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EFFECT OF FEEDING LEVELS ON BODY WEIGHT CHANGES, MILK PRODUCTION AND CALVING-CONCEPTION INTERVAL OF DAIRY COWS UNDER TROPICAL CONDITIONS

Efecto del nivel de alimentación sobre los cambios de peso, producción de leche e intervalo parto-concepción en vacas lecheras bajo condiciones tropicales

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ABSTRACT

To determine the effect of low (L), medium (M) and high (H) feeding levels on body weight (BW) changes, milk production and calving-conception interval, a total of 108 dairy cows, 54 Brown Swiss (BS) and 54 Holstein (HF) were divided each in two groups according to their parturition condition, primiparous (PP) and multiparous (MP) and assigned to three experimental diets, individually provided. Rations consisted of a combination of green chopped forage (*Sorghum vulgare*), with 6.4% crude protein (CP) and 49% total digestible nutrients (TDN), and a supplement containing 18% CP and 75% TDN, to obtain diets approximately similar to 80 (L), 100 (M) and 120% (H) of the 1989 Nation Research Council (NRC) nutrient requirements. The experiment was carried out during 8 weeks prior calving and 22 weeks post-partum, in a 2x2x2x3 factorial arrangement. Breed (HF and BS) were considered to be the main plot and parturition conditions (PP and MP), feeding periods (pre- and post-partum periods), and diets (L, M and H feeding levels) were respectively assigned to a split-split-split plot arrangements. Rations were adjusted weekly according to body weights (BW) and milk production. Prior calving, BW of MP and PP were 539 ± 18.3 and 489 ± 15.2 kg, respectively. During post-partum MP and PP lost 3.8 ± 0.48 and 4.9 ± 0.66% BW ($P<0.05$). Multiparous cows produced more milk ($P<0.05$) than PP (11.3 ± 1.4 vs. 10.5 ± 1.4 kg) and HF more ($P<0.05$) than BS (12.2 ± 1.5 vs. 9.6 ± 0.59 kg). Pre- and post-partum feeding regimes influenced ($P<0.05$) milk production, averaging 10.5 and 9.8, 11.0 and 11.2 and 11.2 and 11.7 kg/day, respectively for feeding periods and L, M and H feeding levels. Multiparous cows had a daily intake of 5.2 ± 1.4 kg concentrate and PP 4.9 ± 1.6 kg. Significant regressions ($P<0.05$) of concentrate intake vs milk production were: $y= 6.735 + 0.878x$ and $y= 8.125 + 0.484x$, respectively for MP and PP. Cows were also influenced by breed, being the effect greater ($P<0.05$) in HF than in BS. Time intervals between calving and conception independently of feeding regimes, indicate that BS animals had a shorter intervals than HF (162.1 vs 197.5 days) and MP performed better ($P<0.05$) than PP (197.5 vs 262.6 days). Nutritional levels also affected calving to conception interval. This value was particularly improved in HF breed. It is concluded that feeding level during pre- and post-calving periods influences milk production, weights and calving-conception interval.

Key words: Holstein, Brown Swiss, feeding levels, age, milk, weight changes, calving-conception interval.

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RESUMEN

Para determinar el efecto de tres niveles de alimentación, bajo (B), medio (M) y alto (A), sobre los cambios de peso, producción de leche e intervalo parto-concepción, 108 vacas lecheras (VL), 54 Pardos Suizas (PS) y 54 Holstein (HF) fueron divididas en dos grupos de acuerdo al número de partos en primíparas (PP) y multíparas (MP), las cuales fueron asignadas a tres dietas experimentales. Las dietas estaban constituidas por forraje verde picado (*Sorghum vulgare*) y un suplemento, con 18% proteína cruda (PC) y 75% nutrientes digestibles totales (NDT), calculado para obtener aproximadamente el equivalente al 80 (B), 100 (M) y 120% (A) de los requerimientos nutricionales de la National Research Council (NRC) de 1989. El experimento fue realizado durante 8 semanas antes y 22 semanas después del parto, en un diseño de parcelas divididas con arreglo factorial 2x2x2x3, con raza (HF y PS) como la parcela principal, condición de parto (PP y MP), período de alimentación (pre y post-parto) y nivel de alimentación (B, M y A), como las subparcelas, respectivamente. Las dietas fueron ajustadas semanalmente de acuerdo a los cambios de peso y a la producción de leche. Antes del parto, los pesos de las MP y PP fueron de 539 ± 18,3 kg y 489 ± 15,2 kg, respectivamente. Durante el periodo de post-parto las MP y las PP perdieron 3,8 ± 0,48 y 4,9 ± 0,66% del peso inicial, respectivamente. Las MP produjeron más leche (P<0,05) que las PP (11,3 ± 1,34 vs 10,5 ± 1,4 kg) y las HF mas (P<0,05) que las PS (12,2 ± 1,5 vs 9,6 ± 0,59 kg). La alimentación pre y post-parto influenció la producción de leche (P<0,05), promediando 10,5 y 9,8; 11,0 y 11,2 y 11,2 y 11,7 kg/día, respectivamente para los dos periodos y niveles B, M y A de alimentación, respectivamente. Las MP tuvieron un consumo diario de 5,2 ± 1,4 kg de concentrado y las PP 4,9 ± 1,6 kg. Se encontraron regresiones significativas (P<0,05) entre consumo de concentrado y producción de leche, que se describen por y = 6,735 + 0,878x; y y= 8,125 + 0,484x, respectivamente para MP y PP, siendo "x" el nivel de concentrado e "y" la producción de leche en kg. El intervalo parto–concepción, independientemente del régimen alimenticio, fue más corto en BS que HF (162,1 vs 197,5 días) y MP fue mejor (P<0.05) que PP (197,5 vs 262.6 días). El nivel de nutrición ofertado también redujo el intervalo, particularmente en las HF. Se concluye que la producción de leche, cambios de peso vivo e intervalo parto-concepción, están influenciados por el nivel de nutrición durante el el pre- y post-parto.

Palabras clave: Holstein, Pardo Suizo, alimentación, edad, leche, cambios de peso, intervalo parto-concepción.

INTRODUCTION

Environmental, technological, nutritional conditions and diseases impair dairy cattle *(Bos taurus)* production in tropical areas, having a negative effect on milk production, health and reproductive performance of the herd. As a consequence, dairy activity is characterized by low milk production and low economical profits. This is particularly true for European breeds that are more susceptible to the adverse tropical environment, showing poor adaptability, production and reproduction and, as a consequence, present low capital investment returns [3, 12, 17, 18]. Nevertheless, most tropical countries have imported Holstein and Brown Swiss animals in an attempt to palliate milk deficit for human consumption. Failure of this policy is largely described in the international literature [4, 11, 16, 26, 27].

Within the adverse effects of the tropical environment on milk production and reproduction, nutrition plays an important role due to poor quality forages, seasonal effects of rainfalls, high cost of feed concentrates, and high temperature that negatively influence feed intake and other physiological processes. Therefore, the objective of this research was to provide additional information on the effect of the nutritive quality of the diet during pre- and post-calving periods on the performance of Holstein and Brown Swiss cattle, under tropical conditions.

MATERIALS AND METHODS

To determine the effect of feeding levels on body weight (BW), milk production and calving-conception interval an experiment was conducted in the central northern region of Venezuela (Aragua State), located at 452 m.a.s.l. with an average temperature of 24.5 °C, 77% of relative humidity and 976 mm of rainfall. A total of 108 dairy cows, 54 Brown Swiss (BS) and 54 Holstein (HF), were divided each in two groups according to their parturition condition, primiparous (PP) and multiparous (MP), and assigned to three experimental diets, individually provided. Rations consisted of a combination of green chopped forage (*Sorghum vulgare*), with 6.4% crude protein (CP) and 49% total digestible nutrients, (TDN) and a supplement containing 18% CP and 75% TDN (TABLE I), to obtain diets approximately similar to 80 (L), 100 (M) and 120 (H) % of the 1989 NRC nutrient requirements [14]. This was achieved by adjusting forage: concentrate ratio.

TABLE I
COMPOSITION OF CONCENTRATE FED TO MULTIPAROUS AND PRIMIPAROUS DAIRY COWS

Ingredients†	%
Cotton cake meal	14.0
Ground corn meal	73.0
Urea	2.0
Dicalcium phosphate	1.0
Molasses	9.0
Calcium carbonate	0.5
Total	100.0

† Supplement contained (%): crude protein, 18.5; estimated total digestible nutrients: 74.8; calcium: 0.5; phosphorous: 0.40. In addition, a complete mineral supplement was offered ad-lib.

The experiment was carried out during 8 weeks prior calving and 22 weeks post-partum, in a 2x2x2x3 factorial arrangement, using a complete randomized design. Breed (H and BS) was considered to be the main plot, and parturition conditions (PP and MP), feeding periods (pre- and post-partum periods), and diets (L, M and H feeding levels in both, pre- and post-partum periods) were respectively assigned to a split-split-split plot arrangements [9]. The model used is described by:

$$\begin{aligned} Y_{ijklm} = \; & \mu+\rho_k +\alpha_i +\omega_{ik} \\ & +\beta_j +(\alpha\beta)_{ij} +\gamma_{ijk} \\ & +\delta_l +(\alpha\delta)_{il} +(\beta\delta)_{il} +(\alpha\beta\delta)_{ijl} +\varphi_{ijkl} \\ & + \Delta_m + (\Delta\alpha)_{im} + (\beta\Delta)_{jm} + (\delta\Delta)_{lm} + (\alpha\beta\Delta)_{ijm} + (\alpha\delta\Delta)_{ilm} \\ & + (\beta\delta\Delta)_{jlm} + (\alpha\beta\delta\Delta)_{ijlm} + \varepsilon_{ijklm} \end{aligned}$$

where:

Y_{ijklm} = individual response variable measured

μ = overall mean

ρ_k = main effect due to of kth replication

α_i = main plot effect due to ith breed

ω_{ik}= the main plot error

β_j = sub plot effect due to jth level of parturition

$(\alpha\beta)_{ij}$ = interaction effect due to ith breed and jth parturition level

γ_{ijk} = sub plot error

δ_l = sub-sub plot effect due to lth level of feeding period

$(\alpha\delta)_{il}$ = interaction effect due to ith breed and lth feeding period

$(\beta\delta)_{jl}$ = interaction effect due to jth level of parturition and lth feeding period

$(\alpha\beta\delta)_{ijl}$ = interaction effect due to ith breed, jth level of parturition and lth level of feeding period

φ_{ijkl} = experimental sub-sub plot error

Δ_m = sub-sub-sub plot effect due to the mth feeding level

$(\Delta\alpha)_{im}$ = interaction effect due to ith breed and mth feeding level

$(\beta\Delta)_{jm}$ = interaction effect due to jth parturition level and mth feeding level

$(\delta\Delta)_{lm}$ = interaction effect due to lth feeding period and mth feeding level

$(\alpha\beta\Delta)_{ijm}$ = interaction effect due to ith breed and jth parturition level and the mth feeding level

$(\alpha\delta\Delta)_{ilm}$ = interaction effect due to ith breed and lth feeding period and the mth feeding level

$(\beta\delta\Delta)_{jlm}$ = interaction effect due to jth parturition level and lth feeding period and the mth feeding level

$(\alpha\beta\delta\Delta)_{ijlm}$ = interaction effect due to ith breed, jth parturition level, lth feeding period and the mth feeding level ε_{ijklm} = the sampling error of the sub-sub-sub plot.

Prior calving, BW of MP and PP were 539 ± 18.3 and 489 ± 15.2 kg, respectively. The rations were adjusted weekly according to BW in the pre-calving period and milk production of the preceding week, during the post-partum period, with daily records of milk yield (corrected to 3.5% fat), forage and concentrate intake.

Heat detection was checked 60 days post-partum by using teaser bulls. Reproductive performance was measured at time intervals (days) between calving and conception. Primiparous and MP female bovines were naturally bred, with eight bulls, in a rotational system. Semen quality was checked on weekly bases.

Crude protein was determined by Kjeldahl method [1] and TDN in forage was estimated by *in vitro* dry matter digestibility (IVDMD), using the equation described by Heaney and Pigden [10]: ETDN%= 5.81 + 0.869x %IVDMD. Data were analyzed by ANOVA and means adjusted by least squares including in the model breed, age, pre- and post-calving feeding effects and the corresponding interactions [9]. Concentrate intake was correlated to milk production and BW losses to estimate the tendency of these parameters for MP and PP.

RESULTS AND DISCUSSION

Total dry matter (DM) intake increased (P<0.05) as feeding level was improved (TABLE II). The greater feed intake appears to be caused by narrowing forage: concentrate ratio. Forage consumption was constant, while concentrate feed showed a linear increase, with relative values of 27.4, 41.8 and 50.9 as percent of total DM intake respectively, for L, M and H feeding levels. In no case, there was replacement of forage by concentrate supplement. This is partially due to a greater offer of concentrate feed to reach the nutritional levels required by the experimental design, as well as to a greater milk production, as nutrition was improved. Increased feed intake with higher milk production is a common finding [7, 16, 17, 20], and, in addition, body reserves are used to meet energy, protein and minerals demands for milk, particularly in early lactation. At this time, there is an increase in nutrient absorption and mobilization of nutrients. The size of the gut and its absorptive capacity increases to allow greater absorption of nutrients, in an attempt to meet requirements. Multiparous cows had higher feed consumption than PP. Daily concentrate intake values were 5.2 ± 1.4 kg and 4.9 ± 1.6, for MP and PP, respectively. When expressed as percent of total DM intake, these values were similar. The difference reached significance (P<0.05) when total DM intake was considered, since cows had greater forage intake than heifers. This is probably due to greater BW and milk production of MP than PP. When feed intake was expressed as percent of BW, no differences were found between them (MP, 2.35%; PP, 2.39%). In both cases feed intake was low. This has been related [15, 19, 21] to the high temperatures of the tropics that cause heat stress in the animals with negative effect on several physiological processes, decreasing feed intake, energy utilization and milk production [8, 22, 24, 29].

Feeding level had a significant effect on milk production, averaging 10.50 and 9.79, 11.02, and 11.17, and 11.18 and 11.74 kg/day, respectively for feeding periods (pre- and post-calving) at L, M and H feeding regimes, being this effect more evident in the post-partum feeding (P<0.05). The overall milk production, as an average of all feeding levels pre- and post-calving, was 10.90 kg /day. Corresponding BW losses (%) were 5.42 and 4.87, 4.54 and 4.34, and 3.10 and 3.87, respectively for feeding periods (pre and post-calving), at L, M and H feeding levels, based on percentage of initial BW, being the differences significant (P<0.05), particularly more evident in pre-partum feeding (TABLE III).

Adjusted means suggest that feeding regimes during pre-calving period had a major effect on diminishing body BW losses when animals were lactating, while post-partum feeding had a greater effect on milk production. These findings were reported earlier [5, 30] indicating that pre-partum feeding has a greater effect on BW, while post-partum has more influence on milk production.

During 22 weeks after calving, adjusted mean values (TABLE IV) indicate that HF cows produced more milk (12.2 ± 0.73 kg/day) than BS cows (9.59 ± 0.07 kg/day), and HF lost more weight (4.92 ± 0.64%) than BS (3.78 ± 0.45%) when data were based on percentage of initial BW.

When MP cows were compared with PP, the former showed greater milk yield (11.30 ± 1.64 vs 10.50 ± 0.98 kg/day) and lower body losses (3.81 ± 0.48 vs 4.90 ± 0.66%). In all cases the differences were significant (P<0.05). This is a common finding for European breeds in the tropics, where animal are subject to high temperature and other environmental stresses. Genetic-environmental effects in relation to temperature on milk production are not clear yet [15], though other factors such as comfort, diseases, chromosome maternal effect, besides nutrition, may play an important role [3, 23].

Milk production and BW, independently of feeding level and breed type (TABLE V), varied during the 22 weeks of the recorded data. Noticeable BW losses were recorded during the first 10 weeks of lactation, averaging 222 and 290 g/day with a milk production of 12.18 and 11.41 kg/day for MP and PP, respectively.

By the end of the 22 weeks period, HF and BS animals were unable to recover BW losses, being these (P<0.05) lower than initial BW. Body losses at peak of lactation are a physiological condition in lactating animals that are unable to have a nutrient intake and efficient utilization of absorbed nutrients at tissue level to compensate nutrient utilization for milk production [18].

Significant regressions (P<0.05) of concentrate intake vs milk production were: $y= 6.735 + 0.878x$ and $y= 8.12\ 5 + 0.484x$, for MP and PP, respectively. For the same order, intake vs BW losses, the equations were: $y = -3.5907x + 221$ and $y= -0.5591x + 130.2$. The estimated predicted values for BW and milk production (TABLE VI) indicate that, with 80% concentrate in the diet, milk production can reach 17 kg/day, while 60% concentrate in the diet maintains negative values for BW changes after the first 22 weeks of lactation. These calculated data suggest the importance of the quality of the diet for higher milk production.

Feeding regimes prior calving, independently of breed type and age, showed a tendency to diminish the days from calving to conception along with higher feeding levels. The val-

TABLE II

INTAKE OF FORAGE AND CONCENTRATE SUPPLEMENT ON DRY MATTER BASIS OF MULTIPAROUS AND PRIMIPAROUS COWS DURING LACTATION

Feeding levels	Forage, kg/day	Concentrate, kg/day	Concentrate, % of total intake	Total, kg/day
Low	7.358 ± 1.4	2.773 ± 1.2	27.4	10.131a ± 2.1
Medium	7.194 ± 1.3	5.163 ± 1.7	41-8	12.357b ± 2.2
High	6.958 ± 1.1	7.214 ± 1.8	50.9	14.172c ± 1.8
Primiparous	6.831 ± 1.9	4.903 ± 1.6	41-8	11.734a ± 2.0
Multiparous	7.509 ± 1.8	5.197 ± 1.4	40.9	12.706b ± 1.9

a,b,c Means in the same column with different letters differ (P<0.05).

TABLE III

EFFECT OF PRE AND POST-PARTUM FEEDING LEVELS ON MILK PRODUCTION (kg/day) AND BODY WEIGHT LOSSES (%) † INDEPENDENTLY OF BREED

	Post-partum						Average	
Pre-partum	Milk	BW	Milk	BW	Milk	BW	Milk	BW
Low	9.47	5.82	11.05	6.42	10.98	4.02	10.50a	5.42C
Medium	9.46	5.78	12.02	4.08	11.58	3.78	11.02a	4.54B
High	10.44	3.02	10.44	2.52	12.66	3.82	11.18a	3.10A
Average	9.79a	4.87B	11.17b	4.34AB	11.74b	3.87A	10.90	4.37

† As percent initial BW. a,b Means (Milk)in the same row or column whit different letters differ (P<0.05). A,B Means (BW) in the same row or column with different letters differ (P<0.05).

TABLE IV
MILK PRODUCTION (kg/day) AND BODY WEIGHT LOSSES (%) † DURING 22 WEEKS AFTER CALVING

	Primiparous		Multiparous		Average	
Breed	Milk	BW	Milk	BW	Milk	BW
Holstein	11.48	5.56	12.94	4.28	12.21 ± 0.73a	4.92 ± 0.64 A
Brown Swiss	9.52	4.23	9.66	3.33	9.59 ± 0.07b	3.78 ± 0.45 B
Average	10.50 ± 0.98b	4.90 ± 0.66A	11.3 ± 1.64a	3.81 ± 0.48B	10.90 ± 1.40	4.35 ± 0.79

† As % initial body weight. a, b Means (Milk)within the same row or column with different letters differ (P<0.05). A, B Means (BW) within the same row or column with different letters differ (P<0.05).

TABLE V
MILK PRODUCTION (kg/day) AND BODY WEIGHT CHANGES (g/day)† OF MULTIPAROUS AND PRIMIPAROUS COWS DURING 22 WEEKS AFTER CALVING

Weeks lactation	Primiparous		Multiparous	
	Milk	BW	Milk	BW
01-10	11.41	-290	12.18	-222
11-22	9.75	74	10.57	73
01-22	10.58 ± 0.98b	-108 ± 182B	11.3 ± 0.81a	-74 ± 147A

a, b (Milk) and A, B (BW) Means within the same row with different letters differ (P<0.05).

TABLE VI
ESTIMATED MILK PRODUCTION (kg/day) AND BODY WEIGHT LOSSES (g/day) OF MULTIPAROUS AND PRIMIPAROUS COWS INDEPENDENTLY OF FEEDING LEVELS

	Milk production†			BW losses†		
	Concentrate intake as % of total dry matter intake					
	0	40	80	0	30	60
Primiparous	4.92	11.48	17.10	222	105	10
Multiparous	6.82	10.95	12.18	130	113	97

†Values calculated by regression.

ues were: 208.6, 173.1 and 157.7 days, respectively for L, M and H feeding levels. Post-partum feeding showed similar tendency with values of 190.2, 183.2 and 166.0 days. In both cases the differences were significant (P<0.05) only when the low feeding regime was compared with the other two (TABLE VII). As indicated for BW changes, feeding levels prior calving seem to have a greater benefit on reproduction performance.

Time intervals between calving and conception (TABLE VIII), independently of feeding regimes, indicate that BS animals had a shorter intervals than HF (162.1 vs 197.5 days) and MP performed better (P<0.05) than PP (197.5 vs 262.6 days).

Calving to conception interval is one of the major constrain for cattle productivity in the tropics, particularly in dairy cattle [25]. European breeds show greater difficulty to overcome the adverse environmental conditions that negatively affect reproduction performance [8]. This is particularly true for PP, since, in addition to milk production and conception, they are still in the growing stage, therefore requiring better nutrition in addition to improved environmental comfort [6].

The overall means of calving to conceptions intervals, independently of animal age, show a tendency to decrease as feed level increased with values of 190.2 ± 35.9, 183.2 ± 30.2 and 166.0 ± 29.9, for L, M and H feeding levels, respectively. However, the two breeds performed differently to feeding regimes (P<0.05). Holstein animals had a similar tendency than the overall means, while BS showed a slight trend to increase calving-conception intervals with an increase of feeding levels (FIG. 1). This is probably due to lower milk production and BW losses of BS cattle than HF during the experimental time.

An important condition to achieve satisfactory reproduction performance of dairy cattle is the maintenance of BW at calving time and during lactation [20]. This is a result of a balance between nutrient intake and milk production. Under major conditions, immediately after calving, there is an increase of feed intake, which is at lower rate than milk production that increases abruptly during the first months of lactation. The imbalance between nutrient intake and milk production causes BW losses, since animals are imposed to mobilize body tissues to

TABLE VII

COMBINED EFFECT OF PRE AND POST-PARTUM FEEDING REGIMES ON DAYS FROM CALVING TO CONCEPTION, INDEPENDENTLY OF ANIMAL TYPES (BREEDS AND PARTURITION FREQUENCY

		Post-partum feeding level			
		Low	Medium	High	Average
Pre-partum feeding level	Low	218.6 ± 18.6	225.5 ± 25.4	181.7 ± 23.2	208.6a ± 22.7
	Medium	183.3 ± 21.4	173.7 ± 20.7	161.4 ± 19.7	173.1b ± 20.4
	High	168.7 ± 16.9	150.5 ± 17.2	153.9 ± 13.1	157.7b ± 20.9
	Average	190.2a ± 22.8	183.2ab ± 21.4	166.0b ± 18.7	179.8 ± 25.2

a,b Means in the same column or row with different letters differ (P<0.05).

TABLE VIII

INTERVAL (days) BETWEEN PARTURITION AND CONCEPTION OF PRIMIPAROUS AND MULTIPAROUS COWS, INDEPENDENTLY OF FEEDING REGIMES

Breed	Primiparous	Multiparous	Average
Holstein	218.3 ± 25.4	176.7 ± 20.7	197.5 ± 21.4a
Brown Swiss	175.7 ± 23.6	148.5 ± 19.4	162.1 ± 18.9b
Average	197.0 ± 24.5a	162.6 ± 20.1b	179.8 ± 19.5

a,b Means in the same column or row with different letters differ (P<0.05).

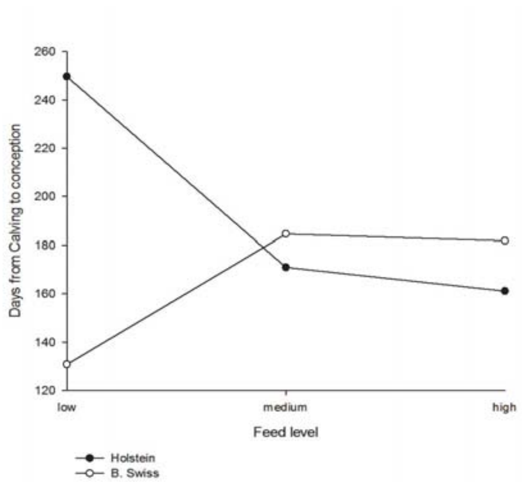

FIGURE 1. EFFECT OF FEEDING LEVELS AND TYPE OF BREED ON CALVING TO CONCEPTION INTERVAL (DAYS).

supply nutrients for milk production. This seems to explain the better performance of BS than HF animals, since the former lost less weigh and produced less milk than the latter [13].

Reproduction problems can be of greater importance than milk production, under tropical conditions, particularly for European breeds [2, 27, 28]. The length of calving-conception interval has a restrictive effect on animal production. Bodisco and Rodríguez [2] showed that in one herd of HF and another of BS, the life span of cows had 2.31 and 3.02 lactations with a total milk yield of 11,364 and 14,196 kg, respectively. When these yields were calculated on daily basis of the production lifetime, average milk production were 4.97 and to 6.19 kg/day, respectively. Similar results were reported by Vaccaro *et al*. [28] who indicated that a primiparous herd in tropical areas of Venezuela had an average of 1.8 calving-lactation periods in their productive life span, mostly due to high mortality and very long calving intervals. European breeds have little tolerance to high temperatures and other environmental stresses that prevail in the tropics [19, 29].

Nutrition seems to have an important role in the production of dairy herds in the tropics, as it has been demonstrated in this research. Body weight, milk production, and shortening of calving-conception time can be improved by better nutrition. Nevertheless, nutrition by itself cannot guarantee productivity of European dairy cattle en the tropics [11].

CONCLUSIONS

It is concluded that milk production and BW are influenced by pre- and post-calving nutrition as well as by breed type and animal age. Milk yield of HF is higher than BS, either in MP as in PP cows.

Feeding levels appear to have higher effect on BW prior calving, while post-partum feeding is more effective on milk production. Peak of milk yield corresponds to major body losses that were still in negative values after the first 22 weeks of lactation. Feed efficiency of concentrate for milk production may be reduced in cows replenishing body stores lost during early lactation. Breed also affected calving to conception interval. However, although this effect is not independent from nutrition level, in both breeds higher nutrition decreased this interval. Nutrition by itself could not guaranty productivity of European dairy cattle in tropical regions.

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