Managing Palm Kernel Expeller to Meet the Fat Evaluation Index Grading System on New Zealand Dairy Farms.

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Abstract

Palm Kernel Expeller (PKE) is a popular supplementary feed option for dairy farmers due to its low price and ease of use relative to other supplementary feeds. However, high levels of PKE fed to lactating cows alter milk fat composition and product specifications. Fonterra has introduced a Fat Evaluation Index (FEI) grading system designed to restrict PKE feeding. Milk price penalties apply if suppliers exceed FEI thresholds. To quantify the economic and environmental impacts of different options for complying with FEI thresholds, six case-study farms representing high, medium, and low PKE use were modelled in Farmax and OVERSEER©. PKE was either removed altogether, or fed to remain below the FEI threshold, in conjunction with changes to types of supplements used, herd size, or class of stock to which PKE was fed. Replacing PKE completely with alternative purchased supplementary feed to maintain herd size reduced operating profit by $99-$398/ha. Removing PKE and reducing herd size to maintain a similar comparative stocking rate (CSR) resulted in $67-$198/ha reduction in operating profit. Adjusting PKE feeding levels while maintaining a similar CSR resulted in $0-$76/ha reduction in operating profit. Substantial reductions in nitrogen leaching and greenhouse gas emissions were only predicted when both PKE fed and herd size were reduced.

Key words

Palm Kernel Expeller, Farm systems modelling, Operating profit.

Introduction

The amount of Palm Kernel Expeller (PKE) imported annually to New Zealand has increased from 15 tonnes in the early 1990’s to almost 2.3 million tonnes in 2017 (MPI, 2017). Feeding PKE has grown in popularity due to its availability, relatively low price, and ease of incorporation into a pasture based system. Use of PKE ranges from strategically maintaining high stocking rates to tactical use during periods of feed deficit. Feeding PKE to pasture fed cows is associated with increased fat content in milk ((DairyNZ, 2017; van Wyngaard & Meeske, 2017). It also alters milk fatty acid composition with an increase in concentration of short and medium chain fatty acids (Dias, 2010). It is primarily this change in milk fat composition that impact the processing of fat-based dairy products. Research data indicate a linear relationship between the amount of PKE fed to lactating cows and the concentration of short chain fatty acids (Dias, 2010). However, feeding PKE to non-lactating cows does not affect milk fat composition in the following lactation (DairyNZ, 2017). Fat Evaluation Index (FEI) is an index developed by Fonterra to indicate the suitability of milk fat acid composition for processing. Fonterra FEI grading system is designed to control PKE induced milk fat acid composition by penalising farmers who exceed thresholds. The main
objective of this study was to quantify the economic and environmental impacts of different options for complying with FEI thresholds.

Methods

Actual farm physical and financial data for 2014/15 were used to model 6 case study farms across the North Island representing high, medium, and low PKE users. Climate, milk price ($6/KgMs) and cost structures in 2014-15 were close to average for the NZ dairy industry. Farmers feeding more than 1 tonne of PKE per cow per year were classified as high users, those feeding between 0.5 and 0.7 tonnes as medium users and those feeding less than 0.25 tonne as low users. FARMAX (Bryant et al., 2010) model was used to simulate the economic impacts of a range of farm system options while OVERSEER® version 6.3 was used to determine the environmental outcomes. It was assumed to comply with FEI grading thresholds, PKE fed to lactating cows should be limited to not more than 15% of daily diet (DairyNZ 2017).

The options modelled were:

1. Removing PKE from the system and:
   a) replacing on a dry matter basis with feeds such as maize silage, or soybean hulls; or
   b) reducing herd size to maintain a similar comparative stocking rate (CSR; kg liveweight per tonne dry matter feed offered).

2. Reduce PKE feeding to 15% of the diet then:
   a) purchasing an alternative supplement to meet the feed shortfall; or
   b) reducing herd size to match feed demand with supply, to maintain the same CSR; or
   c) swapping the remaining PKE with supplements normally fed to non-lactating cows.

The assumed average long-term cost/kgDM of pasture, PKE, purchased maize silage and purchased soybean hulls are presented in Table 1.

Table 1: Assumed average long-term cost$/kgDM of pasture, PKE, purchased maize silage, and purchased soybean hulls.

<table>
<thead>
<tr>
<th>Feed</th>
<th>Cost$/kgDM</th>
</tr>
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<tbody>
<tr>
<td>Pasture</td>
<td>0.13</td>
</tr>
<tr>
<td>PKE</td>
<td>0.28</td>
</tr>
<tr>
<td>Maize silage</td>
<td>0.36</td>
</tr>
<tr>
<td>Soybean hulls</td>
<td>0.42</td>
</tr>
</tbody>
</table>

Results and discussion

Removing PKE from the system and replacing it with alternative purchased supplementary feeds was the least profitable option investigated (Table 2) because it led to a higher average feed cost (Table 1). Removing PKE and then reducing herd size led to greater environmental benefits and a smaller reduction in predicted operating profit because less total supplementary feed was required. Operating profit was not reduced when PKE fed to lactating was reduced to 15% of the diet and the remaining PKE swapped for supplements usually fed to non-lactating cows. This is a potential low impact option but is not viable if low quality feed such as hay or straw is swapped for PKE in the milking cow diet. Alternatively, when PKE was reduced to 15% of the diet and herd size reduced, there was
minimal impact on predicted operating profit (Table 2). In systems where feed management is not optimal, reducing PKE usage and optimising pasture utilisation will increase profitability. Environmental benefits induced by meeting FEI standards are more likely when both stocking rate and PKE fed is reduced, a reflection of less feed inputs coming onto the farm.

Acknowledgements
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References


Table 2: Predicted implications for profit and environmental emissions of different Palm Kernel Expeller (PKE) feeding strategies for meeting milk grading compliance thresholds when applied to farms currently using high, medium, or low amounts of the feed. * PKE replaced with purchased maize silage, ^ PKE replaced with Soybean hulls.

<table>
<thead>
<tr>
<th>Strategy 1, remove PKE from the system</th>
<th>Strategy 2, feed PKE to compliance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove PKE and replace with other purchased feeds (1a)</td>
<td>Remove PKE and reduce herd size (1b)</td>
</tr>
</tbody>
</table>

**High PKE users**

**Farm1 (1.1tDM PKE/cow)**
- Change in Operating profit $/ha: -$398* - $357^ - $76* - $31 - $31
- % change in greenhouse gases (GHG): -4* - 2^ - 0* - 3 - 3
- % change in N leaching: -7* - 10 - 2* - 3 - 3

**Farm2 (0.97tDM PKE/cow)**
- Change in Operating profit $/ha: -$113 - $198 - $55^ - $17 - $7
- % change in GHG: -17 - 11 - 0^ - 1 - 0
- % change in N leaching: -10 - 10 - 1^ - 1 - 0

**Medium PKE users**

**Farm3 (0.7tDM PKE/cow)**
- Change in Operating profit $/ha: -$243* - $111 - $47* - $47 - $8
- % change in GHG: -11 - 11 - 0* - 2 - 0
- % change in N leaching: -4* - 7 - 1* - 1 - 0

**Farm4 (0.56tDM PKE/cow)**
- Change in Operating profit $/ha: -$99* - $67 - $28* - $25 - $10
- % change in GHG: -11 - 11 - 1* - 4 - 0
- % change in N leaching: -3* - 8 - 1* - 3 - 0

**Low PKE users**

**Farm5 (0.25tDM PKE/cow)**
- Change in Operating profit $/ha: -
- % change in GHG: -
- % change in N leaching: -

Already feeding to compliance levels
<table>
<thead>
<tr>
<th></th>
<th>Farm6 (0.2tDM PKE/cow)</th>
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<tbody>
<tr>
<td><strong>Change in Operating profit $/ha</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-$118*</td>
</tr>
<tr>
<td><strong>% change in GHG</strong></td>
<td>-1*</td>
</tr>
<tr>
<td><strong>% change in N leaching</strong></td>
<td>-2*</td>
</tr>
<tr>
<td><strong>Farm6 (0.2tDM PKE/cow)</strong></td>
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<tr>
<td><strong>Change in Operating profit $/ha</strong></td>
<td>-$63*</td>
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<tr>
<td><strong>% change in GHG</strong></td>
<td>-1*</td>
</tr>
<tr>
<td><strong>% change in N leaching</strong></td>
<td>-1*</td>
</tr>
</tbody>
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Already feeding to compliance levels