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.

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 newborn 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
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 Nottingham 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’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 summarised a number of studies involving several hundred cows, in which 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.

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 Pike, 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 Murphy 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.
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 Cambridge\(^5\) 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 Mayne\(^7\) 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 in dairy rations

To maximise milk production

The benefits of fishmeal

DAIRY RATIONS

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

In addition, as
fishmeal stimu-
lates 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.

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 fish-
meal 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.

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

<table>
<thead>
<tr>
<th></th>
<th>Keady and Murphy 1997</th>
<th>Carrick et al 1997</th>
<th>Lawson et al 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
<td>Fishmeal</td>
<td>Control</td>
</tr>
<tr>
<td>Milk yield (kg/day)</td>
<td>24.5</td>
<td>25.6*</td>
<td>28.8</td>
</tr>
<tr>
<td>Fat (g/kg)</td>
<td>40.0</td>
<td>38.5*</td>
<td>42.0</td>
</tr>
<tr>
<td>Protein (g/kg)</td>
<td>32.6</td>
<td>33.5*</td>
<td>32.2</td>
</tr>
<tr>
<td>Protein yield (kg/day)</td>
<td>0.80</td>
<td>0.86*</td>
<td>0.93</td>
</tr>
</tbody>
</table>

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

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

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

*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 Wright 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). 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%.

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 Bridgets, SAC Auchincruive and the Agricultural Research Institute of Northern Ireland (ARINI). 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%.

Wright 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
The benefits of fishmeal in dairy rations

5 As an effective supplement
via fishmeal, whose benefits for milk production and protein output were already proven. In his studies, 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 study, 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 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

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 degredation in the rumen and hence it is an excellent source of DUP.

Nutritional value of fishmeal

<table>
<thead>
<tr>
<th>Feed ingredient</th>
<th>% as fed</th>
<th>White</th>
<th>Fishmeal Chilean</th>
<th>Herring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude protein</td>
<td></td>
<td>65</td>
<td>66</td>
<td>70</td>
</tr>
<tr>
<td>Oil</td>
<td></td>
<td>6</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Moisture</td>
<td></td>
<td>7-9</td>
<td>9</td>
<td>7-9</td>
</tr>
<tr>
<td>Ash</td>
<td></td>
<td>19</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Metabolisable energy MJ/kgDM</td>
<td>13.1</td>
<td>13.4</td>
<td>16.4</td>
<td></td>
</tr>
</tbody>
</table>

Source: The Feed Directory, Rowett Research Institute
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

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.

#### Seven reasons to use fishmeal

1. **Rich source of protein with high content of digestible undegradeable 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

<table>
<thead>
<tr>
<th>Dairy stock</th>
<th>g/day</th>
<th>% inclusion in compounds or home mix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cows in late pregnancy</td>
<td>Up to 500</td>
<td>2.5–10</td>
</tr>
<tr>
<td>Lactating dairy cows</td>
<td>Up to 750</td>
<td>5–10</td>
</tr>
<tr>
<td>Calves</td>
<td>Up to 100</td>
<td>2.5–10</td>
</tr>
</tbody>
</table>

Bulk density: 550–650kg/m³
References


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:

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