

Examining the Role of Glucose Transport in Milk Production

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Glucose transport in the bovine mammary gland is essential for the production of lactose and therefore plays a key role in milk synthesis. Glucose transporters (GLUTs) mediate glucose transport into the secretory cells of the mammary gland. GLUT1 is the major glucose transporter present in bovine mammary gland and it is thought to play an important role in glucose transport during lactation. The objective of this study was to determine the rate at which glucose is transported by bovine GLUT1. We hypothesized that because of the high demand for glucose in the mammary gland and the low blood glucose levels typical of ruminant metabolism, bovine GLUT1 would transport glucose at a faster rate than GLUT1 from non-ruminant species. The transporter was expressed in frog oocytes by microinjection of mRNA coding for bovine GLUT1 protein. The rate of glucose transport by bovine GLUT1 was analyzed using a radioactive non-metabolizable glucose analogue which was added to the medium in which the oocytes were cultured. The GLUT1 protein was found to be localized to its proper position in the plasma membrane, and it significantly increased glucose transport into the oocytes. Glucose transport was dramatically inhibited by specific glucose transport inhibitors, showing that GLUT1 was functioning normally. The transport activity of bovine GLUT1 was half-saturated at 7.69 ± 1.7 mM glucose, indicating that at normal blood glucose concentrations of 3-3.5 mM bovine GLUT1 is ~20% saturated. Glucose transport by bovine GLUT1 was inhibited by mannose and galactose, demonstrating that it can transport other sugar molecules. Our results provide insight into the role of bovine GLUT1 in supplying the mammary gland with glucose, which is an essential process for efficient lactation.