

Study on Fiber Ratio of the Feed Intaked Voluntarily by Steers

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Summary

The study was carried out to know the roughage-concentrate ratio and the fiber ratio of the feeds intaked by steers voluntarily in the free access to soilage and concentrate respectively. As roughage, soilage of Italian ryegrass was used in the experimental period covering 12 days, and rice straw was used in the control period covering 12 days. The concentrate used was a commercial mixture of grains for fattening cattle. Seven steers of the Holstein breed were employed in this study, averaging 13 months old in age and 435 kg in body weight. They were allowed to eat freely roughage and concentrate ad libitum respectively. The fiber ratio of the feed intaked was 7.1 in experimental period (Italian ryegrass period) and 7.6 in the control period. The fiber ratio in the experimental period was lower than that in the control period. This difference seems to be due to physical condition of the roughage. The fiber ratios in the feeds intaked by the steers voluntarily were around 7.5. It was proved again that the fiber ratio in the range of 7 to 8 will meet steer's physiological requirement.

Introduction

In the early work of POWELL^{13,14}, it was demonstrated that feeding low-roughage-high concentrate rations or feeding roughage in a finely ground state caused the fat content of the milk to decrease as much as 60%. Since the work of Powell, many have reported on the effect of combinations of grains and roughage on milk production, milk constituent, rumen volatile fatty acid. Feeding conditions reported to be responsible for a low milk fat test are feeding restricted roughage and high concentrates^{6,11,20}, the type of concentrates fed^{16,18}, heat treatment of the concentrate^{3,16,18}, and so on.

Changes in molar production of volatile fatty acids formed in the rumen^{2,7,11,20}) or narrow ratio of acetate to propionate were reported to be the cause of fat depression in milk. These reports let the dairymen have had a great interest to the grain levels and minimum amount of roughage in rations. Reid¹⁵ reported the roughage level being able to prevent decline of fat percentage of the milk.

Due to the increasing supply of feed grains and shortage of conventional roughage, cattlemen are finding grains to be a more economical source of nutrients than roughages. This is a tendency in the most of developed countries, and it is true particularly in our country where number of cattle per household of farmer increased abruptly in spite of limited area of pasture and sources of roughage. Ad libitum grain and restricted roughage feeding is the popular way of feeding beef cattle, particularly in the finishing period. Roughage levels is also important factor for growth of cattle and daily gain. Optimal levels of roughage for gains was reported by many workers, and ratio of roughage to grains was expressed in term of percent of roughage to concentrate or percent of fiber content in the ration.

Wada *et al.* reported a optimal range of ratio of rice straw and concentrate for body

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weight gain, using the term of fiber ratio in the ration. The authors defined the fiber ratio as ratio of crude fiber content to dry matter of the feed. The authors demonstrated that fiber ratios in a narrow range around 7.5 are the most economical and the most effective in gain of beef cattle on the feed of combination of rice straw and concentrates. This was proved in the previous report by the present authors⁹⁾. Voluntary feed intake in free access to concentrates and roughage respectively in cafeteria system of feeding is probably the most suitable intake physiologically to cattle and the total energy intake meets with their energy requirement. OKUSHIMA and WADA⁹⁾ proved that fiber ratio of rice straw and concentrate intaked voluntarily was 8.1 and this ratio is very close to the fiber ratio in the ration which showed the highest gain in the trial reported by WADA *et al*^{21,22)}.

It is naturally that fiber ratio may vary with physical condition of feed, especially roughage. The present study was designed to find the fiber ratio of Italian ryegrass soiled and concentrate when they are fed to dairy beef cattle ad libitum respectively.

Methods And Materials

Seven steers of the Holstein breed were employed in this study. At the time of start of the study, their age averaged approximately 13 months old and their body weight averaged 453 kg. The period of feeding of the study was consist of two periods, namely, experimental period and control period. Each period started after 5 days preliminary period and covered 12 consecutive days. The experimental period began on 20th of October, 1974, and the control period on 6th of November in the same year.

Roughages and concentrate were given ad libitum in a cafeteria system of feeding. The steers could access freely to Italian ryegrass and concentrate respectively in the experimental period, and freely to rice straw and concentrate respectively in the control period.

Table 1 Body weight and gains

(kg)					
Period	Steer No.	Initial B.W.	Final B.W.	Gain	Daily gain
Experimental (Italian ryegrass period, 12days)	1	455.0	457.3	2.30	0.19
	2	462.5	465.7	3.20	0.27
	3	421.5	434.0	12.50	1.04
	4	423.0	435.0	12.00	1.00
	5	419.0	435.2	16.20	1.35
	6	480.5	473.2	-7.30	-0.61
	7	515.0	520.5	5.50	0.46
	M \pm S.D	453.78 \pm 35.91	460.12 \pm 31.06	6.34 \pm 7.95	0.52 \pm 0.66
Control (Rice straw period, 12days)	1	461.5	477.4	15.9	1.325
	2	469.7	484.5	14.8	1.233
	3	436.7	443.4	6.7	0.558
	4	436.7	439.5	2.8	0.233
	5	435.5	431.6	-3.9	-0.325
	6	476.5	492.4	15.9	1.325
	7	522.6	528.9	6.3	0.525
	M \pm S.D	462.74 \pm 31.41	471.10 \pm 34.97	8.36 \pm 7.57	0.696 \pm 0.630

The concentrate used was a commercial mixture of grains for fattening cattle. The nutrients in the concentrate intaked was caluculated on the basis of commercial indication. The rice straw was cut into approximately 20 cm in length and fed to the animals. Contents of nutrients in the straw were caluculated on the basis of the Special Report No. 3 issued from the National Institute of Animal Industry, Ministry of Agriculture and Forestry, Nutrients content of the Italian ryegrass were culuculated on the basis of analytical result in the present junior author's Laboratory.

The steers were kept with stanchion and fed individually, furnishing two mangers, one for roughage and another for concentrate. Intake of the feeds were weighed daily. Body wight of the animal was weighed on the first day and final day of each period. Management of the animal was made according to usual way except that no litter was used.

Results And Discussions

1. Body weight gain :

Body weight gain of each steer was shown in Table 1. Daily gain was 0.52 ± 0.66 kg in the experimetal period (Italian ryegrass period) and 0.70 ± 0.63 kg in the control period (rice straw period). Body weight gain in the Italian ryegrass period was lower than that in the rice straw period. This is due to the difference dry matter (DM) intake or nutrients intake.

2. Feed intake :

Feed intake of each steer was shown in Table 2 and 3. Italian ryegrass intake per steer was 138.65 ± 13.9 kg in the experimental period and its dry matter content was 26.2 ± 2.6 kg. In the same period, concentrate intake was 84.16 ± 6.75 , and its dry matter content was 72.7 ± 5.83 kg. Rice straw intake per steer in the control period was 11.58 ± 0.22 kg and its dry matter content was 10.17 ± 0.20 kg. In the same period,

Table 2 Feeds and nutrients intaked for the experimental period (12 days)
(Mean \pm S. D., kg)

Feed	Feed		Nutrients			
	Intake	Daily intake	TDN	DCP	DM	DCFiber
Italian ryegrass	138.65 ± 3.95	11.55 ± 1.16	17.04 ± 1.71	3.04 ± 0.31	26.20 ± 0.63	3.46 ± 0.34
Concentrate	84.16 ± 6.75	6.95 ± 0.65	60.59 ± 4.86	8.41 ± 0.67	72.71 ± 5.83	3.61 ± 0.29
Total	200.98 ± 41.4	18.72 ± 1.41	77.62 ± 5.72	11.45 ± 0.84	98.91 ± 7.22	7.07 ± 0.52

Table 3 Feeds and nutrients intaked for the control period (12 days)
(Mean \pm S. D., kg)

Feed	Feeds		Nutrients			
	Intake	Daily intake	TDN	DCP	DM	DCFiber
Rice straw	11.58 ± 0.22	0.96 ± 0.02	4.28 ± 0.08	0.034 ± 0.00	10.17 ± 0.20	3.30 ± 0.06
Concentrate	109.57 ± 7.35	9.12 ± 0.60	78.88 ± 5.22	10.95 ± 0.72	94.66 ± 6.27	4.70 ± 0.31
Total	121.15 ± 7.33	10.09 ± 0.61	81.83 ± 4.24	10.99 ± 0.72	104.84 ± 6.34	7.97 ± 0.28

concentrate intake was 109.57 ± 7.25 kg, and its dry matter was 94.66 ± 6.27 kg. Total amount of dry matter intake per steer was 98.91 ± 7.22 kg in the Italian ryegrass period and 104.84 ± 6.34 kg in the rice straw period. This fact seemed to be a major cause of the difference in body weight gain between the two periods. Ratio of dry matter intake in the experimental period to that in the control period was 100 : 106. The steers intaked actually 6% more DM in the control period than did in the experimental period.

3. Nutrients intake :

Total digestible nutrients (TDN) intake per steer estimated was 77.63 ± 5.72 kg in the experimental period and 81.83 ± 4.24 kg in the control period. Ratio of TDN intake between the two periods was 100 : 150.4. Digestible crude protein (DCP) intake per steer estimated was 11.45 ± 0.84 kg in the experimental period and 10.99 ± 0.72 kg in the control period. Ratio of DCP intake between the two periods was 100 : 95.9. This indicated that weight gain has a more close relation to DM intake or TDN intake than to DCP intake.

4. Feed requirement :

Feeds or nutrients requirement per 1 kg gain was shown in Table 4. Nutritional requirement per unit weight of gain was higher in the experimental period than that in the control period, in another words, soilage reduced the feed efficiency due to its greater volume or greater content of water in comparison with those of hay and straw.

Table 4 Feeds and nutrients requirement per 1 kg gain

Period	(kg)					
	TDN	CCP	DM	DCFiber	Concentrate	Roughage
Experimental	12.24	1.80	15.60	1.11	13.10	21.76
Control	9.78	1.31	12.54	0.95	13.20	1.38

5. Roughage-concentrate ratio :

Ratio of roughage to concentrate was shown in Table 5. The ratio of roughage to concentrate was shown in ratio of TDN, DCP, DM, crude fiber, and actual weight respectively. Ratio of dry matter of roughage to that of concentrate was 36.0 in the Italian ryegrass period and 10.7 in the rice straw period.

Table 5 Roughage-concentrate ratio in feeds intaked and fiber ratio

Period	Roughage-concentrate ratio				Fiber ratio
	TDN	DCP	DM	Row material	
Experimental	28.0 : 100	36.1 : 100	36.0 : 100	164.74	7.14
Control	5.4 : 100	3.1 : 100	10.74 : 100	10.56 : 100	7.60

This is a natural roughage-concentrate ratio due to the nature of steer because that they intaked the feeds voluntarily. The ratio came around 7.5 and this coincide approximately with the ratio reported previously by the present authors⁹⁾. It is concluded that roughage-concentrate ratio in the feed intaked on free access system of feeding is around 7.5. This ratio will meet to cattle physiologically.

There are many reports concerning the roughage-concentrate ratio in the feed of dairy cattle in relation to milk fat depression^{1,2,4,5,8,10,12,17,19,23,25)}. Reid reported that

roughage level below 0.5 kg per 100 kg of body weight caused a decline in milk fat test¹⁵). In beef cattle, however, more lower level of roughage will be enough to fatten the cattle. The present authors would recommend that approximately a half of the level above-mentioned will be enough for fattening cattle, using rice straw or hay. And it should be noted that roughage-concentrate ratio will vary according to physical condition of roughage. Additionally writing, fresh forage is not always suitable for growth or gain in cattle because of its limited content of DM or nutrients.

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去勢肥育牛の自由摂取飼料の粗濃比に関する研究

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(附属農場)

要 約

此の研究は生草および濃厚飼料自由摂取における去勢肥育牛摂取飼料の粗濃化および繊維率を見出すために行った。粗飼料としては、12日間わたる試験期間中はイタリアンライグラスの生草を用い、また12日間わたる対照期間中は稲わらを用いた。濃厚飼料は牛の肥育用配合飼料を用いた。平均13カ月令、平均体重 435 Kg のホルスタイン種去勢牛7頭を此の研究に用いた。供試牛には不断給飼で濃厚飼料および粗飼料を自由に摂取させた。繊維率は試験期間(イタリアンライグラス期)に7.1対照期間(稲わら期)に7.6であった。試験期間における繊維率は対照期間におけるよりも低かった。この差は粗飼料の物理的条件によるものと思われる。去勢牛の自由摂取飼料の繊維率は7.5付近にあった。以上の如く、7~8の範囲の繊維率が牛の生理的要求に合うことが、ここに再び証明できた。

正 誤 表 (Errata)

頁 (Page)	行 (Line)	誤 (Erratum)	正 (Correct)
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82	21	anb	and
83	9	weigheddaily	weighed daily
84	3	priod	period
〃	26	shwn	shown
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