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BRIEF COMMUNICATION: Relationships between longevity and herd-test traits in a dairy goat herd

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Introduction

Doe longevity has a significant impact upon the dairy goat industry. Does which maintain good health and high productivity, remaining in the herd for a greater number of years, will reduce the economic and environmental cost of raising replacement breeding animals per unit of milk production. Although longevity has been studied in sheep and dairy cattle (McIntyre et al. 2012, Harris & Montgomerie 2007), there is little information regarding genetic parameters for longevity traits in New Zealand dairy goats. A study (Gautam 2012) has, however, investigated characteristics associated with the length of productive life of dairy goats in New Zealand.

The purpose of this retrospective investigation was to determine the relationship between longevity and milk traits in a New Zealand dairy-goat herd, and whether high-producing does might be more prone to 'burnout', with a resulting decrease in longevity. Several methods exist for measuring longevity, or stayability (McIntyre et al. 2012). An earlier study in this herd (Wheeler et al. 2013) compared the genetic parameters obtained using different measures of longevity, but in this study we have only used one measure: age at final kidding. The herd-test traits included in this study were milk volume, fat yield, protein yield, lactose yield and log of somatic cell count ($\log_{10}\text{SCC}$).

Materials and methods

The longevity and herd test records in this study were from 6269 Saanen does, kidding and lactating in seasons commencing 1991 to 2013 inclusive, in a commercial dairy-goat herd in Northland. Of these does, 4628 died or were culled for commercial reasons during the twenty-two years, and have been assigned an "Age at final kidding". Does still alive in the herd, having kidded in 2013, as well as a group of 200 does sold before kidding in 2013, were assigned a missing value for this trait. The number of herd tests carried out in this herd varied from year to year, and ranged between two and four. In total, there were 41293 herd-test records for the 6269 individual does. Not all milk traits were measured and/or stored in all milking years. For example, lactose was not individually measured until the 2008/2009 milking season, so there are only 11619 lactose records. Likewise, SCC results are only available for the 1999/2000 milking season onwards.

The history and management of this herd, as well as the genetic parameters of milk traits, reproductive traits and live weight, have been described by Morris et al. (1997, 2006 & 2011). An index based on kidding date and breeding values for milk traits was used to select replacement does and future breeding bucks. Does failing to kid as yearlings were culled. Additionally, most does failing to get in kid in subsequent years were also culled. Yearling kidding was taken as the starting point for longevity measurement; only does who kidded at least once were included in the data.

Culling of adult does was primarily for commercial reasons, and culling rates were variable from year to year; fates were not consistently recorded. Hence, unlike the study by McIntyre et al. (2012), this analysis does not distinguish between reasons for a doe exiting the herd, which may have been due to culling for commercial reasons (poor health, conformation, reproductive status), knowledge reasons (based on recorded data and subsequent predictions of performance), or death.

Animal-model restricted-maximum-likelihood analyses were run using ASReml (Gilmour et al. 2009), with full pedigree data, to obtain genetic parameters for these traits. In addition to pedigree, significant fixed effects and covariates, as determined by least squares analyses (SAS 2004), were included in the models. For Age at final kidding, the contemporary group was year of birth; this was the only fixed effect. For milk volume, fat yield, protein yield and lactose yield, fixed effects were contemporary group (kidding year, herd test date within year, management group and age of doe combinations) and number of kids born, with days in milk (DIM) within contemporary group as a covariate. For $\log_{10}\text{SCC}$, the effects were the same as for the other milk traits, with the addition of the quadratic effect for DIM within contemporary group.

The milk-trait analyses used a repeated-animal model to account for the multiple herd-test records. Using the models described above, two-trait analyses were run between Age at final kidding and each of the milk traits, again using a repeated-animal model to account for the multiple herd-test records, in order to estimate genetic and phenotypic correlations.

Results and discussion

Mean Age at final kidding was 3.51 years, with a residual standard deviation of 1.98. The heritability estimate for Age at final kidding, averaged over the five two-trait ASREML analyses, was 0.17 ± 0.03 .

Table 1 shows heritability estimates for the milk traits. Heritability estimates for the milk production traits averaged 0.35 ± 0.02 , while the heritability

Table 1 Estimates of heritability (h^2) \pm standard error of milk traits, and genetic (r_g) and phenotypic (r_p) correlations between milk traits and Age at final kidding.

Trait	Correlations with Age at final kidding		
	Heritability	Genetic (r_g)	Phenotypic (r_p)
Volume	0.38 ± 0.02	0.32 ± 0.08	0.09 ± 0.01
Fat yield	0.34 ± 0.02	0.34 ± 0.08	0.08 ± 0.01
Protein yield	0.39 ± 0.02	0.37 ± 0.08	0.08 ± 0.02
Lactose yield	0.31 ± 0.03	0.37 ± 0.14	0.07 ± 0.03
Log ₁₀ SCC	0.21 ± 0.02	-0.41 ± 0.10	-0.07 ± 0.01

estimate for log₁₀SCC was 0.21 ± 0.02 . Repeatability estimates for the milk production traits averaged 0.49 ± 0.01 , and the repeatability estimate for log₁₀SCC was 0.38 ± 0.01 .

Genetic and phenotypic correlations between Age at final kidding and each of the four milk production traits were significant and favourable, averaging 0.35 ± 0.10 and 0.08 ± 0.02 , respectively. Genetic and phenotypic correlations between Age at final kidding and log₁₀SCC were also significant and favourable, being -0.41 ± 0.10 and -0.07 ± 0.01 , respectively.

McDougall et al (2011) reported that does with a high estimated breeding value for somatic cell count had a higher prevalence of intramammary infection than does with a low estimated breeding value for somatic cell count. As does in this herd which develop mastitis are culled, the genetic and phenotypic correlations between Age at final kidding and log₁₀SCC were not surprising.

Until 2013, once a doe had entered the milking herd as a one year old she remained there unless she failed to get into kid or until she was physically unfit. As a rule, a doe's breeding value for milk production determined whether she would be used to breed replacements from year to year, not whether she would remain in the herd. Consequently, the favourable correlations between Age at final kidding and the milk production traits were less easily predicted than those between Age at final kidding and log₁₀SCC. The significant and positive genetic and phenotypic correlations between Age at final kidding and each of the measures of milk production showed that, in this

herd, does are not "burning out" early as a result of high milk production; in fact, the reverse would appear to be the case. However, these does have been able to remain in good condition throughout the year due to adequate feed availability, and this finding might not apply in herds under less-favourable management conditions. For example, whilst Gautam (2012) found a significant positive relationship between first lactation milksolids yield and protection from removal from the herd in the two years following the second kidding, beyond this age there was a negative (albeit non-significant) relationship.

In conclusion, there appear to be favourable relationships between longevity and all of the milk traits recorded in this herd. Consequently, continuing to select for high milk production should not adversely affect the longevity of does within the herd, provided the herd remains well managed. Future studies could

examine the relationship between longevity and other recorded traits in this herd, such as kidding date, which has been part of the selection index for a number of years, and doe live weight.

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