# Feeding the sow to increase piglet weaning weight

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## Summary

It has become clear that liveweight of the pig at weaning, and indeed at birth, has a substantial impact upon growth rate to slaughter. Use of established regression equations reveal that relatively small increases in birth weight and weaning weight of 0.2 kg and 0.6 kg, respectively, will result in an increase in carcass weight of about 3 kg. As there is a positive relationship between maternal feed intake during pregnancy and piglet birth weight, there may be scope to effectively increase piglet birth weight by increasing maternal energy intake of sows during late pregnancy. However, there appears to be greater scope to increase weaning weight by manipulation of nutrient intake of the sow during lactation. Although the sow is able to buffer milk production by metabolism of body reserves, milk yield still responds to maternal energy intake during lactation; for maternal energy intakes between 20 and 80 MJ DE/day during lactation, daily piglet growth responds by about 0.9 g/MJ DE. A curvilinear relationship appears to describe better the relationship between piglet growth rate and maternal dietary protein during lactation; daily piglet growth is maximised at a dietary level of about 0.9% lysine.

**Keywords:** sow, nutrient intake, piglet, weaning weight, birth weight

## Introduction

There is now realisation that the weight of the pig at weaning, and indeed at birth, bears a strong positive relationship to subsequent growth and the weight at some time in the future. A key performance target in pork production should be maximisation of weaning weight because this will have an overall influence on subsequent growth in the growing and finishing stages. Also of importance is the variation in weaning weight, and weight in the nursery, grower and finisher phases.

The weight of piglets at weaning is one of the most critical factors determining the subsequent growth performance of pigs. Research by Campbell (1990), for example, showed a strong inverse relationship between weight of pigs at weaning at 28 days of age (W) and the length of time taken to grow to 20 kg liveweight (T), as follows:

$$T = 52.1\ (\pm\ 1.69) - 3.39\ (\pm\ 0.224)\ W$$
$$(r^2 = 0.85,\ P < 0.001)$$

Based upon this equation, pigs that are 1 kg heavier at weaning reach 20 kg more than 3 days earlier. Heavier pigs at weaning seem to continue their weaning weight advantage to slaughter weight (Mahan and Lepine 1991) and the age at slaughter could be reduced even further by at least 10 days for a pig that is 1 kg heavier at weaning (Cole and Close 2001). Because of the positive relationship between weaning weight and post–weaning growth performance, any factor that increases piglet weight at weaning should reduce slaughter age.

This paper examines the potential to manipulate nutrient intake of the sow during pregnancy and lactation to influence piglet weaning weight.

## Pregnancy

The sow is able to buffer the developing foetus against nutritional inadequacies during pregnancy, but at the expense of her own body tissue reserves. Although the major effect of increasing maternal feed intake during pregnancy is to increase maternal weight gain, there is also likely to be an increase in average piglet birth weight which may be significant and economic.

Much of the published work on the responses of birth weight to maternal feed intake was conducted with older genotypes between the mid 1960s and the mid 1980s. Pluske *et al.* (1995) reviewed this work and concluded that the relationship between maternal energy intake and birth weight was linear for sows but curvilinear for first–litter sows, particularly in the older genotypes (Figures 1 and 2).

However, the data sets for the relationship in sows were not as robust as that for first–litter sows, with several of the experiments comparing only two or three

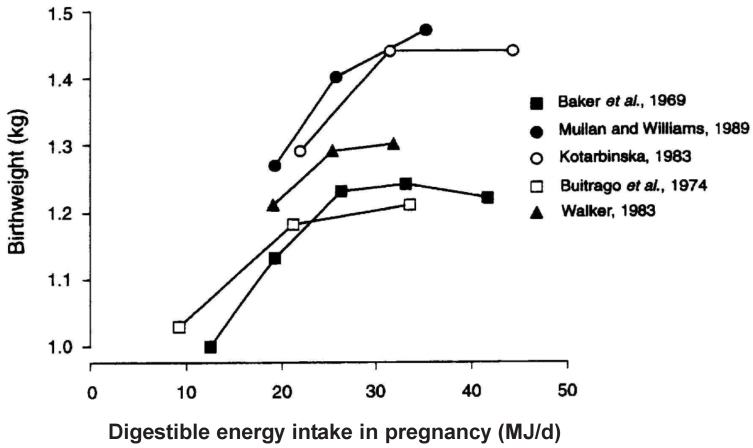


**Figure 1** Relationship between maternal energy intake of gilts during pregnancy and piglet birth weight (Pluske *et al.* 1995).

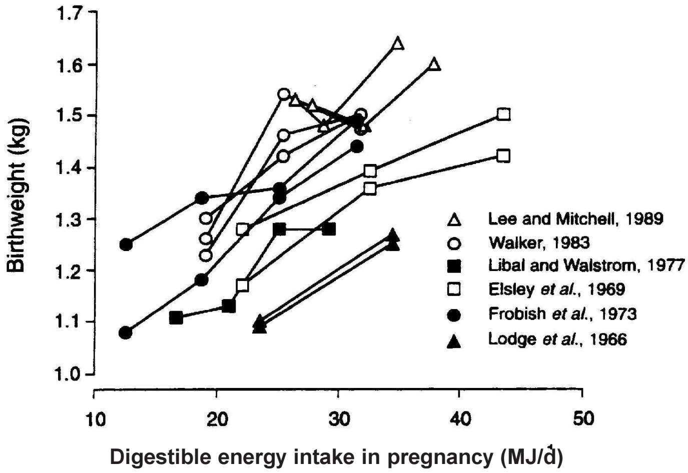


**Figure 2** Relationship between maternal energy intake of sows during pregnancy and piglet birth weight (Pluske *et al.* 1995).

feed intakes. The relationship between daily maternal energy intake of sows and piglet birth weight is essentially linear (Pluske *et al.* 1995) and can be described by the equation:

Birth weight = 0.83 + 0.019 MJ DE/d

The importance of birth weight and its effect on subsequent performance has been recently demonstrated by Cole and Varley (2000) in a commercial herd; birth weight accounted for 37% of the variation in weaning weight. Whittemore (1993) estimated that for a small 0.2 kg increase in birth weight, daily gain from birth to slaughter increases by 24 g which is equivalent to an increase in subsequent carcass weight of about 3 kg, which is worth more than $ 6/pig. Moreover, piglet birth weight is now recognised as one of the major drivers of not only piglet survival but also individual piglet weaning weight and subsequent growth rate. Increased maternal energy intake may also reduce variation of birth weight, particularly in larger litters. Reducing variability of pig growth has become important in pig production, particularly in all–in all–out production systems, where all pigs may be removed from the shed and sent to slaughter on the one day. Thus, strategies to reduce variation as early as body weight at birth may assist in reducing variability in slaughter weights. It is appropriate to re–evaluate the cost effectiveness of increased maternal energy intake of sows during late pregnancy on piglet birth weight and within birth weight variability as well as any adverse effects on sow lactation performance.

# Lactation

## Maternal energy intake

Although the sow is able to buffer milk production by metabolism of body reserves, milk yield still responds to maternal energy during lactation. A review of the results of experiments which have examined the effect of dietary energy intake on litter growth rate indicates that although the response is variable there appears to be a strong linear relationship between litter growth rate and maternal intake (Mullan *et al.* 1993).

The results of several recent experiments which have investigated the response of milk yield or piglet growth rate to increasing levels of maternal feed intake or energy intake during lactation are shown in Figure 3. The data indicate that, for maternal energy intakes between 20 and 80 MJ DE/d during lactation, daily piglet growth responds by about 0.9 g/MJ DE and there is little evidence that a plateau of milk production is achieved within this range.

Thus every effort should be made to ensure high voluntary feed intakes by sows during lactation to optimise sow milk yield. Voluntary feed intakes of lactating sows in commercial herds may be often be below 5 kg/d, particularly for sows that are lactating during the hot summer months. Various nutritional and management factors should be examined to ensure high voluntary feed intake by lactating sows. The influence of some of these factors has been reviewed by O'Grady *et al.* (1985) and is illustrated in Table 1.

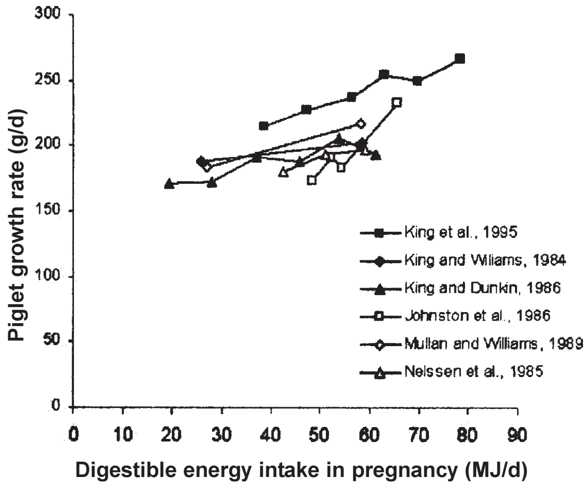


**Figure 3** Comparison of the relationships between maternal energy intake of first litter sows and piglet growth rate.

## Maternal protein and amino acid intake

Whilst there appears to be a strong linear relationship between litter growth rate and maternal energy intake (Mullan *et al.* 1993), a curvilinear relationship appears to better describe the relationship between piglet growth rate and maternal dietary protein during lactation (King *et al.* 1993). Figure 4 represents a summary of experiments conducted to examine the influence of maternal protein and amino acid intake on piglet pre–weaning growth rate.

The requirements for dietary amino acids to maximise milk yield are often lower than those required to maximise nitrogen balance during lactation (King *et al.* 1993). A reasonable objective during lactation is to optimise nitrogen balance rather than milk yield, as a reproductive performance is likely to be compromised if dietary amino acid intake is not sufficient to meet the needs of maintenance, milk production and tissue deposition, particularly in young sows (Tritton *et al.*

**Table 1** Attempts to increase voluntary feed intake of sows during lactation.

| Parameter | Treatments | Voluntary feed intake (kg/day) |
|---|---|---|
| Density of diet | 12.5 MJ DE / kg | 4.9 |
| | 13.8 MJ DE / kg | 5.1 |
| Wet vs dry | Dry feeding (*ad libitum*) | 4.7 |
| | Wet feeding (twice daily) | 5.3 |
| Shed temperature | 27°C | 4.6 |
| | 21°C | 5.2 |
| Protein level during pregnancy | 9% CP | 5.2 |
| | 13% CP | 5.7 |
| | 17% CP | 6.0 |
| Protein level during lactation | 12% CP | 5.0 |
| | 18% CP | 6.3 |
| Daily feed intake during pregnancy | 1.4 kg | 4.3 |
| | 1.9 kg | 4.3 |
| | 2.4 kg | 3.9 |
| | 3.0 kg | 3.4 |

O'Grady *et al.* 1985

1996). Often daily intakes in excess of 70 g lysine (King and Eason 1998; King *et al.*1995) may still fail to optimise nitrogen balance in young sows, although milk yield rarely responds to these higher intakes of essential amino acids.

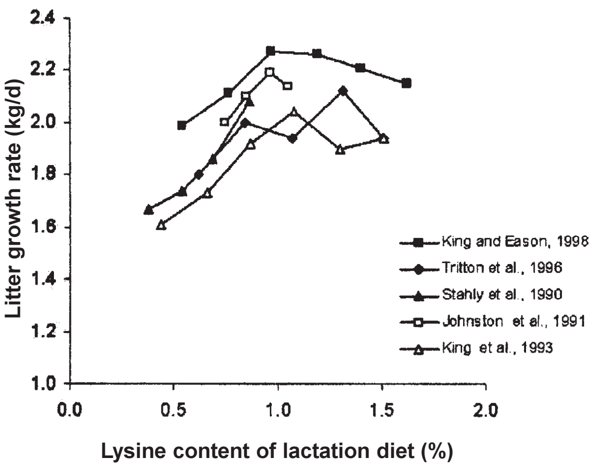


**Figure 4** Comparison of the relationship between lysine content of the lactation diet given to first litter sows and piglet growth rate.

## Conclusion

Attempts to increase birth weight by nutritional manipulation of the sow in pregnancy may be cost effective in some situations. In addition, heavier sows may experience lower culling rates and less fertility problems. There are greater opportunities of sow nutrition during lactation particularly through increased feed intake, to increase the growth of piglets prior to weaning which can have profound effects on subsequent growth rate, slaughter weight and profitability of commercial pork production.

## References


Baker, D.H., Becker, D.E., Norton, H.W., Sasse, C.E., Jensen, A.H. and Harmon, B.G. (1969). Reproductive performance and progeny development in swine as influenced by feed intake during pregnancy. *Journal of Nutrition* 97, 489–495.

Buitrago, J.A., Maner, J.H., Gallo, J.T and Pond, W.G. (1974). Effect of dietary energy in gestation on reproductive performance of gilts. *Journal of Animal Science* 39, 47–52.

Campbell, R.G. (1990). The nutrition and management of pigs to 20 kg liveweight. In: *Pig Rations: Assessment and Formulation. Proceedings of the Refresher Course for Veterinarians,* 132, pp. 123–126. Post Graduate Committee in Veterinarian Science, University of Sydney.

Cole, D.J.A. and Close, W.H. (2001). The modern pig setting performance targets. *Animal Talk* 8, (3).

Cole, M. and Varley, M. (2000). Weight watchers from birth. *Pig International* 30, (12) 13–16.

Eastham, P.R., Smith, W.C., Whittemore, C.T. and Phillips, P. (1988). Responses of lactating sows to food level. *Animal Production* 46, 71–77.

Elsley, F.W.H., Bannerman, M., Bathhurst, E.V.J., Bracewell, A.G., Cunningham, J.M.M., Dodsworth, T.L., Dodds, P.A., Forbes, T.J. and Laird, R. (1969). The effect of level of feed intake in pregnancy and in lactation upon the productivity of sows. *Animal Production* 11, 225–241.

Frobish, L.J., Steele, N.C. and Davey, R.J. (1973). Long term effect of energy intake on reproductive performance of swine. *Journal of Animal Science* 36, 293–197

Johnston, L.J., Orr, D.E., Tribble, L.F. and Clarke, J.R. (1986). Effect of lactation and rebreeding phase energy intake on primiparous and multiparous sow performance. *Animal Science* 63, 804–814.

Johnston, L.J., Pettigrew, J.E. and Rust, J.W. (1991). Response of maternal–line sows to dietary protein concentration during lactation. *Journal of Animal Science* 69, (Suppl 1) 118 (Abstract).

King, R.H. and Dunkin, A.C. (1986). The effect of nutrition on the reproductive performance of first–litter sows. 3. The response to graded increases in food intake during lactation. *Animal Production* 42, 119–125.

King, R.H. and Eason, P.J. (1998). The effect of body weight of sows on the response to dietary lysine during lactation. *Journal of Animal Science* 76, (Suppl. 1) 162 (Abstract).

King, R.H. and Williams, I.H. (1984). The effect of nutrition on the reproductive performance of first–litter sows. 1. Feeding level during lactation, and between weaning and mating. *Animal Production* 38, 241–247.

King, R.H., Toner, M.S., Dove, H., Atwood, C.S. and Brown, W.G. (1993). The response of first–litter sows to dietary protein level during lactation. *Journal of Animal Science* 71, 2457–2463.

King, R.H., Toussaint, J., Eason, P.J. and Morrish, L. (1995). The effect of food intake during lactation on nitrogen metabolism of first–litter sows. In: *Manipulating Pig Production V,* p. 133. (eds. D.H. Hennessy and P.D. Cranwell). Australasian Pig Science Association, Werribee, Australia.

Kotarbinska, M. (1983). Chemical body composition of gilts and sows. *Pig News and Information* 4, 275–278.

Lee, P.A. and Mitchell, K.G. (1989). Feeding sows for specific weight gains in pregnancy and its effects on reproductive performance. *Animal Production* 48, 407–417.

Libal, G.W. and Wahlstrom, R.C. (1977). Effect of gestation metabolizable energy levels on sow productivity. *Journal of Animal Science* 45, 286–292.

Lodge, G.A., Elsley, F.W.H. and MacPherson, R.M. (1966). The effects of level of feeding of sows during pregnancy. 1. Reproductive performance. *Animal Production* 8, 29–38.

Mahan, D.C. and Lepine, A.J. (1991). Effect of pig weaning weight and associated nursery feeding programs on subsequent performance to 105 kilograms body weight. *Journal of Animal Science* 69, 1370–1378.

Mullan, B.P., Close, W.H. and Cole, D.J.A. (1993). Predicting nutrient responses of the lactating sow. In: *Recent Development in Pig Production 2,* pp. 332–346 (eds. D.J.A. Cole, W. Haresign and P.C. Garnsworthy). Nottingham University Press, Loughborough, UK.

Mullan, B.P. and Williams, I.H. (1989). The effect of body reserves at farrowing on the reproductive performance of first –litter sows. *Animal Production* 48, 449–457.

Nelssen, J.L., Lewis, A.J., Peo, E.R. Jr. and Crenshaw, J.D. (1985). Effect of dietary energy intake during lactation on performance of primiparous sows and their litters. *Journal of Animal Science* 61, 1164–1171.

Noblet, J. and Etienne, M. (1987). Metabolic utilization of energy and maintenance requirements in lactating sows. *Journal of Animal Science* 64, 774–781.

O'Grady, J.F., Lynch, P.B. and Kearney, K.A. (1985). Voluntary feed intake by lactating sows. *Livestock Production Science* 12, 355–365.

Pluske, J.R., Williams, I.H. and Aherne, F.X. (1995). Nutrition of the neonatal pig. In: *The neonatal pig — Development and survival*, pp.187–238 (ed. M.A. Varley). CAB International, Wallingford, UK.

Stahly, T.S., Cromwell, G.L. and Monegue, H.J. (1990). Lactational responses of sows nursing large litters to dietary lysine levels. *Journal of Animal Science* 68, (Suppl. 1) 369 (Abstract).

Tritton, S.M., King, R.H., Campbell, R.G., Edwards, A.C. and Hughes, P.E. (1996). The effects of dietary protein and energy levels of diets offered during lactation on the lactational and subsequent reproductive performance of first–litter sows. *Animal Science* 62, 573–579.

Whittemore, C.T. (1993). The Science and Practice of Pig Production. Longman Scientific and Technical, Essex, UK.

Walker, N. (1983). The effects of food intake in gestation on sows lactating for 14 days. *Animal Production* 37, 25–31.