Final Report for DHIF

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Project Title: Relationship between milk protein percentage and reproductive performance in seasonal calving herds

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Executive Summary

- The objective of this study was to gain a better understanding of the relationship between milk protein percentage and reproductive performance. This information could then be used as a basis for future field studies, with a possible view to using milk protein percentage, alone or in combination with other variables, as an indicator of energy status and reproductive function.

- In this study, a subset of the InCalf Project database was used and then refined to only include Holstein Friesian cows with between one and five milk production records during the first 120 days of lactation in seasonal-calving herds which carried out artificial insemination (AI) for at least the first six weeks of the mating period. This subset then comprised 8,795 cows in 66 herds.

- The mean milk protein percentage for all cows in the first 120 days of lactation was 3.15% (range 2.36 – 4.59). Cows with low milk protein percentage were common in the study herds as 95% of herds (63 of 66) had some cows with low milk protein concentration (less than 3%).

- The mean 3-week submission rate was 19% lower for cows in the lowest (62.5%) compared to the highest (81.5%) quartile for milk protein percent. The mean 6-week incalf rate was 15% lower for cows in the lowest (52.9%) compared to the highest (67.8%) quartile for milk protein percent. The mean 21-week not incalf rate was 5% higher for cows in the lowest (13%) compared to the highest (8%) quartile for milk protein percent. There was only a 4% difference in first insemination conception rates (three-weeks) between the highest (51.3%) and lowest (47.5%) milk protein quartiles. Almost all the variation in 6-week in-calf rate occurred in the first three weeks of mating as the four to six-week in-calf rate varied only slightly (range 21.0 to 23.5%) across milk protein quartiles. There was more variation in four to six-week in-calf rate across milk protein quartiles (range 31.2 to 42.2%) when expressed as a proportion of the cows that were not in calf in the first 3-weeks of mating.

- More than a quarter of all cows in this study were calved less than 42 days at Mating Start Date. Of these cows, 47% were submitted for AI in the first three weeks of mating, 38% were in calf in the first six weeks of mating and 19% were not in calf after 21 weeks of mating. The latter figure represented 50% of all the cows not in calf after 21 weeks of mating. In the cows calved less than three weeks at Mating Start Date, 26.3% were not in calf after 21 weeks of mating.
- The relationship between milk protein and reproductive performance was consistent across lactation number and whether cows are induced or not. Cows with low milk protein percent had a different calving pattern from those with higher milk protein percent. Whereas 92.5% of cows in the high milk protein quartile had calved by at least 3 weeks at mating start date, only 84.3% in the low milk protein quartile had calved by the same date. This indicated that the relationship between milk protein percent and reproductive performance is repeatable across mating periods based on the differences in calving pattern.
- We then tested this hypothesis by assessing whether early lactation milk protein percentage of primiparous cows was associated with their prior reproductive performance (i.e. as nulliparous heifers). We also compared the strength of the association between MP% and previous reproductive performance in nulliparous heifers with that in multiparous cows.
- In seasonal calving herds, cows are mated in groups; the planned start of calving (PSC) date for the group is 282 days after the date that breeding commenced. Thus the interval between the herd PSC date and each animal's actual calving date (PSC-CI) reflects time to conception.
- High milk protein percentage was associated with shorter PSC-CI. However, interactions were detected between milk protein percentage and milk volume and between milk protein percentage and cow age. The interaction between milk protein percentage and milk volume indicated that cows with low milk protein percentage that also had high milk volume had shorter PSC-CI than cows with low milk volume. The interaction between milk protein percentage and cow age indicated that the association between PSC-CI was stronger in multiparous cows than in primiparous cows. For a one percent increase in milk protein percentage PSC-CI decreased by 8 days in primiparous cows and by 31 to 35 days in multiparous cows.

Conclusions

- The association between milk protein percent and reproductive performance was driven mainly by the incidence of non-cycling cows with consequent effects on submission rate in the first 3 weeks of AI as well as in the second 3 weeks. Late calving cows with low milk protein percentage were at the greatest risk of not being submitted for AI and remaining not incalf at the end of a relatively long mating period of 21 weeks.

- Observed associations between PSC-CI and early lactation milk protein percentage were likely due to biological determinants present before and during the cow's breeding period that are associated with both reproductive performance and subsequent milk volume / milk protein percentage.

- Since these associations were present in non-lactating dairy heifers, the biological determinants causing these associations are not restricted to lactation-specific determinants such as post partum negative energy balance. However, the stronger association observed in multiparous cows than in primiparous cows (nulliparous heifers) may be explained by additional effects of lactation-associated factors such as negative energy balance in lactating dairy cows. Furthermore, these biological determinants are operating in addition to milk volume, milk fat percentage, cow-sire ABV's for milk volume and milk protein percentage, precalving liveweight and effects of 'herd' as these variables were fitted simultaneously in the multivariable model.

- A review of the literature indicates that many studies report associations between milk protein percentage and fertility in multiparous cows similar to what we report here. However, as far as we are aware this is the first study to report an association between the conception pattern of non lactating dairy heifers and their future milk protein concentration.

- Further research is required to determine the biological determinants causing the observed relationship in this study.