

The logo for the Fishmeal Information Network (FIN) features the lowercase letters 'fin' in a bold, blue, serif font. The letters are positioned in the lower-left corner of a square image that shows a close-up of rippling water in shades of green and blue.

FISHMEAL
INFORMATION
NETWORK

Fishmeal for DAIRY COWS

Fishmeal for dairy cows – a feed with a very healthy future

Benefits for the producer – productivity, cost-efficiency, animal health

- 1 Improved fertility – fishmeal boosts conception rates and aids embryo survival
- 2 Maximise forage utilisation – fishmeal can enhance the value of home-grown forage and reduce concentrate use
- 3 Add value to milk output – by increasing milk protein yield and reducing fat content
- 4 Promote livestock health – fishmeal encourages good health and can help to reduce disease and improve survival of new-born calves

Benefits for the consumer – animal welfare, healthier milk and dairy products

- 1 Milk fat composition – fishmeal can reduce saturated fat and boost levels of health-giving omega-3 fatty acids
- 2 Positive nutrition – fishmeal can help produce ‘designer’ milks that promote health and well-being, and prevent heart disease and cancer

Benefits for the environment – less pollution of air and water

- 1 Water supplies – fishmeal’s nitrogen and phosphorus are efficiently absorbed by the animal, so reducing levels excreted
- 2 Global warming – improved dietary performance also limits dairy cows’ production of ammonia

Today's dairy farmer faces many challenges. Depressed milk prices focused attention on the need to improve productivity, reduce input costs and add value to milk output. At the same time, milk processors and consumers are stepping up their demands for assurances of safe, healthy products – produced with care for animal welfare and the environment.

As this leaflet explains, independent scientific evidence suggests fishmeal has a positive contribution to make on all counts.

Inside

- | | |
|---|---------------|
| Fishmeal improves fertility | <i>Page 2</i> |
| Maximising milk production and value within quota | <i>Page 3</i> |
| Using fishmeal on the farm | <i>Page 6</i> |

The benefits of fishmeal

DAIRY RATIONS

The benefits of fishmeal in dairy rations

1 Improved fertility

1 Improved fertility

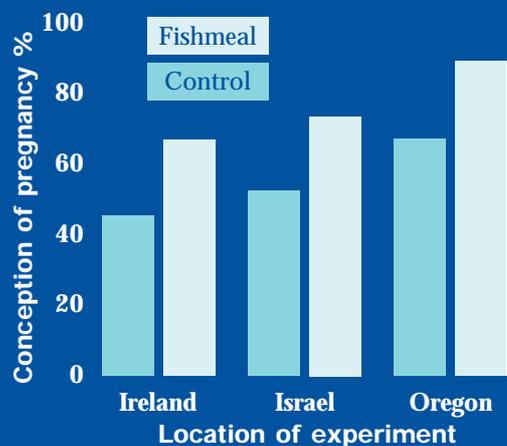
Independent scientific evidence suggests that fishmeal can improve fertility in the dairy herd.

Reduced fertility is a major issue for UK dairy farmers. Research at the University of Nottingham¹ has shown that pregnancy rate to first service declined from 55.6% in 1975–1982 to 39.7% in 1995–1998. This translates into additional cost for producers in terms of unplanned culls, lost milk output and extra AI expenses. Each unplanned reproductive cull costs £600–700 and the lost revenue for every additional day in the conception to calving interval is estimated at £1.73–£4.08/cow/day.

fishmeal was shown to improve dairy cow fertility (see Figure 1). Compared to control diets based on soya bean meal, fishmeal improved fertility performance by around 40%.

The mechanism by which fishmeal improves fertility is not entirely understood, although Professor Bill Thatcher of the University of Florida suggests that embryo survival can be improved by diets suppressing the prostaglandin F2a (a locally acting hormone made from PUFA). In his research, fishmeal produced a significantly lower F2a progesterone response in dairy cows than other feed ingredients.

Figure 1.
The effect of fishmeal on conception



Fishmeal's beneficial effect on conception rates is possibly due to the polyunsaturated fatty acids (PUFAs) it contains. In particular, fishmeal is a good dietary source of the very long chain omega-3 PUFAs, eicosapentaenoic acid (EPA) and

docosahexaenoic acid (DHA). Unsaturated fats are converted to saturated fats within the rumen, but PUFAs vary in their resistance to hydrogenation by rumen bacteria, with EPA and DHA being more resistant and hence a greater proportion of them escape saturation. Fishmeal and fish oil are now the only available feed ingredients supplying EPA and DHA.

Staples *et al*² summarised a number of studies involving several hundred cows, in which

2 Improved forage utilisation

2 Improved forage utilisation

Over the past 20 years, numerous dairy feeding trials have concluded that fishmeal offers productivity gains over alternative protein sources.

Summarised by Dr Ian Pike³, these studies showed that average milk yield increased by 1.6kg in maize silage diets, and by 0.5kg in grass silage diets. The yield response was greater in higher yielding animals and with higher forage to concentrate ratios.

Although grass silage provides adequate amounts of rumen degradable protein (RDP), it is a poor source of digestible undegradable protein (DUP). Consequently much work has been conducted to determine the best energy and protein supplement to complement it.

Keady and Murphy⁴ at Hillsborough investigated grass silage with sucrose as an energy supplement, and fishmeal and soyabean meal as high and low DUP supplements respectively. Fishmeal produced a yield response of 1.7, 1.1, and 0.5kg milk per day at concentrate intakes of 2, 4, and 6kg per day

in

Beyond the FARM GATE

Beyond the farm gate



respectively, clearly demonstrating the most effective response at low levels of concentrate intake and higher levels of silage intake.

Fishmeal also improves forage digestibility and utilisation. Research at the University of Cambridge⁵ has shown a significant increase in the digestibility of the fibre (NDF) fraction, which may account for the performance improvements reported. The diet used in this study was non-limiting in its nitrogen content, leading the authors to conclude that responses to different proteins may be due to their different structure rather than degradability.

More recent research on choice feeding by the Leeds University group of Lawson *et al*⁶ demonstrated the tendency for high yielding cows to select a high DUP diet, whose intake was directly and positively related to milk protein output.

On a practical basis, Sinclair Mayne⁷ reported that 6.5kg of a 34% protein supplement could produce equivalent milk constituent yields to 10kg of a 17% protein supplement provided high quality protein sources such as fishmeal are used. Feeding less of a higher protein concentrate can often be more cost effective than more of lower protein alternatives. As protein is an expensive component in the diet, then using sources that

FISHMEAL – a natural product

Fishmeal is the light brown flour produced by cooking, pressing, drying and milling fresh raw fish. It is mainly produced from whole fish, but also provides a valuable outlet to recycle the trimmings from food fish processing. It is a primary product, not a by-product, manufactured in purpose-built plants according to stringent safety and quality criteria. Each consignment of fishmeal is subject to strict controls to maintain its quality and integrity from factory to farm.

FISHMEAL – from sustainable sources

Fishmeal is a renewable feed source, produced almost exclusively from types of fish for which there is no demand for human use. According to independent scientific evidence, all the fish stocks currently being used to produce fishmeal are subject to science-based monitoring and management regimes to ensure that fishing is conducted in a responsible and sustainable manner.

FISHMEAL – suitable for GM-free rations

Where formulations call for GM-free or low GM products, fishmeal is able to meet this requirement.

FISHMEAL – accepted by farm assurance schemes

Fishmeal is recognised as a safe and natural ingredient, which is an effective feed ingredient for dairy cows. The National Dairy Farm Assurance scheme and Freedom Foods standards accept fishmeal for dairy cows and calves, in the case of the RSPCA standards they specify a maximum inclusion rate of 10% of the total dry matter in compounds for all dairy cows and weaned calves.

The benefits of fishmeal

DAIRY RATIONS

The benefits of fishmeal in dairy rations



are efficiently used makes good sense, not only from a financial aspect, but also as protein excretion in the faeces is minimised thereby reducing the environmental impact of the slurry.

In addition, as fishmeal stimulates

digestion of fibre and microbial protein production then rumen conditions are optimised leading to less waste of valuable nutrients.

Using fishmeal also has practical environmental benefits. This is because its protein and phosphorus are of high digestibility and used very efficiently by the animal minimising the

excretion of nitrogen and phosphorus in slurry. Additionally because fishmeal is an excellent source of DUP, very little ammonia is produced in the rumen and its excretion is also reduced.

3 To maximise milk production and value within quota

For many dairy farmers the route to maintain profitability is to increase output per cow and to keep more cows. For most UK producers this means purchasing or leasing extra quota, which is possible but expensive.

Another approach is to maximise the value of milk produced under the terms of the milk contract, for example by increasing protein output to capitalise on milk protein payments or reducing fat percentage to produce more litres

within existing quota.

Typically the inclusion of fishmeal in the diet will boost milk protein yield and reduce milk fat. Recent research with high genetic merit dairy cows demonstrating these effects is summarised in Table 2.

The effects of fishmeal on milk composition could permit the production of up to 4% more litres

Table 2.
The performance of high yielding dairy cows with and without fishmeal in the diet

	Keady and Murphy 1997 ⁴		Carrick <i>et al</i> 1997 ⁸			Lawson <i>et al</i> 2000 ⁶	
	Control	Fishmeal	Control	Fishmeal	Soypass	Control	Fishmeal
Milk yield (kg/day)	24.5	25.6*	28.8	29.5	29.9	22.3	25.4*
Fat (g/kg)	40.0	38.5*	42.0	41.4	41.1	41.0	40.1
Protein (g/kg)	32.6	33.5*	32.2	32.8*	3.17	32.3	32.8
Protein yield (kg/day)	0.80	0.86*	0.93	0.96*	0.94	0.72	0.83*

*Values with asterisk are significantly different from the control (P<0.05).

Table 3.
The effects of fish oil on milk yield and composition

	Control	Fish Oil (g/day)			Fish Oil Premix
		150	300	450	300
Milk yield (kg/day)	22.5	25.0*	25.2*	25.7*	25.7*
Fat (g/kg)	42.3	40.4	36.6*	27.3*	32.5*
Protein (g/kg)	32.7	32.0	30.1*	28.9*	28.5*

*Mean values differ significantly from the control (P<0.05).

within quota (assuming a standard 4% fat) and give a higher milk value in p/litre, where protein payments form part of the milk price.

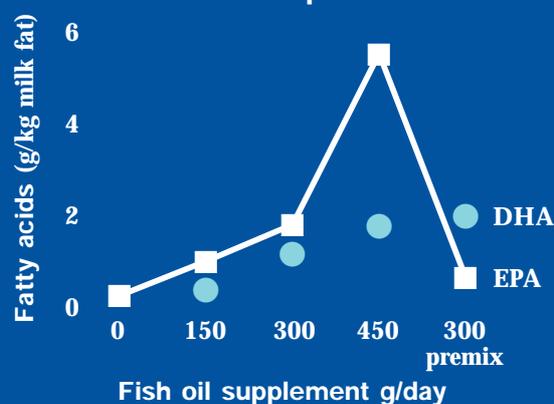
Further benefits of feeding fishmeal have been shown by Dr Tom Wright⁹ in Canada who reported a linear increase in milk protein output when a DUP supplement including fishmeal was fed to lactating dairy cows. Milk yield increased from an average of 22.9 to 26.5kg and protein yield from 0.7 to 0.84kg.

Fish oil tends to have a more dramatic effect on reducing milk fat, as shown in the research of Keady and Mayne (2000)¹⁰. The inclusion of 150, 300, or 450g/day fish oil produced higher yield and lower fat concentrations (see Table 3). At higher levels of fish oil, milk yield increased by 13% from 22.5 to 25.5l, but concentration of both fat and protein in the milk reduced. However, overall fat yield was only markedly lower in the 450/day fish oil and 300g/day premix treatments. Protein yield was not reduced by the addition of oil.

The authors concluded that the reduction of milk fat concentration by up to 15g/kg could allow milk supply within a given quota to be increased by up to 27%.

Manipulating milk fatty acid composition has been achieved by feeding either vegetable or fish oil to lactating dairy cows. Only fish oil produces a significant increase in the very long chain omega-3s (see Figure 2).

Figure 2.
The effect of source and level of fish oil on milk composition



Researchers have investigated the efficiency of converting omega-3 fatty acids from the diet into milk. In the Irish studies the average conversion efficiency across all inclusion levels of fish oil was calculated at 26% for EPA and 27% for DHA. The fish oil premix was converted with a low efficiency: 0 and 17% for EPA and DHA respectively, compared to 35 and 37% efficiency for the 300g/day fish oil. In the Scottish studies conversion efficiency was 3%.

The ADAS Bridgets study used a combination of fishmeal (83g/kgDM) and fish oil (9g/kg DM) to increase omega-3 intake. In this case the conversion efficiency was 5% for EPA and 3% for DHA.

Wright⁹ has focused on the desirability of increasing DHA levels in milk. He also considered potential problems associated with feeding high levels of fish oil to ruminants, such as adverse effects on fibre digestion and dry matter intake. His solution was to supply DHA

4 Healthier milk

4 Healthier milk

Much interest has been shown in altering the fatty acid composition of milk. This is because milk and dairy products are a significant source of dietary saturated fat, which has been linked to the development of heart disease and stroke. Healthier milk, with a fatty acid profile closer to Government dietary recommendations, has moved a step closer to commercial reality according to research from ADAS Bridgets¹¹, SAC Auchincruive¹² and the Agricultural Research Institute of Northern Ireland (ARINI)¹⁰.

The benefits of fishmeal

DAIRY RATIONS

The benefits of fishmeal in dairy rations

via fishmeal, whose benefits for milk production and protein output were already proven. In his studies⁹, including fishmeal led to increases in milk and milk protein yield. More significantly, as the level of fishmeal increased, the efficiency of DHA conversion in milk rose from 15 to 35%.

If these higher levels of conversion can be replicated, the market for omega-3 enriched milk may well become commercially viable.

Milk also contains varying amounts of conjugated linoleic acid (CLA). Health professionals now recognise the benefits of CLA in the diet due to its reported anti-cancer and anti oxidant properties.

In a SAC study¹², 250g/day fish oil in the diet produced a highly significant increase of CLA in milk from 0.16 to 1.55g/100g fat.

5 As an effective supplement

5 As an effective supplement in low input systems

Many dairy farmers are now seeking to reduce concentrate inputs and optimise use of home-grown forage and feeds. Some are also mirroring the New Zealand approach – introducing smaller dairy breeds better suited to more extensive milk production systems.

For these producers, recently published research from the New Zealand group of Macdonald is particularly relevant. In trials with grazing cows yielding 18–20kg milk at the start of the experiment, and where maize silage comprised around 50% of the diet, a true protein supplement was required for optimum digestion and milk solids production. Fishmeal consistently outperformed the alternative proteins – soya bean meal and urea. Overall

Feeding fishmeal

ON THE FARM

Feeding fishmeal on the farm

Fishmeal is a natural balanced feed ingredient that is high in protein, energy, minerals (calcium and phosphorus), a natural source of vitamins (including choline, biotin and vitamin B12, A, D and E) and the micronutrients – selenium and iodine. Fishmeal is one of the best amino acid balances for cows as it is a good source of methionine, lysine, tryptophan and histidine. Typically 60–70% of the protein in fishmeal escapes degradation in the rumen and hence it is an excellent source of DUP.

Nutritional value of fishmeal

Feed ingredient % as fed	Fishmeal		
	White	Chilean	Herring
Crude protein	65	66	70
Oil	6	9	10
Moisture	7–9	9	7–9
Ash	19	11	11
Metabolisable energy MJ/kgDM	13.1	13.4	16.4

Source: *The Feed Directory, Rowett Research Institute*

in

Reasons to use FISHMEAL

Seven reasons to use fishmeal

milk yield was higher with fishmeal compared to soya supplement – 1.6kg, 1.4kg and 0.6kg respectively in spring, summer and autumn. Milk protein yield was also significantly higher in the spring (+9%), summer (+9%) and autumn (+5%).



6 For stronger calves

6 For stronger calves

Increasing DUP supply in the diet of pregnant cows has been shown to increase the immunoglobulin content of the colostrum. It is also possible that the newborn calf benefits from the maternal diet by receiving a similar increase in the supply of immunoglobulins. It is well established that calves receiving relatively higher concentrations of immunoglobulins have lower incidence of disease or mortality.

- 1 Rich source of protein with high content of digestible undegradable protein – for high milk protein yields and higher milk prices
- 2 Excellent source of the essential fatty acids – improves fertility and pregnancy rate with fewer expensive returns to service
- 3 Unique combination of nutrients – that increase milk yields and allows production to be maximised under quota
- 4 Concentrated nutrients – that improve forage utilisation and efficiency
- 5 Rich source of calcium, phosphorus and other minerals – contributes readily available minerals that are efficiently used reducing the environmental burden and reducing the cost of supplementary minerals
- 6 Natural source of anti-oxidant vitamins and selenium – to promote good health, protect cell membranes and improve immune status
- 7 Fish stocks are monitored and subject to controls – to meet the requirements of supermarkets and farm assurance schemes

Typical rates of inclusion of fishmeal

Dairy stock	g/day	% inclusion in compounds or home mix
Cows in late pregnancy	Up to 500	2.5–10
Lactating dairy cows	Up to 750	5–10
Calves	Up to 100	2.5–10

Bulk density: 550–650kg/m³

References

1. **Royal M, Darwash AO, Flint APF, Webb R, Wooliams JA and GE Lamming (2000).** *Declining fertility in dairy cattle: Changes in traditional and endocrine parameters of fertility.* *Animal Science* 70, 487–501.
2. **Staples CW, Mattos R, Risco CA and WW Thatcher (1998).** *Fishmeal may improve cow fertility rates.* *Feedingstuffs* January 12 1998, 12–13.
3. **Pike IH, Miller EL, and K Short (1994).** *The role of fishmeal in dairy cow nutrition,* *IFOMA Technical Bulletin.*
4. **Keady TWJ and JJ Murphy (1997).** *The effects of offering fishmeal and sucrose to dairy cows receiving different levels of concentrate on food intake and animal performance.* *Proceedings British Society of Animal Science Annual Meeting 1997, p87.*
5. **Carro MD, Miller ER and OC Fabb (1997).** *Rumen hydrogenation of long chain fatty acids from fishmeal.* *Proceedings British Society of Animal Science Annual Meeting 1997, p129.*
6. **Lawson RE, Redfern EJ and JM Forbes (2000).** *Choices by lactating cows between concentrates high or low in digestible undegraded protein.* *Animal Science* 70, 515–525.
7. **Mayne S (1996).** *Winter milk production – Opportunities for improving production with grass and grass silage.* *Irish Grassland and Animal Production Association* 30, 22–32.
8. **Carrick IM, Patterson DC and FJ Gordon (1997).** *The response of high genetic merit dairy cows to source and concentration of protein in the concentrate.* *Proceedings British Society of Animal Science Annual Meeting 1997, p90.*
9. **Wright TC, Moscardini S, Luimes PH, Susmel P and BW Mc Bride (1998).** *Effects of Rumen-Undergradable Protein and Feed Intake on Nitrogen Balance and Milk Protein Production in Dairy Cows (1998).* *Journal of Dairy Science* 81, 784–793.
10. **Keady TWJ and S Mayne (2000).** *The effects of fish oil supplementation to dairy cattle on milk fat content and composition.* In: *Milk Composition, BSAS Occasional Publication 25 in press.*
11. **Mansbridge R and JS Blake (1997).** *Nutritional factors affecting the fatty acid composition of bovine milk.* *British Journal of Nutrition* 78, S37–47.
12. **Offer NW, Marsden M, Dixon J, Speake BK and FE Thacker (1999).** *Effects of dietary fat supplements on levels of n-3 polyunsaturated fatty acids trans fatty acids and conjugated linoleic acid in bovine milk.* *Animal Science* 69, 613–625.
13. **Macdonald KA, Penno JA, Kolver ES, Carter WA and JA Lancaster (1998).** *Balancing pasture and maize silage diets for dairy cows using urea, soybean meal, or fishmeal.* *Proceedings of the New Zealand Society of Animal Production* 58, 102–105.

FIN's co-ordinators are Anne Chamberlain, Daniel Pearsall and Karen Green.

Also available from FIN:

Fishmeal for pigs
Fishmeal for poultry
Fishmeal for sheep

For a full list of FIN publication, for further information about any aspect of fishmeal or to be added to the FIN database contact them at:

FIN

4 The Forum
Minerva Business Park
Peterborough
Cambridgeshire
PE2 6FT

Telephone 01733 231133
Fax 01733 232969

E-mail info@fin.org.uk

Web site www.gafta.com/FIN.html



FISHMEAL
INFORMATION
NETWORK



*FIN is an initiative of the
Grain and Feed Trade Association*

Gafta House
6 Chapel Place
Rivington Street
London
EC2A 3SH

Telephone 020 7814 9666

Fax 020 7814 8383

E-mail post@gafta.com