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Phenotypic Relationship between Milk Fatty Acid Profile and Live Weight Change in Early Lactation in New Zealand Dairy Cattle

A thesis presented in partial fulfilment of the requirements for the degree of

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ABSTRACT
The phenotypic relationship between milk fatty acid (FA) profile and live weight (LW) change in early lactation in grazing Friesian x Jersey (FxJ) cows was investigated in this study. Data used in this study compromised of 73,040 daily milk yields, 5,936 fortnightly herd-tests for fat, protein and lactose, 41,981 daily live weights, and 882 determinations of FA profiles from 300 second-lactation FxJ crossbred cows recorded during the production season 2003-04. Cows were classified based on the magnitude of LW change from calving to peak lactation into three groups: cows with low live weight loss (L; below -0.012kg), medium live weight loss (M; below -0.174kg and high live weight loss (H; below -0.340kg). LW change was considered as a proxy for energy balance. Correlations between LW change and individual FAs or group of FAs were estimated at the three stages of lactation (early, mid and late). Stage of lactation affected significantly (P>0.05) the concentration of all FAs considered in this study, except the concentration of C20:0. Higher concentration of C18:0 and C18:1 cis-9 was observed in early lactation relative to other lactation stages. Compared to the L and M cows, the H cows had higher concentration of C18:1 cis-9 in early lactation. Live weight loss in early lactation was significantly associated with higher concentrations of unsaturated (r = -0.19), long-chain FA (r = -0.17), C17:0 (r = -0.14), C18:1 cis-9 (r = -0.20) and C18:3 cis-9, cis-12, cis-15 (r = -0.21), but live weight loss was significantly associated with lower concentrations of saturated FA (r = 0.18), medium-chain FA (r = 0.16), C12:0 (r = 0.24), C14:0 (r = 0.17) and C15:0 (r = 0.22). The association between LW changes in early lactation and most of the FAs were not significant in mid and late lactation. If determination of FA can be implemented using mid-infrared spectroscopy, a conclusion from this study is that concentration C18:1 cis-9 in early lactation can be used as indicator of live weight change (energy balance). Further studies are required to evaluate the inclusion of concentrations of FAs in breeding programs to improve fertility in seasonal grazing dairy cattle.
DEDICATION

I would like to dedicate this thesis to my kids, Abednego and Abigail, and I am grateful to have such wonderful loving kids, to my beloved wife, Beatrice Senyagwa.
ACKNOWLEDGEMENTS

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<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>ΔLW</td>
<td>Live weight change</td>
</tr>
<tr>
<td>ALA</td>
<td>$\alpha$-Linolenic acid</td>
</tr>
<tr>
<td>CLA</td>
<td>Conjugated linoleic acid</td>
</tr>
<tr>
<td>EB</td>
<td>Energy balance</td>
</tr>
<tr>
<td>F</td>
<td>Friesian</td>
</tr>
<tr>
<td>FA</td>
<td>Fatty acids</td>
</tr>
<tr>
<td>FxJ</td>
<td>Friesian x Jersey</td>
</tr>
<tr>
<td>J</td>
<td>Jersey</td>
</tr>
<tr>
<td>LA</td>
<td>Linoleic acid</td>
</tr>
<tr>
<td>LCFA</td>
<td>Long-chain fatty acids</td>
</tr>
<tr>
<td>LW</td>
<td>Live weight</td>
</tr>
<tr>
<td>MCFA</td>
<td>Medium-chain fatty acids</td>
</tr>
<tr>
<td>MIR</td>
<td>Mid-infrared spectroscopy</td>
</tr>
<tr>
<td>MUFA</td>
<td>Monounsaturated fatty acid</td>
</tr>
<tr>
<td>NEB</td>
<td>Negative energy balance</td>
</tr>
<tr>
<td>PUFA</td>
<td>Polyunsaturated fatty acids</td>
</tr>
<tr>
<td>SCFA</td>
<td>Short-chain fatty acids</td>
</tr>
<tr>
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<td>Saturated fatty acids</td>
</tr>
<tr>
<td>UFA</td>
<td>Unsaturated fatty acids</td>
</tr>
<tr>
<td>VA</td>
<td>Vaccenic acid</td>
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