

( )

\*

( // : // : )

(NRC)

/ ± /

( )

( )

( )

---

1. Gross energy efficiency

2. Net energy efficiency

E-mail: ashtiani@ut.ac.ir

( )

---

: : \*

/ / ( )

/ ( )  
( )

( )

(RFI)

(REI)

( )

( :  
(

( )

( )

( )

)

)

(

(

( )

( )

/ /

%

( )

/

( )

( )

( )

(REI)

1. Residual energy intake

2. Residual feed intake

...

:

$$REI = NEI - (NE_m + NE_l + NE_{preg} + ER)$$

( / ) ( / ) ( )

( )

%

$k_f$   $k_l$   $k_m$

( )

( )

( ) SAS

( )

:

$$y_{ijklmn} = \mu + HYS_j + P_k + M_l + a_m + Pe_m + e_{ijklmn}$$

i

$y_{ijklmn}$

( ) j

HYS<sub>j</sub>

$\mu$

$M_l$  ( ) k

$P_k$

$a_m$  ( )

l ( )

$Pe_m$  m

( )

$e_{ijklmn}$  m

m n

( )

/ ± /

( )

( )

DFREML

/ /

( )

( )

/ ( ) /  
 ( ) / /  
 ( )  
 ( )  
 /  
 ( )

/ ( ) /  
 / ( )  
 / / ( )  
 ( )

( )  
 ( )

---

				(%)		
/	/	/			(Mcal/d)	
/	/	/				(kg)
/	/	/				(kg)
/	/	/	(kg)	%		(kg)
/	/	/				(kg/d)
/	/	/				(kg/d)

---

( / ) ( / )

( / ) ( / )  
 ( )

( / / / )  
 / )

( / )  
 ( )

/ ( / )  
 ( )

/ / ) / /  
 (

( )

...

:

	(BW)	(REI)			(MY)	(DMI)	
* (PY)	(FY)	(FCM)	%				
PY	FY	FCM	MY	DMI	BW	REI	صفت
/	/	/	/	/	/	/ ± /	REI
/	/	/	/	/	/ ± /	/	BW
/	/	/	/	/ ± /	/	/	DMI
/	/	/	/ ± /	/	/	/	MY
/	/	/ ± /	/	/	/	/	FCM
/	/ ± /	/	/	/	/	/	FY
/ ± /	/	/	/	/	/	/	PY

± \*

. / /

( )

.( )

.( )

( ) .( )

)

( )

(

( )

/

)

(

( )

( )

( )

## REFERENCES

3. Agricultural and Food Research Council. 1991. Nutritive requirements of ruminant animals: energy. Technical Committee on Responses to Nutrients, Report No. 5. *Nutr. Abstr. Rev. Series B*, 60: 729–804.
4. Archer, J.A., P.F. Arthur, R.M. Herd, & E.C. Richardson. 1998. Genetic variation in feed efficiency and its component traits. *Proc. 6th World Congr. Gen. Appl. Livest. Prod. NSW, Australia*, 25: 81–84.
5. Archer, J.A., S.A. Barwick, & H.-U. Graser. 2004. Economic evaluation of beef cattle breeding schemes incorporating performance testing of young bulls for feed intake. *Aust. J. Exper. Agric.* 44: 393–404.
6. Arthur, P.F., J.A. Archer, D.J. Johnston, R.M. Herd, E.C. Richardson, & P.F. Parnell. 2001. Genetic and phenotypic variance and covariance components for feed intake, feed efficiency, and other post weaning traits in Angus cattle. *J. Anim. Sci.* 79: 2805–2811.
7. Bath, D.L. 1985. Biological requirements for economics of lowering feed costs. *J. Dairy Sci.* 68: 1579–1584.
8. Berry, D.P., F. Buckley, P. Dillon, R.D. Evans, M. Rath, & R.F. Veerkamp. 2002. Genetic parameters for level and change of body condition score and body weight in dairy cows. *J. Dairy Sci.* 85: 2030–2039.
9. Brody, S. 1945. *Bioenergetics and Growth*. Reinhold Publ. Co. New York. NY.
10. Buttazzoni, L. & I.L. Mao. 1989. Genetic parameters of estimated net energy efficiencies for milk production, maintenance, and body weight change in dairy cows. *J. Dairy Sci.* 72: 671–677.
11. Edmonson, A.J., I.J. Lean, L.D. Weaver, T. Farver, & G. Webster. 1989. A body condition scoring chart for Holstein dairy cows. *J. Dairy Sci.* 72: 68–79.
12. Graser, H.U., S.P. Smith, & B. Tier. 1987. A derivative-free approach for estimating variance components in animal models by restricted maximum likelihood. *J. Anim. Sci.* 64: 1362–1370.
13. Gunsett, F.C. 1984. Linear index selection to improve traits defined as ratios. *J. Anim. Sci.* 59: 1185–1193.
14. Jensen, J., W.D. Hohenboken, P. Madsen, & B.B. Andersen. 1995. Sire  $\times$  Nutrition interactions and genetic parameters for energy intake, production and efficiency of nutrient utilization in young bulls, heifers and lactating cows. *Acta. Agric. Scand. Sect. A. Anim. Sci.* 45: 81–91.
15. Jensen, J., P. Madsen, & B.B. Andersen. 1991. Sire by rearing interactions on feed intake, efficiency, and production of bulls, heifers and cows. 2nd Annual Meeting of the EAAP, Berlin.
16. Kennedy, B.W., J.H.J. van der Wert, & T.H.E. Meuwissen. 1993. Genetic and statistical properties of residual feed intake. *J. Anim. Sci.* 71: 3239–3250.
17. Koch, R.M., L.A. Swiger, D. Chambers, & K.E. Gregory. 1963. Efficiency of food use in beef cattle. *J. Anim. Sci.* 22: 486–494.
18. Koenen, E.P.C. & R.F. Veerkamp. 1998. Genetic covariance functions for live weight, condition score, and dry-matter intake measured at different lactation stages of Holstein-Friesian heifers. *Livest. Prod. Sci.* 57: 67–77.
19. Meyer, K. 1997. Programs to estimate variance components by restricted maximum likelihood using a derivative-free algorithm. User notes. Animal Genetics and Breeding Unit, Univ. New England, Armidale, NSW, Australia.
20. National Research Council, 2001. Nutrient requirements of dairy cattle. 7th ed. National Academy Press. Washington, DC.
21. Ngwerume, F. & I.L. Mao. 1992. Estimation of residual energy intake for lactating cows using an animal model. *J. Dairy Sci.* 75: 2283–2287.
22. Pryce, J.E., M.D. Royal, P.C. Garnsworthy, & I.L. Mao. 2004. Fertility in the high- producing dairy cow. *Livest. Prod. Sci.* 86: 125–135.
23. Rauw, W.M., E. Kanis, E.N. Noordhuizen-Stassen, & F.J. Grommers. 1998. Undesirable side effects of selection for high production efficiency in farm animals: A review. *Livest. Prod. Sci.* 56: 15–33.

24. SAS Institute Inc. 2002. SAS/STAT Software: Changes and enhancements through release 8.02, Statistical Analysis Systems Institute Inc., Cary, NC.
25. Svendsen, M., P. Skipenes, & I.L. Mao. 1993. Genetic parameters in the feed conversion complex of primiparous cows in the first two trimesters. *J. Anim. Sci.* 71: 1721–1729.
26. Van Arendonk, J.A.M., G.L. Nieuwhof, H. Vos, & S. Korver. 1991. Genetic aspects of feed intake and efficiency in lactating dairy heifers. *Livest. Prod. Sci.* 29: 263–275.
27. VandeHaar, M.J. 1998. Symposium: Efficiency of production, Efficiency of nutrient use and relationship to profitability on dairy farms. *J. Dairy Sci.* 81: 272–282.
28. Veerkamp, R.F. & G.C. Emmans. 1995. Review: Sources of genetic variation in energetic efficiency of dairy cows. *Livest. Prod. Sci.* 44: 87–97.
29. Veerkamp, R.F., G.C. Emmans, A.R. Cromie, & G. Simm. 1995. Variance components for residual feed intake in dairy cows. *Livest. Prod. Sci.* 41: 111–120.
30. Veerkamp, R.F., J.K. Oldenbroek, H.J. Van Der Gaast, & J.H.J. Van Der Werf. 2000. Genetic correlation between days until start of luteal activity and milk yield, energy balance, and live weights. *J. Dairy Sci.* 83: 577–583.
31. Wang, S., G.L. Roy, A.J. Lee, A.J. McAllister, T.R. Batra, C.Y. Lin, J.A. Vesely, J.M. Wauthy, & K.A. Winter. 1992. Evaluation of various measures of and factors influencing feed efficiency of dairy cattle. *J. Dairy Sci.* 75: 1273–1280.