UNIVERSITI PUTRA MALAYSIA

EMBRYONIC DEATHS IN THE SAHIWAL FRIESIAN COWS IN AN INSTITUTIONAL FARM IN MALAYSIA

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by

DEDICATION

I dedicate this thesis to my dear husband, Dr. Abdul Latif bin Borhan and daughters, Laila Syahira, Nurul Ilani, Maya Sofia and Salma Athira who has been my inspiration throughout the whole course of the study.

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Reproductive wastage is a major cause of production loss in dairy animals. Fertilization failure and embryonic death are suggested to be the main causes of reproductive loss. The dairy industry in Malaysia is hampered by poor reproductive performance which is manifested by repeat breeding and lengthened calving interval. Whether this is due to fertilization failure or embryonic death has never been determined. This study is belief to be the first in the tropics in trying to quantify reasons

for reproductive inefficiency in crossbred cows in the tropical environment and attempts to relates the influence of the hot ambient tropical temperature and humidity to embryonic mortality.

In this study reproductive inefficiency is caused by fertilization failure (9%), luteal insufficiency at insemination (10%), embryonic mortality (53%) and foetal deaths (8%). Embryonic mortality is the major caused of reproductive inefficiency. EED contributed to 73% of all embryonic mortalities with 62% of these taking place from Day 8-21 of the gestation period. Fertilization rate of 81% is achievable in the tropics. Treatment with exogenous progesterone do not increased pregnancy rate neither does keeping early pregnant animal under stallfeeding, but both factors had a positive association in contributing to embryonic mortality.

Poor reproductive performance in this study in not due to fertilization failure but due to embryonic mortality. This study has challenged the traditionally accepted reason of poor heat detection being the main reason for poor reproductive performance (due to fertilization failure) in the Sahiwal Friesian cows.

Abstrak tesis yang di kemukakan kepada Senat Universiti Putra Malaysia bagi memenuhi syarat-syarat untuk Ijazah Master Sains.

KEMATIAN EMBRIO DI DALAM LEMBU KACUKAN SAHIWAL FRIESIAN DI SEBUAH LADANG DI MALAYSIA

oleh

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Kerugian di sebab kegagalan untuk melahirkan anak pada jangka masa yang ditetapkan didalam penternakan lembu tenusu adalah tinggi. Antara sebab kemungkinan bolih berlaku adalah kegagalan untuk persenyawaan ova dan kematian embrio pada peringkat awal kebuntingan. Industri tenusu di Malaysia mengalami masalah pembiakan lembu yang tidak ekonomik dimana jangka selang kelahiran yang panjang dan lembu kerap mengulang untuk dibiakkan.Samada keadaan ini disebabkan olih kegagalan untuk persenyawaan atau kematian embrio peringkat awal kebuntingan tidak pernah diselidiki. Kajian ini adalah yang pertama di jalankan di tropik untuk

menentukan faktor faktor penyebab di samping mengaitkan kelembapan dan cuaca iklim tropik.

Kajian ini mendapati kekurangan fungsi luteal selepas permanian beradas (10%), kegagalan persenyawaan (9%), kematian embrio (53%) dan kematian janin (8%) adalah faktor penyebab kepada masaalah pembiakan lembu. Sebanyak 73% dari kematian embrio berlaku pada peringkat awal kebuntingan dimana 62% darinya berlaku antara hari ke-8 hingga hari 21 kebuntingan. Kadar persenyawan yang tinggi (81%) bolih dicapai di bawah iklim tropik. Memberi rawatan hormon progesterone dan menyimpan ternakan di dalam kandang pada peringkat awal kebuntingan tidak berkesan untuk meningkatkan kebuntingan, tetapi kedua-dua faktor mempunyai kaitan yang tinggi dengan kematian embrio.

Masaalah pembiakan di dalam kajian ini bukan disebabkan olih kegagalan persenyawaan ova tetapi kerana kematian embrio pada peringkat awal kebuntingan. Keputusan dari kajian ini telah mencabar pendapat yang di terima umum bahawa kegagalan mengesan berahi (menyebabkan kegagalan persenyawaan ova) adalah penyebab utama kepada masaalah pembiakan di dalam lembu kacukan Sahiwal Friesian.

CHAPTER I

INTRODUCTION

About half of the world's cattle populations are located in the tropics. However, they managed to only produced less than one third of the world's milk and meat supply. Their productivity is limited by low reproductive rates, unfavourable environmental conditions and less efficient management practices.

In 1974, the dairy development programme was launched by the Department of Veterinary Services (DVS) based on the requirements of the New Economic Policy (NEP), to supplement the income of farmers through dairying activities. To organise and coordinate the dairy operation and all extension activities in dairy development areas (DDA), the DVS has established 40 milk collecting centres (MCC) by 1992 with a total of 7,500 farmers participating in the programme. Today [1994] 3000 farmers were estimated to be still active in dairying. A total of 20,000 Sahiwal Friesian heifers have been imported between 1975 - 1991 for the dairy programme, out of which 14,708 dairy crossbred cows and heifers were distributed to farmers through the MCC's at subsidised government rates (Mustaffa-Babjee, 1994).

All cooperative members are eligible to all services from marketing their milk products, before and advanced dairy training at established government institution, subsidise rate of dairy stocks for initial purchase and replacements, an extension

services which includes artificial insemination and disease control and lastly an organised computation of animal's reproductive and production records at the MCC's. It was hoped that an eventual outcome of this programme, is that the dairy industry in Malaysia will be able to cater 20% of its local milk needs by the year 2000. However the rate of self- sufficiency of milk was only 4.3% (Osman, 1993).

Sharifuddin et al. (1983) found that dairy crossbreds belonging to the smallholder farmers experienced a period of post-partum anoestrus ranging from four to ten months. The longer calving intervals experienced in the small-holder dairy herds were due to inactive ovaries rather than failure to detect heat (Sharifuddin et al., 1985). This was significantly associated with the use of calves to stimulate milk-let-down by the small-holder farmers (Sharifuddin et al., 1986). Jainudeen and Salim (1994) concluded that the major fertility problems of village cattle in the tropics were poor estrus detection, repeat breeding, and prolonged calving-to-conception interval. Delayed puberty was also suspected to be contributing to the problems, as it shortens the production lifetime and reduced the number of lactations and calves per cow .

Reproductive wastage is a major cause of production loss in both dairy and beef cow herds. Fertilisation failure and early embryonic mortality are suggested to be the main causes of this reproductive wastage, and in dairy herd performance it is manifested by repeated breeding and long calving intervals. An analysis of the breeding records maintained by a computer recording system (Dairy Champ, Univ. Of Minnesota) it was found that the calving-to-conception interval of the Malaysian dairy crossbred cattle in two institutionalised farms in Kluang were 131 ± 15 days and 134. ± 9 days and services per conception rate of 3.3

There is clear evidence of repeated services for a cow to conceive. Whether the reason for poor reproductive performance is due to fertilisation failure or early embryonic deaths, need to be established.

Dairy farming in Malaysia receives stiff competition from the plantation sector. Major lands are allocated for rubber, oil-palm and industrial estates, and dairying now occupies marginal lands not large enough for other uses. There is a need for a major shift from extensive system to intensive system of farming. How the reproductive performance of dairy cows will be affected under intensive tropical farming condition is still unknown and need to be studied.

Three reproductive diagnostic tools, namely the embryo recovery technique to determine the fertilization rate, the progesterone radioimmunoassay procedure for assessing luteal function and the rosette inhibition test for detection of early pregnancy factor (EPF) have been used in two experiments.

The objectives of the present studies were as follows:

In Experiment 1, the objectives were:

(a) to establish the fertilization rate of the Sahiwal-Friesian cows,

(b) to study the stage and patterns of embryonic deaths,

(c) to study the factors that contribute to reproductive inefficiency in this herd.

In Experiment 2, the objectives were:

(a) to study the effects of stall feeding and exogenous progesterone supplementation on the conception rates of Sahiwal Friesian cows.

CHAPTER II

LITERATURE REVIEW

The Reproductive Performance of Sahiwal-Friesian Cows in the Tropics

The dairy industry in Malaysia is mainly limited to small scale farming. Dairying as an enterprise and/or business was brought along by the migrants Indians from India and has remain an activity identified with the Indian community. The dairy cattle population in Malaysia originated from a mixture of Indian zebu breeds and has been designated as the Local Indian Dairy (LID) cattle (Mustaffa-Babjee, 1994). Since the implementation of the dairy development programme, 20,000 heads of Sahiwal-Friesian heifers were imported from Australia and New Zealand to form the base stock. Gradual upgrading of the cattle through breeding, selection and progeny testing is in progress towards producing a type of cattle totally adapted to the hot humid conditions in Malaysia.

Conception Rate

Alexander et al. (1984) reported that conception rates in the Australian Sahiwal-Friesian cows was 77% after two inseminations. Sixty nine percent of all inseminations were performed at less than 86 days post calving with an average period of 106 days for calving-to-conception. Records from two institutionalised farms in

Malaysia with similar crossbreds were 21.9 to 39.3% and 22.3 to 51.8% respectively for the past 10 years.

Calving Interval

The calving intervals in Sahiwal-Friesian cows were from 425.5 ±129.5 days in stallholders herd in Malacca (Abu Hassan and Nazri, 1993), 407 days (Eusof and Ngah, 1982), 442 ±12 days (Normala, 1995) for smallholder herds in Banting and 407.0 ±12.7 in Keningau (Normah, 1988). Supriatna (1989) and Surachat (1989) both reported a calving interval of 405±80 days and 452 to 486 days for small holders dairy herds in West Java and North-east Thailand respectively.

On a larger scale of production, two institutionalised dairy farms in Kluang Johore recorded an average of 411± 14.8 days and 414.9 ± 8.8 days respectively, from 1986-1995.

Reproductive Efficiency

Rao et al.(1981) reported their finding on crossbred cows that the frequency of silent heat (39.3%) and percentage of ovulatory failure (41.0%) during the second oestrous cycle after calving were still high, but in the third ovulation which occurred about 20.3 ± 0.8 days after second ovulation the values decreased to about 25.9% and 14.8% respectively. Singh et al. (1981) found that factors affecting conception were anestrus (11.5%) and repeat breeding (25.0%) in 148 halfbred Sahiwal-Friesian cows, while those affected by parturition resulted from retention of placenta (8.1%), abortion (4.1%) and stillbirth (3.4%), making a total of about 15.6%. Normala (1995) reported a mean pregnancy rate of 87.7% and an abortion and stillbirth rate of 1.9% and 2.9%

respectively from 31 smallholder herds around Banting. The report also cited that dystocia, retained placenta and repeat breeding as the main reproductive problems encountered.

Koh (1975), attempted to quantify some of the reproductive parameters that contribute to infertility in a herd from records maintained by the Institution's farm. He found that the percentage of fertilisation failure was 30.9%, and embryonic and early fetal mortality was 30.7%. The abortion rate was 0.7% and a calving percentage of 26.3% in a temperate crossbred group. Jainudeen et al. (1985) in a study involving 186 Sahiwal-Friesian and Friesian-LID cows observed a significant difference in the service period among parity, body conformation and nutrition groups. In Thailand, during the same period, repeat breeding in a similar crossbred was related to the management system (Songsasen et al., 1986)

Factors Influencing Reproductive Performance

Reproductive performance of cattle is relatively low in many of the developing countries and remains a major limitation to the achievement of optimum efficiency and economic production. The reasons for this are multiple and interrelated but may be listed as nutritional, environmental, disease and management factors (Peacock, 1971 and Peters, 1996). Reproductive performance, as described by Coleman et al. (1985), is a measure of the ability of a cow to become pregnant and produce viable offsprings. Under most conditions the optimum calving interval is 365 days or thereabouts. fertility results in losses due to lower milk sales, fewer calves born and slower genetic progress.

The calving interval is the parameter mostly used to asses reproductive efficiency and is composed of the calving to conception interval and the gestation period. Of these the calving to conception interval is the critical variable and in turn consists of:

1) the time to resumption of ovarian cycles (the acyclic period);

2) the occurrence and detection of oestrus;

3) the fertility at service.

Reproductive inefficiency is manifested clinically by anoestrus and repeat breeding. The acyclic period or delayed onset to resumption of ovarian cycles after calving is affected by certain diseases of the puerperium, nutrition and management. Repeat breeding are caused by fertilisation failure or embryonic death.

Factors Affecting the Acyclic Period

Diseases of the Puerperium

Thompson et al. (1983) showed that cows with calving difficulty (dystocia) had longer calving to first service and conception intervals. Similarly, Borsberry and Dobson (1989) found that retain placenta (RFM) and endometritis extended calving to conception intervals by 60 days. Uterine abnormalities including metritis have been shown to be associated with high circulating PG concentration and that the first ovulation post partum does not occur until PG levels have returned to baseline (Madej et al., 1984). Risco et al. (1994) reported that milk fever (hypocalcemia) resulted in extended calving to conception intervals by delaying time of first ovulation post partum and this is associated with delayed involution. Fatty liver disease affects reproductive

performance by delaying ovarian cyclicity post partum and low conception rates (Higgins and Anderson, 1983; Reid et al., 1983).

Cystic ovarian disease also commonly occurs in dairy cows in early lactation and is responsible for delays in rebreeding. Estimates of incidence of cystic ovaries in zebu cattle range from 1 to 13% (Rao et al., 1965). There appears to be a genetic predisposition to cystic ovaries. Animal of all ages are susceptible. Hernendez-Ledezma et al. (1984) observed that the incidence of cystic ovaries increased from 8.4% in primiparous cows to 25.9% in cows in their fifth lactation. The incidence overall was also higher in cows with metritis (14.6%) and in retained placenta (13.6%) than in healthy cow.

Nutrition

Most of the research on nutrition and fertility has focus on the development of feeding dietary regimes that will support milk production at an economic level and maintain cow health and reproductive performance. The dairy cows in early lactation has a higher energy requirement than can be supported by intake and is always in negative energy balance (NEB). The level of NEB is correlated both with milk yield and timing of the first ovulation post partum (Ducker et al., 1985; Butler and Smith, 1989). Canfield and Butler (1991) suggested that ovulation does not occur until the energy balance begins to rise again. Extended period of anoestrus caused by under nutrition was due to repeated development and atresia of dominant follicle. Stagg et al. (1995) found that mean interval from calving to first ovulation was 25 days longer for those receiving 80 MJ as opposed to 120 MJ of metabolisable energy daily. The body condition of cows at calving influences the interval of calving to first ovulation

(Wright et al., 1992). He demonstrated that thin cows on low (60 MJ ME daily) and high (115 MJ ME daily) energy diets had longer calving to first post partum oestrus as compared to fat cows given similar diet.

Low protein intakes can reduce the incidence of behavioural oestrus and conception in beef cows (Robinson, 1996) due to stimulatory effects of digestible undegradable protein (DUP) on milk production thus increasing the magnitude of the deficit in energy balance. Suckler cows in poor body conditions fed with high DUP diets at mating has longer calving to first oestrus interval (Sinclair et al., 1994).

Factors Contributing to Conception Failure

Fertilisation Failure

In cows with normal breeding histories fertilisation rate in excess of 80% are generally achieved (Boyd et al., 1969; Ayalon, 1979; O'Farrel et al., 1983 and Ahmad et al., 1994). In repeat breeder cows fertilisation rate and embryo survival rate may be as low as 56% and 23% (Graden, 1968; Ayalon, 1978 and O'Farrel et al., 1983). Failure to conceive is considered to be caused by fertilisation failure and early embryonic mortality (Graden, 1968; Ayalon, 1978; O'Farrel et al., 1983; Maurier and Chenault, 1983 and Gustaffsson, 1985). Repeat breeding will eventually lengthens the calving-to-conception intervals (Laming and Bullman, 1976; Oltner and Edqvist, 1981; Haresign et al., 1983). Suboestrus and incorrect oestrus detection may result in repeated irregular oestrus intervals. This can also be due to late embryonic or early fetal deaths and other genital infections such as campylobacteriosis or infectious bovine rhinotracheitis (IBR) infection (Noakes, 1988). The origin of non-infectious infertility is often attributed to environmental influences and husbandry factors.

Oestrus detection failure: Faulty oestrus detection is still a major factor contributing to fertilization failure. In the tropics poor accuracy in oestrus detection was due to the predominant zebu type of cattle do not display the overt signs of oestrus (Galina et al., 1990). Oestrus expressions are influenced by group compositions and group size, the hierachial status of the cows with the dominant cows less likely to accept to be ridden (Price, 1987). Galina et al. (1996) in reviewing the findings of other researchers suggested that zebu type cows in oestrus have certain influence on their herd mates. This was supported by observations of Gutierrez et al. (1993) and Larsen and Kiracofe (1995) that non treated control cows are immitating behavioural signs of oestrus of treated animals.

Environmental and Management Factors:

Rain, strong wind, herding or keeping animals accustomed to grazing under corral conditions tends to suppress mounting or oestrus related activities (Vaca et al., 1988; Price, 1987). When temperature peak higher than 30 °C mating behaviour was less frequent (Gwazdauskas et al., 1975) and oestrus cows tends to exhibit more secondary signs in hot weather (Pennington et al., 1985) thus increasing oestrus detection error rate. During heat stress period fertilisation failure was due to the effect of heat stress on the oocyte during follicular development (Monty and Racowsky, 1987).

The incidence of cases of lameness in dairy cow herds caused reduced reproductive efficiency. Lameness increases calving to first service and calving to conception intervals (Lucey et al., 1986; Collick et al., 1989) due to lame cows are less inclined to exhibit oestrus due to pain. Britt et al. (1986) showed that cows housed on concrete flooring showed less oestrus activities than those on straws.

Timing of Insemination: Considerable technical skill is required for a dairyman to detect oestrus. Some dairymen tend to detect oestrus based on secondary overt signs like restlessness, bellowing, sniffing, swelling and reddening of the vulva and mucous discharge. A cow standing to be mounted is the most definitive sign of oestrus. Standing behaviour is critical because the onset of standing heat is closely related to the time of ovulation (O'Connor and Senger, 1997). The highest conception rates are obtained when cows are inseminated between the middle and end of the period of oestrus (Roberts, 1971). Insemination carried out during the early part of oestrus and after ovulation has occurred, resulted in lowered pregnancy (Boyd, 1970; Deas, 1970).

Embryonic Mortality

Embryonic mortality is defined as deaths of the conceptus during the embryonic period usually considered from conception to the completion of organogenesis which is up to 45 days in cattle (Committee on Bovine Nomenclature, 1972). Abortion in cattle is defined as the expulsion of living or dead foetus before 261days.

Reproductive wastage is a major inefficiency in all livestock production. The occurrence and significance of embryonic mortality in farms animal has been extensively reviewed by Ayalon (1978), Edey (1979) and Flint et al. (1982) in farm species like cattle, sheep and pig respectively. A very large portion of the losses occurs during the first 3 to 4 weeks and are designated as early embryonic mortalities. When death occurs at this very early stage of pregnancy, the conceptus may be completely resorbed by the uterus, or the vessicle may passed out through cervix and vagina and usually escapes notice. Clinically the loss remains unrecognised as the loss occurs before any fluctuation in oestrous cycle is obvious. Death of embryos before seven