Repeatability of residual feed intake and indices of body composition in growing Columbia ewes fed the same diet

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Abstract

Residual feed intake (RFI), an efficiency measurement based upon the difference in expected feed intake for a given weight and growth rate and actual feed intake, is used to improve production efficiency of domestic ruminants. The purpose of this study was to evaluate the repeatability of RFI of sheep measured for two consecutive years, and to investigate the relationship of indices of body composition in yearling ewes and RFI. Two trials, using the same Columbia ewe lambs (n = 17 per trial) were conducted in consecutive years (2014, 2015). Ewe were fed for 47 and 45 days, respectively, beginning in September of each year. The diet, an alfalfa-barley pellet, was the same feed for both years. RFI was calculated for each ewe in each year. RFI did not differ (P = 0.77) between years, indicating that on the same diet and environmental conditions, RFI does not appear to change with age. In 2015, ribeye area (REA; cm^2) and backfat thickness (BF; cm) were measured by ultrasonography on day 0 (start of trial), 17, and 45 (end of trial). These variables were used as indices of body composition for determining if low RFI (efficient) or high (inefficient) ewes partition nutrients into either muscle or fat. RFI classification did not affect REA (P = 0.15) or BF (P = 0.25). Interestingly, both REA and BF increased (P < 0.01) from day 0 to 17 and BF increased again from day 17 to 45. Within each day, BF and REA were linearly related (P < 0.04). Thus, RFI is repeatable; however, indices of body composition seem to be independent of RFI in Columbia ewes fed the same diet under similar conditions.

Introduction

The most costly resource in any livestock production system is the cost of feed [1]. As feed prices continue to rise, selection for efficient animals that can gain more on less feed will become more economically important. Residual feed intake (RFI) is an efficiency measurement based upon variation in metabolic differences among individual animals [2] and is often used as a selection tool when making breeding decisions. However, more information is needed on the relationship between the repeatability of RFI at different stages in an animal's productive lifespan [3].The purpose of this study was to evaluate differences in the RFI of Columbia ewe lambs and yearlings in consecutive years, and to investigate the relationship of RFI with body composition indices and estimates in yearling Columbia ewes.

References

[1] Moore, S.S., F.D. Mujibi, and E.L. Sherman. 2009. Molecular basis for residual feed intake in beef cattle. J. Anim. Sci. 87 (Suppl. 14):E41-47. doi: 10.2527/jas.2008-1418.
[2] Carstens, G.E. and M.S. Kerley. 2009. Biological basis for variation in energetic efficiency in beef cattle. In: Proc. Beef Improve. Fed. 41st Annual Research Symposium, Sacramento, CA. p. 124–131.
[3]. Arthur, P.F., J.A. Archer, and R.M. Herd. 2004. Feed intake and efficiency in beef cattle: overview of recent Australian research and challenges for the future. Aust. J. Exper. Agric. 44:361-369. doi:10.1071/EA02162
[4] Koch, R.M., L.A. Swiger, D. Chambers, and K.E. Gregory. 1963. Efficiency of feed use in beef cattle. J. Anim. Sci. 22:486-494. doi:10.2134/jas1963.222486x
[5] Silva, S. R., J. J. Alfonso, V.A. Santos, A. Monteiro, C.M. Guedes, J.M.T. Azevedo, and A. Dias-da-Silva. 2006. In vivo estimation of sheep carcass composition using real-time ultrasound with two probes of 5 and 7.5 MHz and image analysis. J. Anim. Sci. 84:3433-3439. doi:10.2527/jas.2006-154.
[6] Swanson, D.W., T. R. West, W.R. Tatum, M.L. Riley, M.B. Judkins, and G.E. Moss. 1993. Relationship of body composition of mature ewes with condition score and body weight. J. Anim. Sci. 71:1112-1116. doi:/1993.7715112x.
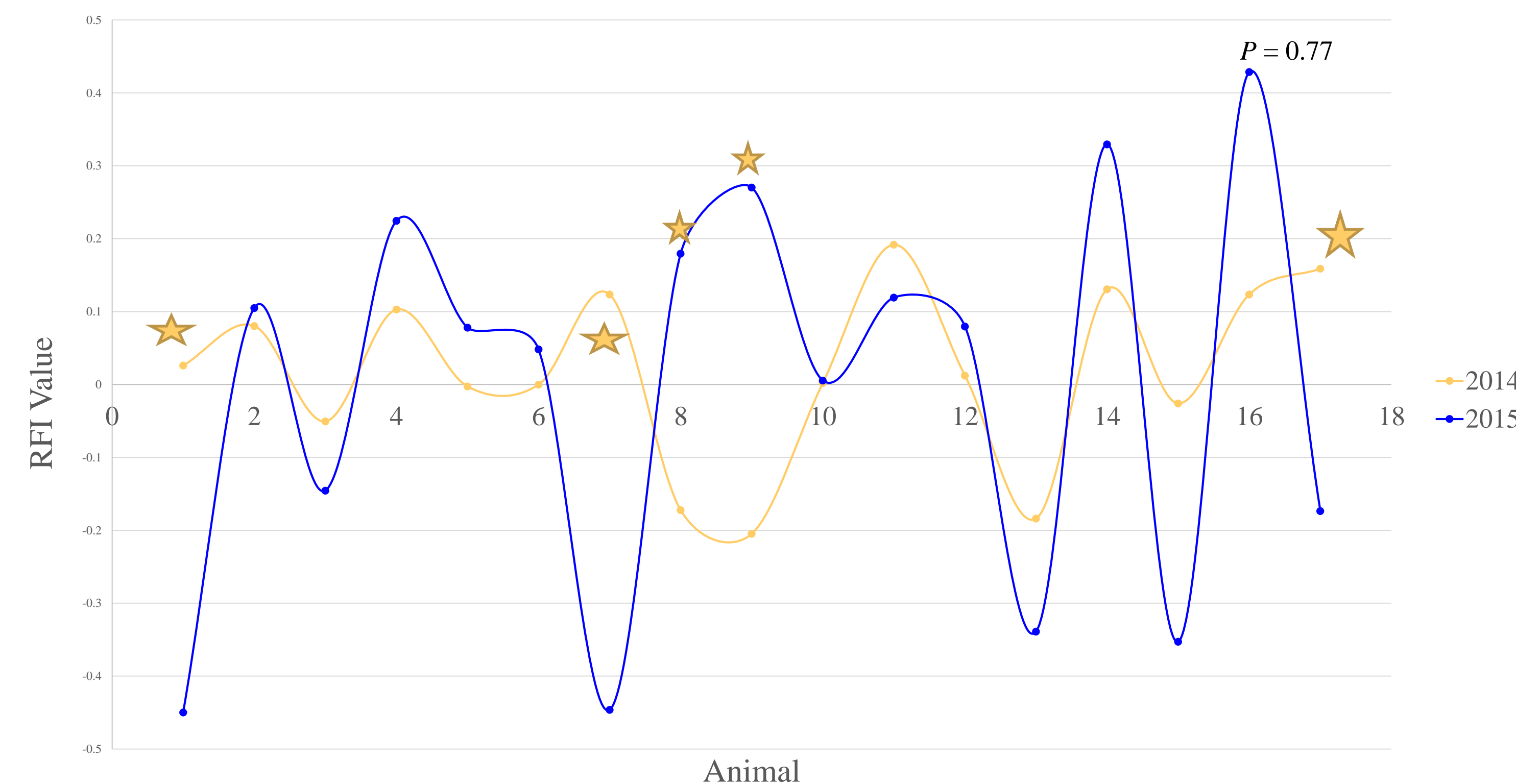
Figure 1. Yearly RFI Comparison of young Columbia Ewes

Table 1. Performance of Columbia ewe lambs and yearlings from different RFI classes in consecutive year RFI trials

Year	Item	RFI Classification			SEM	P-value
		Low	Moderate	High		
2014	Initial wt, lb	67.32	67.98	78.98	17.91	0.57
	Final wt, lb	105.38	102.96	111.54	21.89	0.81
	ADG, lb	0.66	0.62	0.57	0.11	0.56
	DMI, lb	3.76	4.16	4.73	0.84	0.32
	RFI	-0.19	0.03	0.14		
2015	Initial wt, lb	146.52	144.76	139.92	22.75	0.77
	Final wt, lb	170.5	168.74	165.44	22.62	0.87
	ADG, lb	0.55	0.55	0.59	0.18	0.84
	DMI, lb	5.54a	6.47b	7.06b	0.79	0.0002
	RFI	-0.40	0.05	0.34		

a,b Means within a row with different superscripts differ (P ≤ 0.05)

Table 2. Estimated whole-body muscle mass (M), intramuscular fat (IMF), empty body weight (EMW), empty body weight dry matter (EMWDM), empty body weight fat (EBWF), empty body weight protein (EBWP), carcass weight (CW), carcass weight dry matter (CWDM), carcass weight fat (CWF), and carcass weight protein (CWP) of yearling Columbia ewes divergent in RFI class.

Item	RFI Classification			SEM	P-value
	Low	Mod	High		
M, lb	39.56	38.15	34.47	5.37	0.09
IMF, lb	10.93	10.10	9.24	2.05	0.17
EMW, lb	141.26	139.7	136.84	19.23	0.87
EMWDM, lb	113.04	112.42	111.32	7.458	0.87
EBWF, %	28.66	28.18	27.30	5.96	0.87
EBWP, %	15.83	15.93	16.09	1.13	0.87
CW, lb	79.49	78.56	76.82	11.53	0.87
CWDM, %	54.87	54.67	54.26	2.67	0.87
CWF, %	28.57	28.11	27.27	5.65	0.87
CWP, %	17.32	17.41	17.6	1.23	0.87

Poster details available from Katharine A. Perz at katharine_perz@yahoo.com

Materials and Methods

- Columbia ewe lambs (n = 17) underwent a 47-day feeding trial (2014) and a 45-day feeding trial (2015) to determine individual ewe feed intake and ADG
- Residual Feed Intake (RFI), or the difference betweeen expected and actual intake, was calculated following the procedure from Koch et al. [4]
- Ultrasound backfat thickness (BF; cm) and ribeye area (REA; cm^2) were measured at day 0, 17, and 45 in 2015
- Body composition estimates were modeled by regression equations as reported by Silva et al. [5] and Swanson et al. [6]
- Ewes with an RFI greater than 1 standard deviation from the mean were classified as HIGH (inefficient) while ewes with an RFI greater than 1 standard deviation below the mean were classified as LOW (efficient) for both years
- Significance was determined at P < 0.05.

Results/Discussion

- RFI values did not differ between years (P = 0.77; Figure 1)
- RFI classification did not influence initial or final bodyweights, or ADG other than dry matter intake in 2015 (Table 1) or modeled body composition (Table 2)
- Efficient ewes ingested less feed in 2015 (P = 0.002; Table 1)
- RFI classification did not affect BF (P = 0.25) or REA (P = 0.15)
- REA increased from d 0 to d 17 while BF increased from d 0 to d 45 (P < 0.01)
- Within each day, BF and REA were linearly correlated (P < 0.04)

Implications

- RFI was repeatable in consecutive years in young Columbia ewes fed the same feed and maintained in the same environment
- RFI classification did not impact indices of and modeled body composition

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