

Repeatability estimates for endocrine, metabolic and follicle variables in heifers

HJ Van Eesbeck^{1,2}, MA Crowe² JM Sreenan¹, MG Diskin¹

¹Teagasc, Research Centre, Athenry, Co. Galway, Ireland. ²Faculty of Veterinary Medicine, University College Dublin, Belfield, Ireland.

Introduction

Recent studies from this programme show significant variation in how cattle respond to energy intake (Mackey et al 1999; Stagg, 1999). For example, some heifers are sensitive to short-term periods of negative energy balance, becoming anoestrus after a short period while others are more tolerant and maintain oestrous cycles for longer. The biological basis for the apparent sensitivity or tolerance to dietary restriction is unknown. Neither is it known whether this is a repeatable trait or whether there is a genetic component to some of this observed variability. Repeatability is a concept closely linked to heritability and is defined as the “tendency for successive records of the same animal to be more alike than those of different animals”. It is useful and easily quantifiable for those traits that are expressed several times during an animal’s lifetime. Since the same genes or gene combinations affect the successive expressions of a trait, repeatability estimates should at least be as large as heritability and are more likely to be larger because certain permanent environmental influences, which are non genetic, may be included in the numerator of the repeatability equation. It is beneficial to establish repeatability estimates for some of the physiological, endocrine, and metabolic variables that are centrally involved in controlling reproductive function in cattle. The objective of this study was to determine repeatability estimates for a number of endocrine, metabolic and follicle variables in heifers.

Materials and Methods

A total of 64 reproductively normal beef cross heifers were used. Oestrus and ovulation was induced during the dominant phase of the first follicle wave of successive oestrous cycles using prostaglandin F_{2α}. Ovarian structures were examined daily by ultrasonography. All heifers were subjected to a 2nd round of treatments 4 months later. Plasma concentrations of progesterone, oestradiol and follicle stimulating hormone (FSH), insulin-like growth factor-I (IGF-I) and insulin were determined by RIA. Repeatability estimates were derived from an analysis of variance as the interclass correlation among records of traits on the same individual at different waves, both within and between rounds.

Results and Discussion

Repeatability and associated variance estimates for follicle, endocrine and metabolic variables are presented in Table 1. The repeatability estimates calculated for progesterone concentration on days 5 and 6 of the cycle were low, irrespective of whether they were based on successive cycles or on cycles four months apart. This indicates little genetic variation for progesterone at a time when concentrations of progesterone are critical for the establishment of pregnancy. In contrast to progesterone, pro-oestrus oestradiol and basal and pre-

follicle wave emergence rise in FSH produced moderate repeatability estimates with a tendency for somewhat higher estimates for successive follicle waves.

Table 1. Repeatability and associated variance estimates for a number of endocrine, metabolic and follicular variables

Variable	Waves 0 & 1 Round 1.	Wave 1 Rounds 1 & 2
Mean Progesterone on days 5/6	0.02±0.007	0.018±0.004
Mean Pre-ovulatory increase in oestradiol	0.45±0.129	0.366±0.104
Basal FSH	0.48±0.131	0.413±0.031
Peak FSH area under the curve (AUC)	0.46±0.129	0.331±0.085
Mean IGF-I	0.81±0.051	0.83±0.029
Mean Insulin	0.60±0.123	0.64±0.103
No. follicles at new wave emergence	0.45±0.129	0.179±0.032
Follicle growth rate	0.02±0.001	0.010±0.003
Follicle maximum diameter	0.26±0.080	0.028±0.005

Repeatability estimates for number of follicles at new wave emergence were moderate and were largely similar to the estimates for the FSH rise that precedes new follicle wave emergence. Repeatability estimates for follicle growth rate were consistently low, irrespective of whether they were based on successive cycles or on cycles four months apart. For maximum diameter of the dominant follicle there was some evidence that repeatability estimates, based on successive cycles, were somewhat higher than those based on cycles four months apart. Repeatability estimates for IGF-I and insulin concentrations were consistently high, irrespective of whether they were based on successive cycles or on cycles four months apart. This suggests that plasma concentrations of insulin and IGF-I are likely to be moderately heritable and likely to respond to selection.

Conclusions

Repeatability estimates for endocrine and follicular variables were generally low to moderate indicating some possible genetic variability for these variables. Repeatability estimates for the metabolic variables IGF-I and insulin were considerably higher indicating a greater likelihood of worthwhile genetic variability for these two variables. Additional studies are required to clarify their genetic control and, to determine how best to use them as potential indicator traits to improve reproduction and production efficiency. The appropriate incorporation of such easily measurable endocrine and or metabolic variables into breeding programmes would, theoretically, increase the accuracy of selection, provide breeding values at younger ages thereby shortening the generation interval.

Reference

- Stagg K. (2000) Ph.D Thesis National University of Ireland
 Mackey , D.R. Sreenan, J.M. Roche, J.F. Diskin M.G. (1999). Biol. Reprod. 61: 1601-1607.