement without affecting performance. Milk quality (fat and milk protein content) and milk yield were reduced where faba bean was the sole protein supplement included at 8.4 kg/day. The researchers concluded that faba bean should be included at no more than 4-5 kg/cow/day.

Another study looked at completely replacing soybean meal (and partially replacing maize) by including beans at 17.1% of dry matter intake (equivalent to 4.4 kg/cow/day). The control diet with soybean meal and the treatment diet with faba bean matched each other in terms of protein and energy intake and the cows were averaging 41 kg milk/day at the start of the study.

There was no effect of treatment on intake, milk yield, fat or protein percentage and fat or protein yield (Cherif et al 2018).

Table 2 shows that soya can be substituted with faba bean and additional DUP from protected rapemeal to achieve a similar level of protein, bypass protein and starch content in a diet for a 650 kg cow producing 30 litres of milk at 4% fat and 3.3% protein. The methionine content is lower with the faba bean ration but could be rectified with the inclusion of a rumen-protected methionine supplement such as Metasmart ® (which is 50% rumen protected) to help maintain milk yield and milk protein content. While the above study from Cherif did not appear to adjust the diet to provide a similar level of bypass protein, milk output and milk protein yield were still maintained. This raises the question whether there is over-emphasis on requirements for bypass protein in high yielding cows.



High yielding cows at feed fence. Photograph: Hugh MyClymont (SRUC)

Barriers to uptake

While it makes sense to reduce soya imports and rely on more home-grown protein sources, there are several barriers that might limit the uptake of growing or purchasing faba bean to replace soya:

- Soya can be sourced from certified environmentally sustainable sources (from areas not affected by deforestation) including from Europe.

- Soya has been the main "go-to" protein source of choice for dairy farmers where it is often the most cost-effective high-protein feed ingredient (compared to rapeseed meal and distillers dark grains) in terms of cost per unit protein. It is also higher in energy than some other protein sources. Its high DUP content adds to its status as the protein source of choice. Moving away from soya requires changing expectations with the adoption of more complex but more resilent feeding regimes.

- Dairy farmers may not have access to land for home-grown bean production. Even for those with arable enterprises, producing faba bean must compete with the other arable crops, including those grown for feeding the herd.

- For farmers who cannot grow faba bean, availability depends on local and regional production, processing and marketing.

Key practice points

Faba bean can be used as a substitute for soya in dairy rations. Maximum inclusion rate is up to 5 kg/cow/day. Above this, unless the diet is properly balanced to meet DUP requirements, milk yield and protein content are likely to be affected.

Processing of faba bean is essential for dairy cows due to the hard seed coat. This will prevent the faba bean passing whole through the digestive tract and allows sufficient digestion of the protein and starch. Rolling or coarse grinding is recommended.

When considering substituting soya with faba bean, cost must be taken into consideration, as well as the potential effect on income from any impact on milk volume and composition changes. Although faba bean (whether home-grown or purchased) will be cheaper on a cost per tonne basis, the financial impact of the change will depend on the relative costs of soya and cereals.

Table 2. An example of a comparison of ration formulations for a 650 kg, 30 litre cow (4% fat and 3.3% protein) using either soya or faba bean as the main supplementary protein source calculated using Ultramix-Professional 2018 FiM ration programme.

Ingredients		M+30 litres soya diet	M+30 litres beans diet
Feeds			
Grass silage		32.0	32.0
Whole crop wheat		10.0	10.0
Barley		4.00	1.25
Soya Hipro		2.25	0
Dairy mineral		0.15	0.15
Molasses		1.00	1.00
Limestone		0.10	0.10
Protected rapemeal		0	0.50
Beans field		0	4.50
Total		49.5	49.5
Nutrient Analysis			
DMI[1]	kg	20.5	20.5
Forage DM	kg	14.1	14.1
M.E	MJ	242	245
M/D	MJ/kg DM	11.8	12.0
Crude protein	% DM	16.0	15.6
MPB[2]	% DM	941	954
MPN	g	2,298	2,246
MPE	g	2,077	2,047
Excess MPN	g	221	199
% MPB of MPE[3]		45.3	46.6
NDF	% DM	34.1	34.5
Oil	% DM	2.77	3.24
Starch + sugar	% DM	23.1	22.4
Total Starch[4]	% DM	17.1	17.0
Sugar	% DM	6.02	5.45
Rumen stability		69.5	73.7
YieldMP		30.2	29.5
YieldME[5]		31.1	31.7
Lys	% MPE	7.11	7.13
Met[6]	% MPE	1.90	1.81

[1]same intake
[2]similar bypass protein g
[3]similar bypass protein % of MPE
[4]same starch level
[5]similar predicted yield
[6]slightly lower

Further information

Johnston D. J., Theodoridou, K., Gordon, A. W., Yan, T., McRoberts, W. C., Ferris, C. P., 2019. Field bean inclusion in the diet of early-lactation dairy cows: Effects on performance and nutrient utilization. J. Dairy Sci., 102 (12), 10887–10902.

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