EFFECT OF RUMEN-PROTECTED FAT ON GROWTH PERFORMANCE, MEAT QUALITY AND INTRAMUSCULAR FAT DEPOSITION IN FATTENING YAKS

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I. INTRODUCTION

With a population of 16 million, the yak industry provides considerable beef product for the meat consumption market in China. However, the low productive performance and poor meat quality under traditional grazing feeding pattern are currently hindering the modernization development of yak industry. Fat, as an essential nutrient for livestocks, may cause adverse impact on ruminal microbes and fermentation at high supplemental levels in a ruminant diet. Rumen-protected fat (RPF) which is coated by physical or chemical method has been reported to avoid the interference with ruminal microorganisms, meanwhile promote growth performance and milk production via the effective improvement of dietary energy. At present, there is few literatures on the application of RPF to yak ration. Therefore, the objective of this study was to investigate the effect of dietary RPF supplementation on growth performance, meat quality and intramuscular fat deposition of fattening yaks.

II. MATERIALS AND METHODS

The Institutional Animal Care and Use Committee of the Sichuan Academy of Grassland Sciences approved all procedures in the study. Male yaks (n=24, 3-4 years old) with similar body weight (275.63± 9.84 kg) were assigned to 1 of 3 treatments with completely randomized design. Yaks in different treatments received (1) basal diet (CON), (2) basal diet with 1.5% RPF supplementation (RPF1.5), or (3) basal diet with 3.0% RPF supplementation (RPF3.0), respectively. There were 8 yaks for each treatment. The experimental diets fed as TMR consisted of concentrate, corn silage and wheat straw.

After an adaptation period of 7 d and an experimental period of 90 d, all yaks were weighed. Three yaks in each treatment were randomly selected for slaughtering measurements following standard procedure, respectively. *Longissimus dorsi* samples were collected to analysis meat quality and gene expression related to intramuscular fat (IMF) deposition. Statistical analyses were performed using the one-way ANOVA procedure of SAS (SAS Institute Inc.).

III. RESULTS AND DISCUSSION

Growth Performance and Carcass Traits

Table 1. Effect of rumen-protected fat supplementation on the growth performance of fattening yaks

Items	CON	RPF1.5	RPF3.0	SEM	P-value
Initial body weight, kg	274.56	274.88	277.44	3.56	0.828
Final body weight, kg[1]	343.31^{B}	350.69^{AB}	358.50^{A}	4.03	0.048
Body weight change, kg	68.75^{B}	75.81^{A}	81.06^{A}	2.09	0.002
Average daily gain, g/d	763.89^{B}	842.36^{A}	900.69^{A}	23.20	0.002
Dry matter intake, kg	8.12	8.05	7.96	0.09	0.484
Feed to gain ratio	10.71^{A}	9.62^{B}	8.87^{B}	0.27	<0.001

[1]Values in the same row with different letter superscripts differed significantly (P<0.05).

We observed significant increase of body weight change for yaks fed RPF diets compared with those fed basal diet ($P < 0.05$, Table 1). Average daily gain differed significantly among treatments while yaks received 3.0% RPF supplementation showed the highest growth ($P < 0.05$). Yaks in RPF1.5 and RPF3.0 group had significantly lower feed to gain ratio which reveals greater feed efficiency ($P < 0.05$).

After slaughtering measurements, significant effect on the carcass traits occurred with dietary RPF supplementation. 1.5% and 3.0% RPF supplementation resulted in greater visceral fat weight in comparison with control group ($P < 0.05$). The eye muscle area, carcass weight, net meat weight, dressing percentage and net meat percentage of yaks fed RPF3.0 diet were significantly higher than those fed basal diet ($P < 0.05$).

Meat Quality

The cooking loss and shear force of *Longissimus dorsi* were significantly reduced by RPF3.0 treatment ($P < 0.05$, Table 2). And we found a significant increase of IMF content for yaks received RPF diets when compared with CON ($P < 0.05$). The fatty acids composition in IMF including SFA, MUFA and PUFA did not differ significantly among treatments.

Table 2. Effect of rumen-protected fat supplementation on meat quality and nutrients composition of fattening yaks

Items	CON	RPF1.5	RPF3.0	SEM	P-value
Cooking loss, %	37.61^{A}	34.13^{AB}	32.20^{B}	1.23	0.063
Shear force, kg	7.49^{A}	6.58^{AB}	5.78^{B}	0.08	0.017
Protein, %	22.17	22.07	21.83	0.42	0.861
Intramuscular fat, %	2.60^{C}	3.53^{B}	4.57^{A}	0.20	0.005
SFA[1], %	55.30	55.62	57.32	1.18	0.550
MUFA, %	41.66	42.46	40.50	1.20	0.589
PUFA, %	3.05	1.93	2.16	0.47	0.446

[1]SFA=Saturated fatty acids; MUFA=Monounsaturated fatty acids; PUFA=Polyunsaturated fatty acids.

Gene Expression Related to Intramuscular Fat Deposition

Table 3. Effect of rumen-protected fat on gene expression related to intramuscular fat deposition of fattening yaks

Items	CON	RPF1.5	RPF3.0	SEM	P-value
Acetyl-CoA Carboxylase (ACC)	1.00^{A}	0.81^{A}	0.54^{B}	0.06	0.008
Fatty Acid Synthase (FAS)	1.01^{A}	0.61^{B}	0.66^{B}	0.06	0.006
Stearoyl-CoA Desaturase (SCD)	1.02	1.10	1.18	0.08	0.539
Diacylglycerol O-Acyltransferase 1 (DGAT-1)	1.02^{C}	1.51^{B}	2.10^{A}	0.09	<0.001
Lipoprotein Lipase (LPL)	1.00	1.07	0.94	0.09	0.714
Hormone-Sensitive Lipase (HSL)	1.01	0.96	0.93	0.07	0.722
Adipose Triglyceride Lipase (ATGL)	1.03	1.19	1.03	0.15	0.756
Carnitine Palmitoyltransferase 1 (CPT-1)	1.01^{B}	1.28^{A}	1.48^{A}	0.07	0.012
Acyl-CoA Oxidase (ACOX)	1.02	1.24	1.24	0.12	0.368

The gene expression of ACC and FAS, key enzymes of *de novo* lipogenesis, was significantly lower in the RPF3.0 group than control group ($P<0.05$, Table 3). The DGAT-1 gene expression differed significantly among treatments, and yaks fed with RPF1.5 and RPF3.0 supplementation had significantly greater DGAT-1 expression compared with those fed basal diet ($P<0.05$). In contrast, no effect of treatments on the gene expression of key enzymes of lipolysis was observed, except CPT-1 which was increased significantly in RPF groups in comparison with the control group ($P<0.05$).

IV. CONCLUSION

The results of this study indicate that yaks fed with 3.0% RPF supplementation had improved growth performance and meat-producing capacity. Based on the reduced shear force and cooking loss, as well as elevated intramuscular fat content, the meat quality of yak could be improved by dietary RPF supplementation. The increased IMF deposition resulted from the direct utilization of the fatty acids derived from RPF for triglycerides synthesis, instead of *de novo* lipogenesis.

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