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BLOOD METABOLITE AND HORMONE CONCENTRATIONS
OF DAIRY CALVES DIFFERING IN GENETIC POTENTIAL
FOR MILK FAT PRODUCTION

A THESIS PRESENTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE DEGREE OF MASTERATE OF AGRICULTURAL SCIENCE
IN ANIMAL SCIENCE AT MASSEY UNIVERSITY
NEW ZEALAND

GUO QIANG XING

1985
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Department of Animal Science
Beijing Agricultural University
Beijing, China
The present study was conducted at the Massey University Dairy Research Unit to investigate the effect of genetic merit for milk fat production on the physiology and metabolism of Friesian calves.

Twenty four Friesian calves divided into four groups namely High Breeding Index (HBI) heifers, HBI bulls, Low Breeding Index (LBI) heifers, and LBI bulls were challenged with four different experimental treatments, ie. fasting, feeding, intravenous arginine infusion, and subcutaneous synthetic corticosteroid injection at ten to eighteen days of age. A total of eighteen blood samples were collected from each calf through an indwelling jugular cannula and the concentrations of plasma glucose, insulin, GH and cortisol were determined.

Some statistically significant differences were found in plasma metabolite and hormone concentrations between the HBI and LBI groups.

1. The basal glucose concentration in HBI group was significantly higher than that in LBI group (P<0.05). The basal plasma insulin concentration was also significantly higher in HBI group than in LBI group (P<0.01). The basal GH concentration in HBI calves was higher in HBI calves than in LBI calves, but the difference was not quite significance at 5% level (P=0.059).

2. Following feeding, plasma insulin and GH concentrations in HBI group were significantly higher than those in LBI group (P<0.01, P<0.05 respectively).

3. Acute intravenous arginine infusion induced hyperinsulinemia and hypoglycemia in all calves. LBI calves had significantly higher increments of plasma insulin measured as a percentage of basal levels than HBI calves. The response of GH concentration to arginine challenge differed significantly in terms of level and pattern between HBI and LBI groups, with the HBI calves having more prolonged higher GH concentration than LBI calves (P<0.05).

4. Subcutaneous injection of synthetic corticosteroid resulted in significant increments in plasma glucose and insulin concentrations, and a significant decrease in endogenous cortisol production in all calves. (P<0.01, P=0.05, P<0.01 respectively). But no significant differences were detected between HBI and LBI groups.
Effects of sex on plasma metabolite and hormone concentrations were also found in the present study. Plasma insulin concentration was consistently higher in bulls than in heifers and the differences were significant at the time of fasting, after feeding, and after arginine infusion ($P<0.01$). Plasma glucose concentrations following feeding were significantly higher in bulls than in heifers ($P<0.05$). GH concentration was slightly but not significantly higher in bulls than in heifers for most of the experiment.

It was concluded that differences exist in some important metabolic and endocrinological characteristics between HBI and LBI calves, and these differences could become significant under certain physiological conditions and experimental treatments such as those applied in the present study. This study also showed the promise of identifying genetically superior Friesian dairy cattle at an early age by using physiological markers. However this possibility has yet to be tested by carrying out measurements on calves for which breeding index value for milk fat production will be determined by methods such as progeny test.
ACKNOWLEDGMENT

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The Usefulness of physiological markers in dairy cattle breeding

It has long been desired, as recently discussed in several papers (Gorski, 1979; Kiddy 1979; Linstrom, 1982; Peterson et al, 1982; Land et al, 1981) to be able to identify genetically superior dairy cattle from their contemporaries at an early stage of their life by using physiological or biochemical markers which are genetically correlated with milk production.

A dairy breeding system using such markers would have advantages over the conventional breeding technique, progeny test, in several respects: 1) reduced breeding cost, 2) more intensive selection of bulls, as a large population of animals can be tested for the marker, 3) shorter generation intervals, due to the early intensive use of the identified bulls in the artificial insemination scheme.

Animal breeding programmes for dairy cattle, so far, have been based on the principles of quantitative genetics. These programmes are expensive and genetic improvement is slow. In New Zealand, contracts are made each year by the Dairy Board with individual farmers to purchase about 150 newborn dairy bulls (including both Friesian and Jersey breeds) for progeny testing. All these bulls are kept in the breeding centre till they are 5 years old, waiting the assessment of their daughters' production. Thereafter only a few of the proven bulls are used intensively in the AI scheme while others are culled. Nevertheless, this conventional breeding method has proved reliable and rewarding in dairy herd improvement as witnessed by the great improvement in milk production of Friesian cattle both around the world (Jasiorowski et al, 1983) and within New Zealand (Bryant et al, 1981; Davey et al, 1983; Wickham et al, 1978). This provides the opportunity to compare the physiological differences between two groups of genetically diversified Friesian cattle, a study of which may lead to the identification of suitable gene markers which could, in turn, aid in further improvement of dairy cattle production.