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MILK PRODUCTION, REPRODUCTION AND DEATH RATES OF HOLSTEIN HEIFERS IMPORTED INTO THE TROPICS

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A study was made throyghout their first year after the arrival (January 1981 - January 1982) of 98 grade Holstein heifers imported in advanced pregnancy from Virginia, USA, to the lowlands of Venezuela, with the object of evaluating their reproductive and milking performance as well as their survival rates. The animals were housed in cement-floored corrals and fed on maize and sorghum silage with 5-9 kg concentrates/head daily. Of all pregnancies, 76.4% resulted in live calves, 12.2% in dead calves, 11.3% in abortions and retention of the placenta was recorded in 18.7%. The percentage of calves which died during the first year after birth was 81.3, mainly as a result of pneumonia, diarrhea and pneumoenteritis. The percentage of all deaths which occurred within three days of birth was 60.7. Eight of the heifers died within the first year, having been in very poor physical condition. During the first month after arrival, the mean respiration rate of the heifers was 84 ± 14 inhalations/minute, when resting at 10:00 - 12:00 hours. The respiratory rate tended to increase at the start of lactation and to decrease as the time after arrival increased. By the ninth month after arrival, 40.0% of the heifers presented foot or leg problems and 20.4% of them had lost one or more quarters from mastitis, in some cases even before calving. The estimated milk yield per heifer imported was 2419 kg during the first year with 75% of them in the eighth, or later, month of lactation. European x zebu heifers on the same farm had produced a mean of 2495 kg in 244 days in 1980. These results support existing evidence regarding the impracticability of dairy development plans for the tropics based on the importation of pregnant heifers of specialized, temperate zone breeds.

Key words: Milk yield, abortion, survival, respiration rate, mastitis, foot and leg problems, Holstein heifers imported into tropics.

One of the possible methods proposed for the improvement of tropical milking cattle is crossbreeding with specialised, temperate climate breeds. Another approach has been the use of pure temperate breeds. This has produced variable results, depending principally on management levels, type of feedstuffs and the rigours of the climate involved. Many governments, as well as private producers, consider this second alternative as the best short term solution to the deficits of milk and meat which tend to increase as human populations and purchasing power rise. The purpose of this study was to record the performance of a group of 98 grade Holstein heifers imported from Virginia, USA, in an advanced state of pregnancy, to the State of Portuguesa, in the Venezuelan lowlands. An analysis was made of their milk yields, reproduction and survival rates during the first year after arrival in the tropics.

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Materials and Methods

The farm used in the study is located in Acarigua a 9°35' N and 69° 14' W, at approximately 220 m above sea level. The mean temperate is 27.2°C and the average annual rainfall 1570 mm, of which about 85% falls during May-October. The level of management of the farm is above average for the region.

The heifers arrived in Venezuela by air in January of 1981, which is the driest and coolest season of the year in the area in question. Even so, there was an important difference between the winter temperature in their place of origin and that encountered in Venezuela. The animals were housed in a corral of 35 x 35 m, with floors of roughened cement, 95 m of feeding troughs and 160 m^2 of shade given by a pitched aluminium roof measuring 3.50 m and 4.50 m at the lowest and highest points, respectively. Bedding material was occasionally placed in the shaded area. When the animals arrived, they were given a preventive treatment of two doses of oxytetracycline. Two weeks later, intramuscular injections of Vitamins A, D_3, E, B_{12} and phosphorous were applied. Inmediately after calving, the heifers again received the vitamin and phosphorous treatment, as well as oxytocin and an interuterine application of terramycin.

Feeding was based on maize and sorghum silage, with a 5% crude protein content on a dry matter basis and an *in vitro* digestibility of 54.3%. In addition, the cattle received 5 kg/head/day of a concentrate made up of 50% maize flour, 30% cotton seed meal, 10% cotton seed hull, 8% molasses and 2% minerals. Once in milk, they received an extra 4 kg/day concentrates.

Foot and mouth vaccinations were carried our routinely every three months and external parasites controlled by spray baths every 14 days. The heifers were vaccinated against anaplasmosis 4 months after their arrival. The herd was passed through a foot bath containing copper sulphate during three consecutive days on two occasions during the first year, and smaller groups of animals were treated separately from time to time.

Calves were born in calving pens with a cement floor covered with straw or sawdust, but generally damp. Frequently, various cows were placed in a single pen to calve, because of limited space. Calves did not always receive immediate attention after birth; they were weaned at variable ages but always within the first 7 days of life. On the second day, they were vaccinated against pneumoenteritis.

Cows were machine milked twice daily. No change occurred in the farm's labour supply or buildings and equipment due to the arrival of the imported heifers.

Results

The results are presented according to the chronological order in which the events occurred.

On arrival, the heifers carried the heavy hair coats typical of zones with harsh winters. They all presented acute symptoms of heat stress, with high respiratory rates, open mouths, protruding tongues and abundant salivation. Twenty per cent of them started to secrete milk, as evidenced

by a persistent dripping from some or all teats during the first days after arrival. According to information from the owner, the mean live weight of the cattle at embarkation was 449 kg, but 399 kg on arrival in Venezuela. Individual weighing of the heifers and their calves on the farm was never possible, due to the lack of a balance.

Calvings: All heifers arrived with positive, advanced pregnancy diagnoses. Assuming that the resulting calvings should have occurred within the first 280 days, the distribution of calvings and abortions during that time was as shown in Table 1.

Table 1:

Distribution of calvings and abortions of imported heifers, according to time after arrival

Days after arrival	Percentage of all heifers which produced:		
	Live calves	Dead calves	Abortions
1 - 30	2.0	-	3.1
31 - 60	6.1	-	-
61 - 90	2.0	-	-
91 - 120	26.5	2.0	-
121 - 150	31.6	5.1	-
151 - 180	6.1	3.1	-
181 - 210	2.1	2.0	-
211 - 280	-	-	-
Date unknown	-	-	8.2
Total	76.4	12.2	11.3

During the first month, three abortions were recorded, one normal calving and one premature calving, to judge by the size of the phenotypically Holstein Friesian calf. Apart from the first three abortions, 7 heifers were assumed to have aborted since no calving date was recorded during the first year, and another produced a mummified foetus which had to be extracted. Altogether, 12.2% of the heifers produced calves dead at birth, and in one of the dystocic calvings the mother as well died. In total, 23.5% of the heifers either aborted or produced dead calves.

Of the first 20 calves born, 8 were evidently crossbreds, since they were completely black in colour. Seventeen of the heifers which calved or aborted had retained plancentas.

Survival: During their first year after arrival, 8 heifers died, all of which had calved. Five of these had foot problems, anaemia, respiratory difficulties and were in poor physical condition. Another was slaughtered because of dystocia, and the remaining two died from bloat. Fifty per cent of the deaths occurred during the fifth month after arrival and the

rest afterwards. Six of the heifers which died completed less than 90 days in lactation.

Of a total of 75 calves born alive, only 14 survived until 31st January, 1982: 10 females and four males. The principal causes of death were pneumonia (48% of the total), diarrhea (24%) and pneumoenteritis (14%). The distribution of deaths according to age is shown in Table 2.

The percentage of all deaths which occurred during the first three days after birth was 60.7.

Table 2:

Distribution of deaths of calves of imported heifers, according to age

Age (days)	Dead calves tos	
	Quantity	% (Accumulated)
1	1	1.6
2	17	29.5
3	19	60.7
4	9	75.4
5	5	83.6
6	1	85.2
7 a 30	8	96.7
> 30	1	100.00
Total	61	

Respiration rate: The rate of respiration of the heifers was counted on six separate occasions. The count was made at between 10.00 and 12.00 hours, except on the last occasion which coincided with the 220th day after arrival, when the measurement was done at 15.00 - 16.00 hours. The animals were sampled randomly from those observed to be resting, whether lying down or standing up. Recently calved heifers were not included in the sample, except on the 154th day. Table 3 shows the mean values obtained on each occasion. There was a tendency for the values to decrease with time. The maximum and minimum rates recorded were 144 and 36 respirations per minute.

The sample taken on the 154th day included heifers which had not yet calved, others which had calved in the previous two weeks and another group with more than two weeks post partum. The mean respiratory rates per minute of the three groups are shown in Table 4.

Despite the small size of the sample, there was an obvious effect of the stress of the physiological processes associated with calving, which tended to decrease as lactation advanced.

Foot problems and mastitis: Foot problems were frequently observed, starting in the first few months after arrival. In addition, there was a high incidence of joint swellings in all four legs and of raw places on

Table 3:

Mean respiration rates per minute of imported heifers at 10:00 - 12:00 hours, according to time after arrival

Days after arrival	Number of animals observed	$\bar{x} \pm s$
26	17	81 ± 14
40	21	68 ± 17
61	20	65 ± 16
103	19	64 ± 15
154	15	70 ± 15
220*	21	101 ± 22

* Reading taken at 15.00-16.00 hours.

Table 4:

Respiration rates per minute 154 days after arrival, according to physiological condition

Condition of heifers	Number observed	$\bar{x} \pm s$
< 14 days post partum	5	95 ± 10
> 14 days post partum	8	77 ± 13
Not yet calved	7	62 ± 13

the sides of the legs. In the ninth month after arrival, a random sample of 70 of the heifers was examined and 28 were found to have foot and/or leg problems in up to all four of their limbs. Those with four limbs affected were in very poor physical condition.

During the year, 79 cases of clinical mastitis were recorded which required a minimum of three intramammary treatments in from one to four of the quarters. Many of these cases were observed in the heifers before they calved. As a result, one or more quarters were lost by a total of 20 heifers, in some cases even before calving. Altogether, 8 of the 20 heifers lost two quarters and 12 lost one, giving a total loss of 7.14% of the quarters of the 98 heifers.

Milk production: Milk yields were recorded routinely on the farm at intervals of usually less than a month. Even though calvings or abortions were observed for 91 heifers, the maximum number which was ever recorded at milking reached only 76. The maximum daily yield per heifer varied between 11.0 and 23.5 kg. During the first year, daily mean yields of the group in milk ranged from 10.3 ± 2.89 to 17.1 ± 3.04 kg and, by the end of the year, a total of 237 046 kg milk had been produced. This is equivalent to 2419 kg milk in the first year after arrival, per heifer imported. Because of identification problems with some of the herd, it was not possible to estimate lactation yields individually. However, since 75% of

the heifers which came into milk had already been eight, or more, months in lactation by the end of the year, the total quantity of milk produced divided by the number which calved of aborted, which is to say 2605 kg, is not far off as an estimate of the mean first lactation milk yield. This may be compared with the average 2495 kg milk produced in 244 days by European x Zebu crossbred heifers existing on the same farm in 1980 (ROPL. 1980).

Discussion

The results obtained with respect to calvings, survival and milk production follow the general pattern observed with temperate breed cattle in the tropics (Pearson de Vaccaro, 1973, 1974).

Foetal losses up to calving were abnormally high in comparison with values reported in the literature for pure European and high grade crossbred cattle in tropical environments (Rios et al, 1965; Amble & Jain, 1967; Pearson de Vaccaro, 1974; Madsen & Vinter, 1975; Vaccaro & Vaccaro, 1981, 1982b; Combellas, 1982). The majority of these losses (12.2%) were of fully developed calves born dead, while 11.3% referred to abortions. These figures differ from the values reported by Amble & Jain (1967) for high grade European crossbreds born and raised in India, in which case 18% of abortions and 4% of still births were observed. On the other hand, Kurek (1966) recorded a loss of 18.9% through abortions in the first year among Friesian heifers imported from Holland to Morocco. One of the reasons for the perinatal deaths may have been uterine inertia, as observed by Ansell (1975) in 25% of Friesian heifers imported into the Persian gulf zone.

While the incidence of retained placenta exceeded that of 5 - 12 % considered normal in temperate zones (McDowell et al, 1974), it was similar to the rate given by Fenton et al (1976) for a Holstein herd in Maracay, Venezuela. These authors mention the poor nutritional state of the cattle as one of the possible causes, and the problem was so serious that 27.1% of the cows with retained placenta in Maracay were later culled for infertility.

The death rate of the heifers in the present study was 8.2% during the first year, with 75% of the losses occurring within the first three months of lactation. Apparently, calving and lactation puts an additional physiological strain upon the animal which is in the process of adaptation to the tropical environment, tending to upset the precarious balance. Similar rates of mortality were reported by Wilkins et al (1979) from Santa Cruz, Bolivia, for imported Holstein and Brown Swiss cows. Bodisco (1973) reported a loss before first calving of 20.8% of Holstein heifers imported at between 3 and 5 months of age into Venezuela. Higher death rates were observed among heifers imported pregnant into Trinidad than among older animals (Gonzalez et al, 1968).

With regard to the calves, the death rate observed (81.3%) was unusually high compared with cases of imported dams, similar to the present one. The nearest estimate reported elsewhere is that of a loss of 66.6% of the calves of Holstein heifers imported into the Phillippines (Hermosura & Laygo, 1953), but the age limit of the calves is not known. In the Bolivian

study, death rate of calves in the first 18 months reached only 35% (Wilkins et al, 1979). The mortality of the calves of Dutch imported heifers in Egypt reached 32.5% per year in the first two years, but later fell to 8.5% (Fahmy et al, 1963). Vaccaro & Vaccaro (1981) reported a death rate of 23.1% up to 9 months of age for high grade Holstein Friesian crosses which, although it does not refer to imported dams, is a figure obtained from the same region of Venezuela and a similar production system to that of the present study.

The main causes of death, pneumonia and diarrhea, as well as the higher frequency of deaths in the first month after birth, coincide with experiences in other tropical zones (Srivastava & Agarwala, 1973; Pearson de Vaccaro, 1973; Sharma & Jain, 1976; Vaccaro & Vaccaro, 1981). Among the possible contributing factors are the poor temperature regulating mechanisms of young European-breed calves, a lack of vigour resulting from poorer uterine development as a consequence of the heat (Bonsma, 1949; CSIRO, 1980), and also the fact that calves will have had poor immunological defences against the local microorganisms due to their dams' recent introduction to the farm.

Perhaps the most obvious effect of the stress suffered by the heifers was their rapid rate of respiration, which greatly exceeded that of 32 per minute considered normal in temperate zones (McDowell, 1972). Although the rate declined during the period under study, indicating a process of adaptation, 7 months after arrival the mean respiration rate was still double that considered normal for the breed in its place of origin. The values obtained on the 220th day suggest that the counts taken in the morning were below the maximum rate obtained during the day, since highest environmental temperatures are usually reached at between 13.00 and 15.00 hours. On the other hand, it is also to be expected that rates lower than those recorded would have been obtained during the night time. The stress due to calving and lactation was manifest in the higher respiration rates observed at that time, as indicated by McDowell (1972). No use was made of cold water showers or sprays in the corrals to reduce the effects of the high temperatures.

While foot problems are to be expected among herds confined in corrals with hard, damp floors, they were particularly serious in the present study both with regard to the intensity and the number of animals affected. The proportion affected (40%) indicates the gravity of the problem, which is bound to have influenced food intake and milk production. In Panama, foot problems explained 18% of the reasons for culling in an imported Holstein herd (Narvaez, 1951) and, together with losses from udder problems and infertility, 78.7% of the total losses.

Both the corrals and the milking facilities have cement floors and, to judge from the results, the area covered with bedding and the occasional use of copper sulphate foot baths were insufficient to prevent foot problems. A contributing factor was the poor drainage of the corrals and the fact that the rainfall during the year studied exceeded the average of the previous eleven years by 75% (UNELLEZ, 1982).

Little information is available about the incidence of mastitis in animals recently introduced into the tropics. In the present case, reference is only made to the severe clinical cases which were obvious on

simple inspection, thus underestimating the real importance of the problem. However, some estimate of its practical consequences is given by the fact that 20.4% of the heifers lost at least one quarter as a result. The proportion of lost quarters (7.14%) is above the average found in herds in Zulia and the central region of Venezuela which does not exceed 4.0% (P. Piñate, personal communication). The persistent dripping of milk observed in some of the heifers on arrival may be explained by a relaxation of the teat sphincter, combined with functional changes in the adrenal glands, ovaries and hypothalamus - pituitary complex due to heat stress and/or changes in the hours of daylight (Abilay et al, 1979; Thatcher, 1974).

The yield of milk estimated per heifer imported during the first year was similar to the mean obtained the year before on the same farm with crossbred heifers, and lower than that reported by Ansell (1975) for Friesian heifers introduced into the United Arab Emirates. Lactation milk yields of 507.3 to 3585.5 kg were reported by Wilkins et al (1979) from four farms in the tropical lowlands of Bolivia using imported Holsteins under different production systems. The two farms with highest milk yields had a mean interval between first and second calvings of over 530 days. The estimate of milk yield during the first year per heifer imported in the present study was similar to that obtained in Bolivia from locally bred Holsteins kept on pasture with supplementary feeding. The authors showed that, with a system similar to that described in the present study and with a mean calving interval of 416.7 days and death rates of calves and adults below 6%, milk yields of 4200 kg per cow/year were required to cover the costs of production. In the region described in the present study and using a similar production system, R. Cardozo and L. Vaccaro (personal communication) found that crossbred Holstein x Zebu cows produced a mean 2667 ± 1355 kg milk in their first lactation, with an average interval between first and second calvings of 432 ± 97 days (Vaccaro & Vaccaro, 1982b).

Conclusions

The results obtained with reference to milking performance, reproduction and survival were inferior to those expected according to evidence from other tropical regions, given apparently similar conditions. The advanced state of pregnancy of the heifers, the general problems of management, especially with regard to the calves were the most important factors which, combined with high temperature and humidity, determined the results obtained. One aspect which should be considered is the reproductive performance of these cattle in their new environment. Long periods of anoestrous and intervals between calvings have been pointed out by Wilkins et al (1979). In addition, a herd life of about 2.15 years with 1.9 to 2.6 calvings reported in the tropics under similar conditions (Narvaez, 1951; Vaccaro & Vaccaro, 1982a) raise doubts as to the biological and economic viability of the operation carried out as described in the present case. The results reported tend to confirm existing evidence concerning the impracticability of dairy development plans in the tropics based on the importation of pregnant heifers of specialised, temperate zone breeds.

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