HOW TO ESTIMATE THE AVERAGE FAT CONTENT OF HUMAN MILK: A NON-INVASIVE METHOD

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During a feed from a breast, the fat content of the milk rises in a non-linear manner (Hytten, 1954). Often, significant amounts of milk remain in the breast at the end of the feed.

Despite these facts, most analyses of human milk are based on the complete expression of a breast's contents. Apart from the obvious disruption of normal feeding of the infant, this approach includes in the sample some fat-rich hind milk that the baby might not have consumed if allowed to feed at that time. Thus, samples based on complete expression may overestimate both the volume consumed and the fat (and therefore energy) intake.

We have conducted a study involving 28 mothers and 220 feeds from a breast, with infants aged from one to eleven months. At each feed from a breast, the baby was weighed on an integrating electronic balance (to the nearest gram) at the beginning and end of the feed, and small samples of fore- and hind-milk were obtained. In addition, the feed was interrupted between 0.5 and 5.0 minutes after the start, different times being randomly selected for each feed; at the interruption, the baby was weighed, and a small milk sample obtained. Babies almost invariably re-attached to the same breast following the interruption.

Thus, for each feed from a breast, we had a three-point plot of fat concentration (f) against volume consumed since start of feed (v). While these plots varied somewhat in shape, we were able in all cases to fit a mathematical equation; different feeds required different equations. Integration then yielded an estimate of the total fat consumed during a feed (TF), and hence the "true" mean fat concentration for the feed (TM).

We compared TM for each feed with other proposed predictors of mean fat concentration: the mean of the fat concentrations of fore- and hind-milk (PM - Prentice *et al.*, 1981), and the more elaborate formula involving the fat concentrations of fore- and hind-milk derived for expressed milk by Rattigan (RM - Hartmann *et al.*, 1985). The RM predictions exceeded TM by an average of 10 g/L (resulting in an average overestimate of 26% for TF), and PM predictions exceeded TM by an average of 5 g/L (an average overestimate of 14% for TF).

With a little manipulation, we found that PM could be used to provide a more accurate prediction of TM:

$$\text{predicted TM} = (12.0 \times \sqrt{PM}) - 39.7$$

where PM and TM are expressed as g/L. The average discrepancy between observed TM and this prediction was zero. For over 80% of feeds, the prediction was within ±5 g/L of the observed value, with the result that predicted TF was within 9% of the observed TF.

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