Investigations on the energy metabolism in growing cattle. growing buffaloes and weathers fed on different diet structures

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Abstract

Although widely accepted the idea that buffaloes use better the feed than the cattle, our investigations did not observe such a situation. The loss of energy by urine and methane are within the normal limits, specific to ruminants. The caloric energy related to the ingested energy is slightly increased in the steers than in buffaloes but the difference is not significant, the weathers having values between the other two species. Comparing the values of caloric energy related to the metabolic weight there were no differences between the 2 species (cattle and buffaloes), the sheep having lower values compared to the large ruminants.

Keywords: *cattle, buffaloes, sheep, energy metabolism, utilization*

Introduction

The problem of providing the caloric energy and the additional heat following feed ingestion is as ancient as Lavoisier and Seguin (cit. after Mac Rue and Lobely, 1980), who observed a higher oxygen consumption in subjects after feed ingestion. Only at the end of the 19^{th} century and the beginning of our century, the German researchers Zuntz and Henegamnn (1898) (cit. after Blaxter, 1980) and Kellner and Kohler (1900) Fingerling (1914)(cit. after Mac Rae and Lobely, 1980) and the American researcher Armsby (1903)(cit. after Blaxter, 1980) started to measure systematically the increase of caloric energy after feed ingestion. These researchers related the caloric energy to 100 units of gross energy administered additionally.

Starting from this idea our purpose was to study comparatively in cattle and buffaloes the loss of caloric energy following the administration of diets with Sudan hay supplemented with different amounts of soybean.

Literature has few data on comparisons between cattle and buffaloes.

Material and method

The experiments used 4 growing buffaloes weighing 400 kg and 4 Holstein-Friesian steers of 500 kg. The animals were castrated and then fistulized ruminally in the beginning of the experiment, using large canula, 12 cm in diameter in order to perform additional determination on the same animals: microbiological analysis, VFA, sugar, protein metabolism and in vitro digestibility.

There were 4 stages of the experiment, similar as development but different as diet structure, each stage having 8 weeks.

The diets consisted on Sudan hay as basal ingredient supplemented either only with barley or soybean meal, or with a mixture of the two, as shown below:

	Sudan hay	Barley	Soybean meal
Diet 1	100	0	0
Diet 2	84	0	14
Diet 2	70	30	0
Diet 4	63	27	10

A premix was added to balance the diets as vitamins and minerals (Burlacu et al., 1996).

During the 4 stages each animal received each of the four diets.

We also conducted determinations of energy metabolism by respiratory exchanges on weathers (4 Palas Merinos weathers weighing in average 56 kg). The animals were assigned to 2 groups and fed diets fully of Sudan grass for the first group and mountain pasture hay for the second group, as follows:

	Sudan grass	Mountain hay
Diet 1	100	0
Diet 2	0	100

The animals were kept in digestibility stalls (large ruminants) and in digestibility cages (small ruminants) allowing feed administration without feed wasting and the collection of feces and urine samples during the periods of balance, which were analyzed chemically and calorimetrically according to Schiemann (1980).

In all species (growing buffaloes, steers and weathers) there were 8 to 10 days of adaptation during which the animals received increasing amounts of feeds and the actual period of 14-21 days during which in vitro digestibility determinations were conducted and samples of feeds and excreta were collected and analyzed.

The feed was given in one meal in the morning at 08.30 for all animals, water was provided at discretion. The animals were weighed in the beginning and end of each weekly balance.

In the weeks for in vitro digestibility the animals were put into respiratory chambers for 24 h, where they received the same diets, in order to determine the energy balance; the respiration quantum (RQ) and the overall heat production were calculated by computer.

Results and discussion

Table 1 shows the chemical composition and the energy content of the feeds.

Table 1 *Chemical composition and calorie content of the diets (average values, g/kg feed, g/kg DM)*

	DM	OM	CP	EE	CF	NFE	Ash	GE (MJ)
Sudan	817	747	61	19	295	373	69	15
hay	1000	915	75	23	361	456	85	18
Barley	874	844	100	20	52	672	30	16
	1000	966	115	23	59	700	34	18
Soybean	876	812	385	24	61	342	64	17
meal	1000	927	440	27	70	399	73	20
Mountain	872	821	66	23	274	458	51	16
hay	1000	941	76	26	314	525	59	18

The average DM intake was 6493 g/day in the growing buffaloes, 6989 g/day in steers and 1111 g/day in weathers (Table 2), which related to the metabolic weight ($kg^{0.75}$) yielded 70.52 g for the buffaloes, 66.73 g in steers and 54.83 g in weathers.

Table 2 *Feed intake in cattle, buffaloes and weathers*

	Animals	Weight	$W^{0.75}$	ingested DM, g/animal/day	ingested DM, kg W	ingested DM, $W^{0.75}$
Diet 1	buffaloes	425	93.60	6490	15.27	69.34
	cattle	526	100.75	7315	13.01	66.65
Diet 2	buffaloes	393	88.20	5955	15.15	67.52
	cattle	535	113.30	7623	14.24	68.49
Diet 3	buffaloes	424	93.40	6954	16.40	74.45
	cattle	525	109.70	7292	13.80	66.47
Diet 4	buffaloes	420	92.86	6572	15.65	70.77
	cattle	531	110.60	7066	13.31	63.89
Diet 1	weathers	57	20.60	1017	18.20	49.75
Diet 2	weathers	56	20.41	1205	22.16	59.90

Organic matter digestibility is shown in Table 3 which shows similar values, 65-70% in cattle and 64-72 in cattle. OM digestibility was 58% (diet 1) and 61% (diet 2) in weathers.

It is generally accepted the theory that buffaloes use better feeds than other ruminants (El Shazly, cit. by Velea *et al.*, 1983), but our investigations did not find differences in digestibility between cattle and buffaloes (Ludri et al., cited by Nicolae, 1993).

Table 3 *Diet digestibility*

	Animals	Weight	% digestibility				
			OM	CP	EE	CF	NFE
Diet 1	buffaloes	425	65	60	60	70	65
	cattle	526	64	58	66	71	66
Diet 2	buffaloes	393	67	72	71	69	70
	cattle	535	69	74	68	73	70
Diet 3	buffaloes	424	66	64	66	64	71
	cattle	525	68	71	67	68	72
Diet 4	buffaloes	420	70	70	71	68	74
	cattle	531	72	72	69	69	73
Diet 1	weathers	57	61	56	53	59	59
Diet 2	weathers	56	58	50	51	62	54

The methane energy and urine energy related to ingested energy had higher values in the buffaloes than in cattle (9.46% compared to 8.88% methane energy, respectively 2.24% compared to 1.92% urine energy). In weathers the energy losses by gas are lower (7%) compared to large ruminants.

The values of caloric energy related to the ingested energy are inverse, being higher in steers (0.41%) compared to buffaloes (0.38%) but the difference is not significant. In weathers the values of caloric energy are in between the values for the other two species (0.40%, Table 4).

Relating the values of energy balance to the metabolic weight we obtained similar values for cattle and buffaloes: 0.48MJ/kg$^{0.75}$ and 0.49 MJ/kg$^{0.75}$, being lower in weathers MJ/kg$^{0.75}$ (Table 5).

Table 4 *Energy balance, average values, MJ/animal/day*

	Animals	Ingested energy	Feces energy	Digest. energy	Urine energy	Methane energy	Metab. energy	Caloric energy	Retained energy
Diet 1	buffaloes	114.35	33.16	75.48	1.87	12.13	68.63	42.17	26.46
	cattle	131.10	35.64	95.67	2.51	13.95	79.22	48.10	31.12
Diet 2	buffaloes	108.18	33.36	82.88	2.81	11.59	68.47	43.78	24.69
	cattle	138.69	34.84	103.85	2.64	12.63	88.61	47.40	41.21
Diet 3	buffaloes	125.05	36.38	88.67	2.72	11.18	74.78	44.18	30.60
	cattle	131.27	36.82	94.46	2.33	11.56	80.56	52.42	28.14
Diet 4	buffaloes	119.47	30.75	88.74	2.33	10.52	75.88	45.79	30.09
	cattle	128.46	35.79	92.66	2.68	11.23	78.75	67.58	11.17
Diet 1	weathers	18.48	8.21	10.36	0.37	1.34	8.75	7.39	1.26
Diet 2	weathers	21.64	9.97	11.69	0.43	1.45	10.36	8.66	1.15

Table 5 *Comparative values of energy balance, MJ/kg*$^{0.75}$

	Animals	$W^{0.75}$	Ingested energy	Feces energy	Digest. energy	Urine energy	Methane energy	Metab. energy	Caloric energy	Retained energy
Diet 1	buffaloes	93.61	1.22	0.35	0.80	0.020	0.13	0.73	0.45	0.28
	cattle	109.75	1.19	0.32	0.87	0.023	0.13	0.72	0.44	0.28
Diet 2	buffaloes	88.20	1.23	0.38	0.94	0.032	0.13	0.78	0.50	0.28
	cattle	111.30	1.25	0.31	0.93	0.024	0.11	0.80	0.43	0.37
Diet 3	buffaloes	93.40	1.34	0.39	0.95	0.029	0.12	0.80	0.47	0.33
	cattle	109.70	1.20	0.34	0.86	0.021	0.11	0.73	0.48	0.25
Diet 4	buffaloes	92.86	1.28	0.33	0.96	0.025	0.11	0.82	0.49	0.33
	cattle	110.60	1.16	0.32	0.84	0.024	0.10	0.72	0.61	0.11
Diet 1	weathers	20.60	0.90	0.40	0.51	0.018	0.07	0.42	0.36	0.06
Diet 2	weathers	20.41	1.06	0.49	0.58	0.021	0.07	0.49	0.43	0.06

Conclusions

Under the same experimental conditions the average dry matter intake/kg$^{0.75}$ was higher by 4.25 g in buffaloes than in cattle, the weathers having lower intakes than the large ruminants.

Although widely accepted the idea that buffaloes use better the feed than the cattle, our investigations did not observe such a situation.

The loss of energy by urine and methane are within the normal limits, specific to ruminants.

The caloric energy related to the ingested energy is slightly increased in the steers than in buffaloes but the difference is not significant, the weathers having values between the other two species.

Comparing the values of caloric energy related to the metabolic weight there were no differences between the 2 species (cattle and buffaloes), the sheep having lower values compared to the large ruminants.

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