EFFECTS OF BODY WEIGHT AND BODY CONDITION CHANGES AFTER PARTURITION ON REPRODUCTIVE PERFORMANCE OF SAHIWAL AND FRIESIAN CATTLE

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ABSTRACT

Nutrition and other environmental factors have a profound influence on performance of domestic female ruminants after parturition. These cows are typically in a state of negative energy balance, because energy required for milk production and maintenance of body function exceeds energy ingested. This attribute is reflected by changes in body weight and condition after calving and may influence resumption of ovarian activity. The objective of this study was to asses weight and body condition changes after parturition and their influence on reproductive performance of Sahiwal and Friesian lactating cattle. Forty in-calf cows comprising 20 Friesians and Sahiwals were selected and upon calving were observed for 24 weeks postpartum. Parameters recorded included weekly live weight and body condition scores postpartum while reproductive attributes recorded included days to commencement of luteal activity, and insemination. Data was analyzed using GLM of SAS. There were breed differences in weight of cows at the start of the experiment with Friesians being heavier than Sahiwals. It was observed that Friesians lost 31.2 Kg from calving to commencement of luteal activity which occurred 68 days *postpartum* and improved from this loss to register a deficit of only 11.3 kg at insemination which occurred 98 days after calving while the Sahiwals lost a mean of 27 kg after 42 days *postpartum* at commencement of luteal activity and a further 8 kg to insemination occurring 73 days after calving. The mean body weight loss for Friesians from calving to commencement of luteal activity was 0.45 kg per day while that of the Sahiwals was 0.64 kg per day. This weight loss in relation to that at calving was 6 and 7% for Friesians and Sahiwals respectively. The mean loss in body condition for the two breeds shows that Sahiwals lost greater body condition at the two points than the Friesians. However, they got into reproduction earlier than the Friesians which had better recovery rates from weight and body condition depression *postpartum*. This shows that Friesians lose weight rapidly and quickly recover at time of insemination while the weight loss for the Sahiwals is gradual and takes longer to recover and is a reflection of how the two breeds adapt to negative energy balance after parturition. Friesians showed weight recovery after 15 weeks *postpartum* and this is when insemination occurred, while the nadir of weight depression occurred between weeks 5and 7 *postpartum* and this coincided with peak milk production. In both breeds insemination occurred 4 weeks after commencement of luteal activities. The Sahiwal depression was gradual and the recovery trends were not so clear-cut. The mean body weight at calving for Friesians inseminated and calved was 427kg compared to those that didn't calve averaging 451kg while Sahiwals that calved had a mean weight of 381kg compared to those that didn't averaging 389kg. An indication that heavier cows in both breeds had difficulty in conception. There was a positive association between body weight and condition scores postpartum in Sahiwals while Friesians exhibited a negative association, this is due to the differences in heamorhesis for the two breeds.

INTRODUCTION

Energy intake of high yielding cows postpartum has been found to be less than half the energy required for production (Van Arendonk *et al*., 1991), the shortfall must be met through mobilization of body tissue, thus appreciable bodyweight loss is inevitable.

There have been several studies on nutritional influence on body condition (BC) and its relationship to fertility. These included 'flushing' before mating to improve fertility and onset of puberty in heifers based on body size rather than age. In cycling heifers, severe restriction in energy intake can induce nutritional anoestrus when body

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weight decreases by 15% (Rhodes *et al*., 1996). This is through the effects on morphological and functional parameters of follicle development such as size, growth rate and steroidogenic activity of the dominant follicles, however, the mechanisms of these effects are not well understood (Rhodes *et al*., 1996). In postpartum dairy cows, extent of negative energy balance and diets with different energy contents has significant impact on population of ovarian follicles and functional competence of the dominant follicle (Gong, 2002).

Loss of BC at time of AI may negatively influence conception, because cows with body condition scores (BCS) of less than 3 at calving were less likely to be inseminated and BCS loss between calving and 45 days in milk was associated with more days open and delayed intervals to 1st insemination (Domecq *et al*., 1999; Santos, *et al*., 2009). The BCS of cows at the end of lactation should be 3.25 – 3.75 (Studer, 1998). Energy balance during the dry period and early lactation as monitored by BCS is a better indicator of conception at 1st service than other risk factors and regular body condition scoring of cows has been recommended as a means to evaluate the relative degree of energy balance (Heuer *et al.,* 1999).

There is a relationship between BCS and cows cycling by end of the elective waiting period. The levels and changes of BCS during the lactation period could affect the resumption of estrus cycle and reproductive success and is indicative of the metabolic status necessary to support production and resumption of cyclicity (Pryce *et al*., 2001; Santos, et al., 2009).

As genetic merit for production increases, so does mobilization of body reserves creating a larger negative energy balance during early lactation. BCS has a negative genetic correlation with calving intervals of -0.40 and can be used for selection of fertility, with thinner cows, or cows in more negative energy balance, tending to have poorer fertility (Pryce *et al.,* 2000). The greatest change in BCS seams to be from calving to week 12 post calving (Pryce *et al*., 2001). The objective of the study was to asses live weight and body condition score changes after parturition on the reproductive performance of Sahiwal and Friesian lactating cattle.

MATERIALS AND METHODS

Forty multiparous cows from two research station herds comprising 20 Friesians and 20 Sahiwal cows were selected based on relative weight within breed, parity (between three and five) and pregnancy status. The cows were two months to parturition at the beginning of the experiment. They were grazed together on pasture leys of predominantly Rhodes grass and upon calving they were supplemented with concentrates based on their milk production ranging from one to four kg fed twice daily. The cows were observed from the time of calving up to 24 weeks (6 months) postpartum for estrus, bodyweight at commencement of luteal activity (Wgtlac) and Insemination (Wgtins) and their changes (Wgt1 and Wgt2) were observed respectively. Similarly body condition scores at calving (Cowbn), at commencement of luteal activity (Bclac) and insemination (Bcins) and their respective changes (Bccan1and Bccan2) were recorded during this time period.

After parturition, body condition scores were determined by the same technician and live weight of the cows was measured using a weighing bridge every two week. The calf was allowed to suckle for one week after which it was withdrawn; hand milking was done twice daily. Cow parameters recorded included date of calving, age and weight at calving, breed, and daily milk yield (summed for the week).

The cows were then observed for behavioral signs of estrus and served using artificial insemination (AI) by two AI practitioners using locally processed Friesian or Sahiwal semen. Cows observed on heat in the morning were served in the afternoon while those exhibiting heat in the later part of the afternoon were served the following morning. The cows were inseminated up to four times, after which they were considered open.

Reproductive data included: days from calving to beginning of luteal activity (Dlac) as determined by progesterone profiles (≥ 3ng/ml) and days to first service (Dins). After insemination, the cows were monitored for return to heat. Pregnancy diagnosis was done by rectal palpation 90 days after insemination and confirmed by progesterone profiles. Conception rates were determined as the proportion of cows bred that became pregnant after AI. Blood samples were collected bi-weekly (20 ml) from each cow for 6 months after calving via jugular venipuncture using tubes containing ethylenediaminetetra-acetate (EDTA) at the rate of 1.8 mg/ml as an anticoagulant for plasma collection. Samples were centrifuged for 15 min at 1 600 rev/min to separate the plasma from the solid blood

components. The plasma was then pippetted into 2 ml plastic vials and stored at -20°C after which progesterone was determined using radioimmunoassay with ^{125}Iodine as the tracer (FAO/IAEA, 1999).

The data were analyzed using the SAS program package release 8.2 (SAS, 2001). Analysis of variance was performed using the GLM procedure of SAS. Differences were considered to be significant if P≤0.05. Data are presented as means ± SEM. Third degree polynomials were fitted onto body weight and condition scores by week to determine trends of their changes overtime.

Pearson's correlations were derived *postpartum* for cow body weights and condition scores and their changes at calving, commencement of luteal activity and at insemination to determine the association between these variables and their relative change as lactation progressed.

RESULTS AND DISCUSSIONS

It was observed that from calving the Sahiwal cow's lost weight and body condition as indicated in Figure 1 and 2 below. The depression in body condition continues until a nadir in week 7 postpartum (Figure 1) and then began to recover until week 16 *postpartum* when it recovered from the effects of parturition and lactation. However, body weight (Figure 2) continued to drop past 25 weeks *postpartum*, this is strange considering that they may not be producing too much milk to compromise recovery from parturition and lactation. It would appear that body condition changes for Sahiwal were not in tandem with weight changes in this experiment. Cows in early lactation are unable to ingest enough feed to provide nutrients for increased milk production and maintenance of body weight and condition, thus resulting in loss of weight and condition. These findings are similar to those of Okantah, *et al*., (2005) who found body weight and condition losses in Sanga cattle during early lactation leading to extended anoestrus and is a reflection of negative energy balance (Roche, *et al*., 2007).

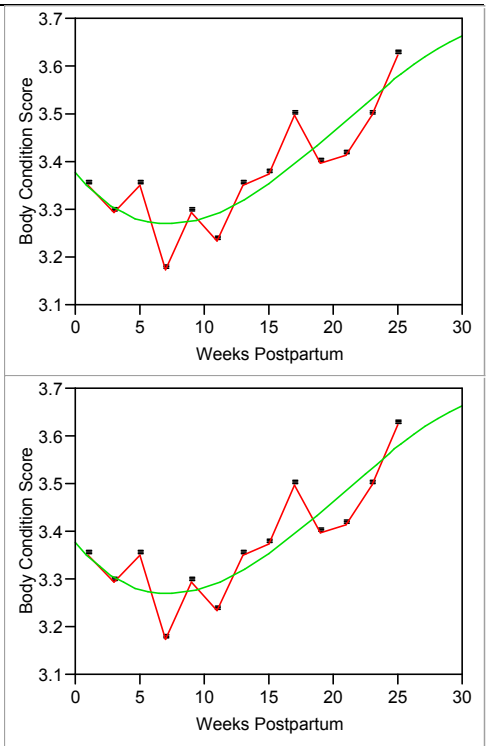

Figure 1. *Postpartum* BCS for Sahiwal Cows

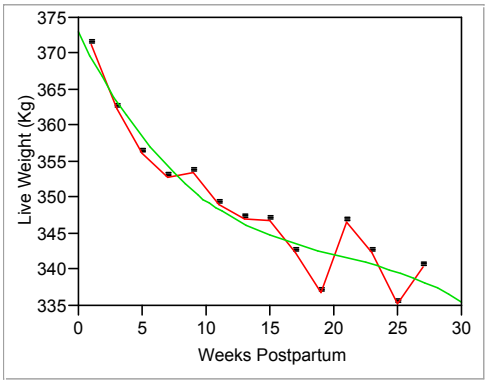

Figure 2. *Postpartum* Weights for Sahiwal Cows

Compared to Friesians the BCS and weight patterns were similar with both nadirs occurring at week 6 and coincided with peak milk production. Full recovery was realized at week 15 *postpartum* for both measures (Figure 3 and 4). However, as the recovery phase progressed luteal activity commenced at week 10 followed by ovulation at week 14 *postpartum* leading to insemination. This could be attributed to the reduced nutritional demands for lactation as lactation persistence progressed, thus availing the ingested nutrients to be channeled for resumption of cyclicity. This is similar to the findings of Chagas, *et al*., (2007) who reported a nadir for BCS, 50 days *postpartum* in Friesian cattle but at divergence with that reported by Obese, *et al.,* (1999) who found that only 60% of Sanga cattle get into ovulation by day 120 *postpartum* and could be attributed to the feeding regime for these cows which were fed on pasture alone as compared to the cows in this experiment which were supplemented. This is because of the increased nutrient requirements to support lactation which may not be met by sufficient nutrient intake, therefore causing mobilization of stored body fat reserves as reflected by the depression of body weight and condition.

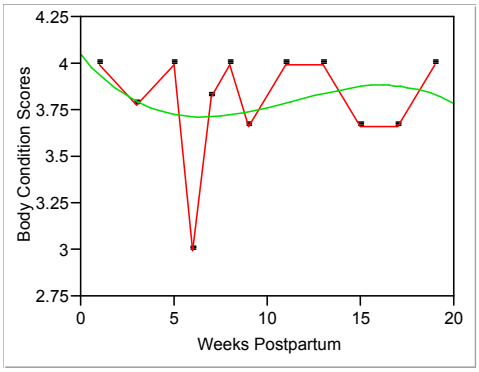

Figure 3. *Postpartum* BCS for Friesian Cows

This shows that Friesians bodyweight and body condition changes are highly related unlike those of the Sahiwals which behave to the contrary (Figure 2). It could be postulated that the body condition scores of Friesians and Sahiwals are better indicators of metabolic status compared to body weight (Obese, *et al.,* 1999).

It was further observed that Friesians lost a mean of 31.2 Kg (Table 1) from calving to commencement of luteal activity after 68 days (10 weeks)

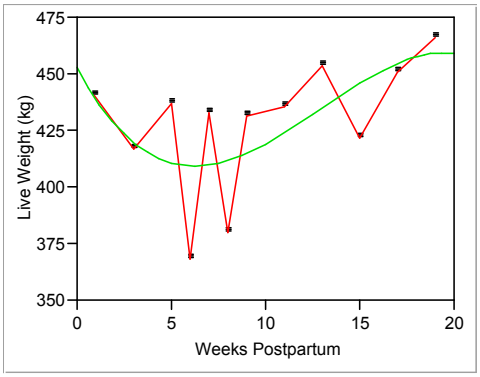

Figure 4. *Postpartum* Weights for Friesian Cows

and improved from this loss to register a deficit of only 11.3 kg at insemination which occurred 98 days (14 weeks) after calving while the Sahiwals lost a mean of 26.8 kg after 42 days (6 weeks) *postpartum* and a further 8 kg to insemination occurring 73 days (10 weeks) after calving (Table 1). The mean body weight loss for Friesians from calving to commencement of luteal activity was 0.45 kg per day while that of Sahiwals was 0.64 kg per day. This weight loss as a proportion of weight at calving was 6% and 7% for Friesians and Sahiwals respectively. However, at insemination the weight loss for Friesians reduced to 1.8% while for the Sahiwals increased to 8%. The mean weight loss *postpartum* averaged 0.53kg per day for both breeds. These findings are similar to those reported by Gutierrez, *et al*., (2006) who reported a weight change of 0.56kg per day after parturition for Friesian cattle.

The mean loss in body condition for the two breeds shows that Sahiwals lost greater body condition at the two points than the Friesians (Table 1). However, they got into reproduction earlier by showing commencement of luteal activity at 6 weeks with subsequent insemination at 10 weeks postpartum compared to Friesians which showed commencement of luteal activity at 10 weeks with inseminations occurring at 14 weeks postpartum despite having better recovery rates from weight and body condition depression *postpartum* relative to the Sahiwals. The resumption of ovarian activities in both breeds is much earlier than that reported by Obbesse, *et al*., (1999) who found an interval of 101.3 days in Sanga cattle in Ghana. It was further observed that ovulation occurred 4

TABLE I- WEIGHT AND BCS CHANGES TO COMMENCEMENT OF LUTEAL ACTIVITY AND INSEMINATION

Breed	Change in BC at Start of Luteal Activity	Change in BC at Insemination	Change in Weight at Start of Luteal Activity (kg)	Change in Weight at Insemination (Kg)
Friesian	-0.33 (68)	-0.4 (98)	-31.2	-11.43
Sahiwal	-0.19 (42)	-0.47 (73)	-26.8	-34.93
All	-0.26	-0.43	-28.9	-23.2

**Numbers in Parenthesis are days to event*

weeks after commencement of luteal activity in both breeds. This is an indication that body condition scores and weight changes during early lactation affect the resumption of luteal activity and thereafter the ovarian cycle proceeds normally. It can be concluded that body condition scores as indicators of metabolic status influence the resumption of luteal activity differently in the two breeds. These findings are similar to those found by Banos *et al*., (2006) who showed a cumulative energy balance decreases up to week 7 postpartum and increased thereafter. However, energy stores during gestation, calving and early lactation affect the length of *postpartum* anoestrus interval and the likelihood of a successful pregnancy (Roche *et al*., 2007).

TABLE II- MEAN±SD OF DAYS TO COMMENCEMENT OF LUTEAL ACTIVITY AND INSEMINATION OF COWS

Non Calving	Breed	N	Dlac*	Dins*	Bcon*	Weight
Non	F	10	74.8±10.6[a]	121.5±40.9[a]	3.8±0.4	451.4±54.9[a]
Non	S	9	42.0±6.6[b]	75.7±18.8[b]	3.6±0.5	389.5±26.2[b]
All		19	58.4±7.2	96.8±21.5	3.7±0.5	422.1±53.1
Calved						
Yes	F	6	57.4±8.8[a]	70.6±28.2[a]	4.5±0.6[a]	427.3±31.7[a]
Yes	S	8	43.1±9.6[b]	70.4±13.5[a]	3.25±0.5[b]	381.5±21.3[b]
All		14	49.1±6.8	70.5±13.4	3.7±0.8	401±34.3

*Superscript within column per category show significant differences p<0.05**Dlac
Days to commencement of luteal activity postpartum
*Dins Days to insemination
*Bcon Body condition scores

The Sahiwal body weight depression was gradual and the recovery trends were not so clear-cut as compared to the Friesians. These trends for weight are contrary to those of mean body condition scores which were depressed up to week 6 *postpartum* before full recovery by week 15 and ovulation occurred by week 10 postpartum.

When the cows were categorized according to calving status it was observed that the mean body weight for Friesians that conceived and calved was 427±31.7 kg and took 57 days to initiate luteal activity and showed estrus for insemination averaging 71 days *postpartum* compared to those that didn't calve which averaged 451.4±54.9 kg and initiated luteal activity74 days *postpartum* and ovulation was observed 121 days after parturition (Table 2). The trends for Sahiwals showed that those calving had a mean weight of 381.5±21.3 kg which is less than those that didn't calve which averaged 389.5±26.2 kg indicating that relatively lighter cows conceived better than their heavier counterparts. This shows that weight at insemination similarly influences conception in both breeds with heavier cows having difficulty in conception.

There was a significant negative association between weight at calving and body weight changes at commencement of luteal activity and insemination in both breeds, with Friesians exhibiting higher values (Table 3 and 4). This is an indication that weight at calving will influence the degree of weight loss post parturition with heavier cows having to shade more weight than lighter cows

because of readily available adipose tissue that can be mobilized and channeled for milk production. This is in agreement with the findings of Garnsworthy, (2007), who found that heavier cows tend to lose more weight than lighter cows *postpartum.*

lactation progresses while Sahiwals do not change condition with progression in lactation.

There was a strong positive association between body condition scores at calving and at commencement of luteal activity in both breeds (r^2=85) and this relationship is extended to time of

TABLE III - CORRELATIONS WEIGHT AND BODY CONDITION MEASUREMENTS POSTPARTUM FOR SAHIWALS

	Wgt	WgtLac	Wgt2	WgtIns	Wgt3	CowBn	Bclac	BCCan1	Bcins	BCCan2
Wgt	1.00	0.93	-0.22	-0.27	-0.83	0.34	0.44	0.13	0.14	-0.19
WgtLac		1.00	0.15	-0.24	-0.76	0.45	0.53	0.09	0.28	-0.19
Wgt2			1.00	0.09	0.20	0.28	0.23	-0.11	0.35	0.02
WgtIns				1.00	0.77	-0.18	-0.35	-0.27	-0.07	0.10
Wgt3					1.00	-0.34	-0.49	-0.25	-0.14	0.19
CowBn						1.00	0.84	-0.36	0.29	-0.66
Bclac							1.00	0.21	0.41	-0.43
BCCan1								1.00	0.17	0.45
Bcins									1.00	0.52
BCCan2										1.00

Body weight at calving was also positively associated with cow body condition and the changes in condition observed postpartum for Sahiwals (Table 3), however, these observations were contrary for the Friesians (Table 4). This was an indication that heavier cows tend to lose less condition in early lactation for Sahiwals, while heavier Friesians lose more condition *postpartum* by availing more adipose for mobilization for milk synthesis. Thus there are breed differences between associations of body weight and condition because of the differences on nutrient partitioning (Collard, *et al*., 2000)

In general, the association between body weight and change in condition scores *postpartum* decreases as lactation progresses in Sahiwals (Table 3), while that of Friesians increases with advancement of lactation (Table 4), this could be due to breed differences in heamorhesis with Friesian condition being more associated with milk production as

insemination (Table 3 and 4). This shows that cows in good body condition at calving will have relatively good condition at commencement of luteal activity and insemination and vice versa i.e. they lose condition proportionate to that at calving. This type of association tends to mitigate the effects of negative energy balance *postpartum* and is conducive in promoting early conception. This agrees with the findings of Garnsworthy, (2007) who found a correlation of r^2=0.82 and is influenced by genetic merit.

However, the association for body condition score at calving and subsequent changes at commencement of lutaeal activity and insemination are highly negative in both breeds (Table 3 and 4). This is an indication that the rate of loss in condition increases for cows calving in good condition relative to those in poor body condition (Garnsworthy, 2007).

TABLE IV- CORRELATIONS WEIGHT AND BODY CONDITION MEASUREMENTS POSTPARTUM FOR FRIESIANS

	Wgt	WgtLac	Wgt2	WgtIns	Wgt3	CowBn	Bclac	BCCan1	Bcins	BCCan2
Wgt	1.00	-0.31	-0.82	-0.06	-0.76	-0.55	-0.71	-0.10	-0.30	0.54
WgtLac		1.00	0.79	0.67	0.66	0.13	0.23	0.11	0.65	0.45
Wgt2			1.00	0.44	0.88	0.43	0.59	0.13	0.58	-0.08
WgtIns				1.00	0.70	0.39	0.55	0.13	0.80	0.20
Wgt3					1.00	0.65	0.87	0.16	0.74	-0.26
CowBn						1.00	0.85	-0.53	0.76	-0.76
Bclac							1.00	0.00	0.65	-0.65
BCCan1								1.00	-0.41	0.41
Bcins									1.00	-0.17
BCCan2										1.00

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