

MONOSACCHARIDES IN THE PERIPHERAL BLOOD OF PIGLETS AFTER INGESTION OF LACTOSE AND FRUCTOSE

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The nursing period of piglets is a critical time for their survival and future health status. An understanding of carbohydrate metabolism at this time is important for both nutritional and pathological reasons. The dominant carbohydrate in the nursing piglets' diet is lactose which is hydrolysed by intestinal lactase to glucose and galactose. These monosaccharides are absorbed by a shared symport mechanism whereas the absorption of fructose, a monosaccharide that becomes an important component in the diet at weaning, occurs by facilitated diffusion. The changes in the plasma concentration of these monosaccharides were investigated in the peripheral blood of piglets following the ingestion of lactose and fructose.

Ten-day old piglets were fasted for at least one hour before oral administration of a carbohydrate solution, containing one of five different amounts of lactose and fructose. Blood samples (60 μ l) were taken from the ear veins of the piglets at 3-5 min intervals for 40 min and then at 60 and 90 min after the dose had been administered. The plasma (20 μ l) was deproteinised and assayed for galactose and fructose (using bioluminometric techniques) and glucose (colorimetrically). The plasma concentration of each monosaccharide was plotted against time and the areas under the curves (AUC) were determined. A similar protocol was used for a suckling study and the amount of lactose ingested was calculated by weighing the piglet before and after it suckled the sow. The results are presented as mean \pm standard error ($n = 6$).

Fasting concentrations of plasma galactose, fructose and glucose were $11.40 \pm 1.31 \mu\text{M}$, $14.63 \pm 4.30 \mu\text{M}$ and $4.92 \pm 0.25 \text{ mM}$ respectively. Peak concentrations of plasma galactose occurred between 15 and 30 min after ingestion of lactose doses of 0.90, 1.35, 1.57, 1.80 and 2.20g and were 57.32 ± 5.26 , 109.41 ± 12.86 , 121.20 ± 10.7 , 181.68 ± 32.6 and $364.47 \pm 107.31 \mu\text{M}$ respectively. The galactose AUC values were fitted to an exponential model ($\log y = 0.38x + 2.94$) and a significant ($r = 0.904$, $p = 0.001$, $n = 38$) first order relationship was found with time. The change in the plasma concentration of glucose was 2.66 ± 0.23 , 2.13 ± 0.26 , 2.89 ± 0.42 , 3.09 ± 0.52 and $4.61 \pm 0.45 \text{ mM}$ for the 0.90, 1.35, 1.57, 1.80 and 2.20g doses of lactose. The peak concentrations of plasma fructose ranged from 285 to 1900 μM , between 15 and 40 min, after fructose doses of 0.15, 0.25, 0.31, 0.37, and 0.45g. The concentrations and AUC for fructose showed a large variation both within and between the different doses. Data from the piglets which suckled showed that the plasma concentration of galactose often peaked more than once after a suckling. The concentrations and the AUC were lower and had a smaller range than those attained after an oral administration of lactose and fructose. However the AUC values were fitted to an exponential model ($\log y = 0.21x + 3.07$) and a significant ($r = 0.848$, $p = 0.016$, $n = 6$) first order relationship was found with dose.

The data from the oral administration of lactose and fructose suggest that the plasma galactose and glucose concentrations are under a tight metabolic control while there appears to be little control of the plasma concentration of fructose in 10 day old piglets. Results from piglets which suckled indicated that some components of milk can influence the rate of digestion of lactose and hence the subsequent change in the plasma concentration of galactose. These findings demonstrate that the AUC for changes in the plasma concentrations of galactose with time provide an index of the amount of lactose ingested and a measure of the efficiency of the digestion and absorption of lactose in piglets.