BODY COMPOSITION CHANGES IN CROSSBRED COWS AND MURRAH BUFFALOES DURING LACTATION

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Summary

Six lactating crossbred cows and six Murrah buffaloes, maintained under similar conditions of feeding and management were studied for body composition by the antipyrine dilution technique. Measurements were made at the start of the experiment when the animals had completed about 50 days in lactation and thereafter at monthly intervals up to 90 days of the experimental period. The percent body water estimates in both species at different time intervals did not change significantly. Percent body fat and protein content also remained unchanged.

The correlation coefficient between body composition parameters and various hormones (growth hormone, insulin, T_3 and T_4) were generally low and non-significant. It was concluded that body composition studies using body water are not sufficiently sensitive to predict changes in body composition of lactating cows and buffaloes and/or the changes in body composition during lactation are not very drastic.

(**Key Words**: Body Composition, Crossbred Cows, Murrah Buffaloes, Antipyrine Dilution Technique)

Introduction

It is widely accepted that high producing dairy cows mobilize considerable amounts of tissue to meet the energy demands of pregnancy and lactation. However, direct experimental evidence in this regard is scanty. The comparative slaughter technique has been the basis for most studies of body composition of farm animals. Slaughter studies have shown that empty body water is related to and can be used to predict both empty body protein and empty body mineral and that fat is predicted reliably from total body water and live weight (Martin and Ehle, 1986). However, the slaughter technique is expensive, lethal and time consuming.

Several isotopic and non isotopic methods are currently in use. Isotopic methods have been discounted in cows because of body and milk contamination and the costs involved. The urea dilution technique has been discounted because urea is metabolizable (Bartle et al., 1983). Antipyrine dilution is a method of choice but has not been much used in determining the body composition of lactating animals.

Few studies of body composition of lactating animals have been reported in literature (Cowan et al., 1979; Degan and Young, 1980) and no studies on body composition of lactating crossbred cows and Murrah buffaloes are to be found in the literature. Therefore the present investigation was carried out to study the body composition changes of lactating animals.

Materials and Methods

Twelve lactating animals comprising 6 Karan Swiss (KS) crosses between Brown Swiss bulls and indigenous cows (Having 50:50 blood level) and six Murrah buffaloes in their second and third lactation were selected from the institute herd. At the start of the experiment the cows had completed on average 51 days lactation and were yielding an average of 15.1 kg milk a day. The buffaloes had completed 53 days in lactation and were yielding an average of 11.6 kg milk a day. The experiments were started during the month of November 1986 and continued up to 90 days. The average daily milk yield and composition is given in table 1 and 2.

At the end of the experiment one cow and one buffalo were 117 and 106 days pregnant, respectively. All the animals were housed in a

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Dutch Barn type shed with open sides. They were stall fed on a balanced ration of concentrate mixture and green maize (*Zea mays*) fodder. The amount of concentrate mixture was based on milk production of individual animals. The roughage offered to individuals, however, was 10% higher than the *ad lib.* consumption. Twenty four hours allowance of concentrate mixture for individual animals was divided into three portions and was quantitatively fed at the time of morning, noon and evening milkings. During the course of the experiment a record of the daily amount of feed consumed and milk produced by individual animals was maintained. The cows were hand milked three times a day, whereas buffaloes were milked twice daily.

TABLE 1. AVERAGE DAILY MILK YIELD (kg / day) DURING DIFFERENT FORTNIGHTS

Fortnight	Cow	Buffalo
1	14.07 ± 0.78	11.47 ± 0.38
2	13.40 ± 1.02	11.09 ± 0.47
3	13.52 ± 0.78	10.52 ± 0.54
4	12.87 ± 0.97	10.00 ± 0.56
5	11.45 ± 0.77	9.72 ± 0.66
6	11.46 ± 0.60	8.96 ± 0.66
Average	12.80 ± 0.39	10.30 ± 0.27
C.D.[1]	0.78	0.75

[1] *Critical difference.*

TABLE 2. COMPOSITION OF MILK (g / 100 g) DURING DIFFERENT FORTNIGHTS

Attribute	Species	
	Cow	Buffalo
Fortnight	Fat	
1	4.02 ± 0.16	6.82 ± 0.59
2	4.27 ± 0.17	6.55 ± 0.63
3	4.33 ± 0.34	7.03 ± 0.70
4	4.47 ± 0.24	6.97 ± 0.56
5	4.28 ± 0.21	7.08 ± 0.56
6	4.22 ± 0.26	7.35 ± 0.59
Average	4.26 ± 0.09	6.98 ± 0.23
	Protein	
1	3.15 ± 0.13	4.53 ± 0.13
2	3.38 ± 0.14	4.52 ± 0.16
3	3.92 ± 0.13	4.55 ± 0.19
4	3.85 ± 0.15	4.62 ± 0.17
5	4.14 ± 0.18	4.93 ± 0.40
6	4.03 ± 0.16	4.95 ± 0.45
Average	3.74 ± 0.08	4.68 ± 0.11
C.D.[1]	0.27	—
	Lactose	
1	5.03 ± 0.05	5.04 ± 0.07
2	4.97 ± 0.07	5.12 ± 0.06
3	4.97 ± 0.06	5.07 ± 0.07
4	4.80 ± 0.04	5.15 ± 0.09
5	4.92 ± 0.09	5.12 ± 0.10
6	4.95 ± 0.08	5.05 ± 0.09
Average	4.94 ± 0.03	5.08 ± 0.03

[1] Critical difference.

Body composition of the experimental animals was determined before the start of the experiment and then at monthly intervals using the antipyrine dilution technique. On the day of sampling at 08:00 a.m., solution containing 0.30 g of antipyrine/ml was injected. The quantity of the solution injected into the jugular vein depended upon the size of the animal. Blood was drawn at 02:30, 03:30, 04:30 and 05:30 hours after the injection. Before the injection of antipyrine an initial blood sample from each individual animal was collected which served as blank. For the analysis of antipyrine in blood and calculation of body water the method described by Wellington et al. (1956) was adopted. From the total body water data, body composition was calculated using the formula given by Reid et al. (1963). Estimation of various hormones (Growth hormone, insulin, triiodothyronine (T_3) and thyroxine (T_4), were carried out as detailed (Jindal & Ludri, 1990a,b, 1991).

Statistical analysis of data was carried out according to Snedecor and Cochran (1980). The correlation coefficients were calculated between the monthly average (average of 8 sampling during two fortnights) of hormone levels from 6 cows (buffaloes) and body composition values determined at 30, 60 & 90 days after the start of experiment from 6 cows & 6 buffaloes.

Results and Discussion

Data on the water, fat and protein content of the body at the start of experiment and thereafter at 30 day intervals have been presented in table 3. In both species there was a significant between animal variability in all the three para-

meters studied. The variability was greater in buffaloes. ($p < 0.01$) as compared to the cows ($p < 0.05$). Percent both water estimates in both the species at different time intervals did not significantly change. Similarly the percent body fat and protein content also remained unchanged.

TABLE 3. BODY WATER, FAT AND PROTEIN CONTENT DURING DIFFERENT EXPERIMENTAL PERIODS

Attribute	Species	
	Cow	Buffalo
	Body water (%)	
At the start of experiment	65.25 ± 2.92	64.89 ± 3.61
After 30 days of experiment	65.20 + 1.40	65.55 + 3.53
After 60 days of experiment	68.61 ± 2.67	66.90 ± 3.04
After 90 days of experiment	63.64 ± 2.44	64.95 ± 3.56
	Body fat (%)	
At the start of experiment	11.36 ± 2.85	12.06 ± 3.76
After 30 days of experiment	11.01 ± 1.41	11.36 ± 3.69
After 60 days of experiment	8.01 ± 2.52	9.81 ± 3.18
After 90 days of experiment	12.84 ± 2.38	11.98 + 3.78
	Body protein (kg)	
At the start of experiment	18.45 ± 0.85	18.35 ± 1.05
After 30 days of experiment	18.45 + 0.41	18.54 ± 1.02
After 60 days of experiment	19.44 ± 0.77	18.94 ± 0.88
After 90 days of experiment	17.99 ± 0.70	18.37 ± 1.03

Correlation between hormones and percent body composition

The absolute values of growth hormone, insulin, thyroxine and triiodothyronine are already published (Jindal and Ludri, 1990a,b & 1991). Values of 'r' between body water, body fat, body protein and various hormones at 30, 60 and 90 days of the experiment have been presented in table 4. In cows the relationship of body water with insulin, T_3 and T_4 was positive and significant. The extent of relationship with T_3, insulin and T_4 was statistically significant 10, 5 and 1 percent levels of significance respectively. The value of 'r' between body water and GH (−0.03) was very low. The relationship between body fat and T_4 was negative (−0.58) and significant ($p < 0.05$). The relationship of body fat with GH was positive (0.13), whereas, with insulin (0.32) and T_3 (−0.38) it was negative but all the three values were statistically non-significant. Body protein was negatively correlated with growth hormone and positively with insulin but none of the 'r' values were statistically significant. The value of 'r' between body protein and T_3 (0.40) and between body protein and T_4 (0.59) were significant at 10 and 1 percent levels of significance respectively, indicating that higher T_3 & T_4 values correlated with higher body protein in cows.

TABLE 4. CORRELATION COEFFICIENT (r)[1] BETWEEN HORMONES AND PERCENT BODY COMPOSITION

Attributes	Value of 'r'	
	Cow	Buffalo
Body water : GH	−0.03	−0.11
Body water : Insulin	0.52**	−0.11
Body water : T_3	0.40*	0.22
Body water : T_4	0.59***	0.07
Body fat : GH	0.13	0.11
Body fat : Insulin	−0.32	0.10
Body fat : T_3	0.38	−0.22
Body fat : T_4	−0.58**	0.11
Body protein : GH	−0.16	−0.11
Body protein : Insulin	0.33	−0.11
Body protein : T_3	0.40*	0.22
Body protein : T_4	0.59***	0.07

[1] Each value is based on 18 observations.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In buffaloes, the values of 't' were low and were not statistically significant. It is therefore concluded that body composition studies using body water are not sufficiently sensitive to predict changes in body composition of lactating cows and buffaloes and/or the changes in body composition during lactation are not too great enough. The animals were apparently in positive energy balance as is evident from the body weight of the animals at different time intervals (table 5). None of the animals lost weight during the experiemtnal period. It seems, therefore, that animals if properly fed, may not mobilize body stores to a great extent and derive most of nutrients for milk synthesis from digestion and absorption of the offered nutrients. It may also be noted that the animals used in the experiment were relatively high yielders taking into consideration the tropical climate.

TABLE 5. BODY WEIGHT (kg) DURING DIFFERENT EXPERIMENTAL PERIODS

Attribute	Species	
	Cow	Buffalo
At the start of experiment	406.33 ± 11.85	546.66 ± 14.18
After 30 days of experiment	410.16 ± 12.51	539.33 + 17.11
After 60 days of experiment	417.16 ± 13.01	542.00 ± 17.11
After 90 days of experiment	414.33 ± 12.00	546.33 ± 20.34
C.D.[1]	8.53	–

Analysis of variance

Source of variation	d.f.	Mean sum of squares	
		Cow	Buffalo
Between animals	5	4,250.86**	8,768.56**
Between periods	3	136.26*	75.27
Residual	15	48.05	172.93
Value of 't'		45.41**	

* $p < 0.05$, ** $p < 0.01$.
[1] Critical difference.

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