

THE EFFECT OF DIETARY PROTEIN ON MAMMARY BLOOD FLOW AND MILK PRODUCTION

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The rate of blood flow to the udder is a major determinant of rate of substrate supply and therefore milk production. Very little work has been done on the effect of diet on blood flow and milk production because of the cost and expertise required in surgically preparing and maintaining the experimental animal.

Six multiparous, mid-lactation Friesian cows were assigned to either a high protein (HP, 18%) or low protein (LP, 12%) diet. The two diets were isoenergetic but contained different levels of degradable and undegradable protein. Cows were fed ad libitum and water intake was unrestricted. The trial lasted six weeks. After a three-week accustomisation period, 16 mm ultrasonic blood flow probes (Transonic Systems Inc., Cornell, New York) were surgically implanted around the right pudendal artery under general anaesthesia. The right pudendal vein was tied off in two places 10 cm apart and severed. Following recovery from surgery, blood flow and milk yield (separate right and left udder) were measured for 12 days. Milk samples were taken every three days. The mean results for the 12 day period were:

| Parameter value | HP cows | LP cows | P |
|------------------------------------|---------|---------|------|
| Blood Flow (L/min) | 4.5 | 3.9 | 0.35 |
| Right Udder Milk Yield (L/day) | 12.1 | 11.2 | 0.16 |
| Milk Yield (Left + Right)(L/day) | 25.1 | 22.4 | 0.06 |
| Blood Flow : Milk Yield Ratio | 537.1 | 501.5 | 0.61 |
| Milk Sampling Days | | | |
| % Fat-corrected Milk Yield (L/day) | 25.9 | 21.2 | 0.01 |
| Protein % | 3.35 | 2.95 | 0.11 |
| Protein Yield (g/day) | 83.7 | 66.1 | 0.01 |
| Fat % | 4.35 | 3.63 | 0.05 |
| Fat Yield (g/day) | 108.5 | 81.4 | 0.01 |
| Lactose % | 4.91 | 4.87 | 0.61 |
| Lactose Yield (g/day) | 123.0 | 109.2 | 0.06 |
| Somatic Cell Count (x1000/mL) | 37 | 63 | 0.41 |

It is apparent that the surgery had little effect on the right udder milk yield since the values for each half are similar. On average the milk yields declined by 57% at two days post surgery but had returned to 93% of their previous yield by seven days after surgery. Tying off the pudendal vein appeared to have little effect on milk yield over the period of study.

Despite the non-significant difference in blood flow between groups, there was a trend to increased blood flow and right udder milk yield in HP cows, suggesting that dietary protein may influence blood flow (Oldham 1984). It is possible that dietary protein stimulates the release of growth hormone which in turn stimulates cardiac output with a concomitant increase in mammary blood flow (Davis et al. 1988). The HP diet has had a marked effect on protein, fat and lactose yield, with increased milk yield and possibly increased blood flow playing a major role in the elevation of these parameters.

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