# The key aspects of chick management – part two

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The main source of energy in chick diets is the carbohydrates, which are easily digested and absorbed after hatch. However, a diet with a high level of energy must have, in its composition, a lipid source of low availability during the early life of the chicks.

Maiorka et al. (1997) showed that diets with different metabolisable energy levels (2,900, 3,000 and 3,100 kcal ME/kg) did not promote any change in feed intake in the first week of age, promoted some change in the second week, and a marked change on the third week (Table 6).

The same level of energy consumption was achieved only with broilers from 14 to 21 days of age. Feed intake only became properly regulated on the third week.

Due to these results, the use of high levels of energy from lipids in the first week of age does not seem appropriate, once the increment in energy intake did not improve weight gain nor feed conversion.

Moreover, if lipids are not fully absorbed, which seems probable, or if they are oxidised in the feed or in the lumen, they can cause serious damage to one week old chicks. Peroxides, produced by oxidative rancidity of lipids, compromise the anatomy of the digestive tract and also impair the availability of several nutrients, such as fat soluble vitamins.

These changes can affect the performance of the chicks in this stage and in later stages. In that trial, soybean oil levels added in the three feeds were 1.1, 3.6, and 6.1%, respectively.

Theoretically, the probability of fat oxidation was higher with the higher addition of oil in the feed.

| | Age (days) | AME level (kcal/kg) 2,900 | 3,000 | 3,100 |
|---|---|---|---|---|
| Feed intake (g) | 1-7 | 177 | 178 | 177 |
| | 8-14* | 423 | 402 | 403 |
| | 15-21* | 701 | 675 | 662 |
| ME intake (kcal) | 1-7* | 513 | 534 | 546 |
| | 8-14 | 1,227 | 1,206 | 1,249 |
| | 15-21 | 2,033 | 2,025 | 2,052 |

***Table 6. Effect of feed metabolisable energy on feed intake and metabolisable energy intake. Adapted from Maiorka et al. (1997). *linear.***

| TG:FFA ratio (%:%) | Lipid digestibility (%) Tallow | Palm oil | Soybean oil |
|---|---|---|---|
| 100:0 | 74 | 79 | 95 |
| 75:25 | 65 | 73 | 94 |
| 50:50 | 61 | 66 | 89 |
| 25:75 | 55 | 60 | 86 |
| 0:100 | 41 | 53 | 83 |

***Table 7. Digestibility of lipid sources in different fatty acids ratios in 10 day old chicks. Adapted from Wiseman & Salvador (1991).***

Cabel et al. (1988) showed that 7meq/kg of peroxide in broiler diets impairs weight gain and feed conversion in 21 and 42 day old birds.

Unfortunately, these authors did not record losses in performance during the broilers' first week of age.

According to Petersen (1971), referred by Krogdahl (1985), in chicks, animal fat digestibility significantly increases with age.

That author suggested the equation $D = 60.0 + 4.0 A - 0.07 A2$ ($r=0.81$), where D represents animal fat digestibility and A the bird age in weeks. As it can be seen by the equation, animal fat digestibility is very low in the first week of age.

Therefore, the undigested fat will remain in the intestinal tract and may be oxidised. It may also be available, as an energy source, to micro-organisms which are present in the intestine or, at least, promotes a process of steatorrhea.

The triglycerides:free fatty acids ratio also influences lipid digestibility in young broilers. The higher the level of free fatty acids in feed, the worse the lipid digestibility.

Wiseman and Salvador (1991) showed that free fatty acids impaired lipid digestibility and this effect was more marked when the lipid source was tallow and palm oil instead of soybean oil (Table 7).

Apparently, the lack of monoglycerides in the lumen reduces lipid digestibility in this stage of the broiler's life.

Hargis and Creger (1980) demonstrated that broilers fed with diets with no supplementation of lipids during the first seven days of life, independent of the diet energy level after this period, deposited less abdominal fat at 49 days of age.

These results are not consistent with those presented by Maurice et al. (1982). The latter found that an 8% addition of fat in broiler diets in the first week of age decreased the percentage of abdominal fat in 49 day old broilers. Bartov (1987) observed that neither the level of supplemented fat nor the energy/protein ratio employed in diets fed to first week old broilers influenced fat deposition in seven week old broilers.

Due to the contradictory results described, the mechanism or mechanisms by which nutrition in the first week affects abdominal fat deposition in later stages is still unknown.

In some species, the excess of feed intake in early life promotes maturation of fat cells and increases their number. However, this evidence is not confirmed in broilers.

**● Sodium in pre-starter diets.** The NRC (1994) suggested 0.20% sodium level for the first three weeks of age of broilers, different from the 0.15% value suggested in 1977 and in 1984.

| Total sodium (%) | Water consumption (ml) | Feed intake (g) | Weight gain (g) | Feed conversion (g/g) | Excreta moisture (%) |
|---|---|---|---|---|---|
| 0.10 | 213[a] | 124[a] | 67[a] | 1.85[a] | 68.3 |
| 0.22 | 282[b] | 139[b] | 104[b] | 1.34[b] | 69.7 |
| 0.34 | 303[bc] | 148[b] | 116[bc] | 1.28[b] | 70.9 |
| 0.46 | 322[c] | 147[b] | 119[c] | 1.24[b] | 71.0 |

***Table 8. Effect of sodium supplementation on water consumption, feed intake, weight gain, feed conversion and excreta humidity of first week broilers. Adapted from Maiorka et al. (1998). P<0.05.***

Britton (1992) showed that 0.15% sodium does not allow correct broiler performance. He studied the effect of sodium supplementation as sodium chloride for broilers up to seven days of age.

Data presented by the author showed that the sodium requirement for broilers during the first week of age is at least 0.24%, higher than the level proposed by the NRC (1994).

| Sodium level (%) | Carcase dry matter (%) Four days | Seven days |
|---|---|---|
| 0.12 | 24.2[a] | 25.7[a] |
| 0.24 | 21.5[b] | 24.4[b] |
| 0.36 | 21.2[b] | 24.6[b] |
| 0.48 | 21.3[b] | 24.3[b] |
| Probability | 0.0001 | 0.05 |

***Table 9. Effect of sodium supplementation on carcase dry matter of four and seven day old broilers. Adapted from Vieira et al., 2003.***

Krabbe (2000) observed that sodium requirements for broilers during the first week of age are higher than those recommended by the NRC (1994).

In three studies, it was found

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| APS (micra) | Feed intake (g) 7 days | Feed intake (g) 21 days | Body weight (%) 7 days | Body weight (%) 21 days | Feed:gain (%) 7 days | Feed:gain (%) 21 days |
|---|---|---|---|---|---|---|
| 437 | $131^{a}$ | 1025 | $150^{ab}$ | $715^{ab}$ | 1.28 | 1.53 |
| 635 | $132^{a}$ | 987 | $158^{a}$ | $730^{a}$ | 1.20 | 1.45 |
| 780 | $126^{ab}$ | 1018 | $150^{ab}$ | $717^{ab}$ | 1.23 | 1.52 |
| 866 | $119^{ab}$ | 980 | $146^{ab}$ | $718^{ab}$ | 1.25 | 1.47 |
| 970 | $115^{b}$ | 982 | $141^{b}$ | $689^{b}$ | 1.25 | 1.53 |
| Prob. | 0.001 | 0.40 | 0.05 | 0.06 | 0.41 | 0.46 |

***Table 10. Effect of particle size on the performance of seven and 21 day old broilers. Adapted from Krabbe, 2000.***

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that the increase in feed intake is correlated to water intake, and also to weight gain and feed conversion of the broilers.

Maiorka et al. (2003), working with increasing levels of total sodium (0.10, 0.22, 0.34, and 0.46%) in first week diets for broilers, also found that the suitable sodium level for this stage is higher than that proposed by the NRC (1994) and very close to that recommended by Britton (1992).

Vieira et al. (2003) confirmed the high sodium requirement in the first week of age. The values determined for weight gain and feed conversion were 0.38 and 0.40% of sodium, respectively.

The authors concluded that part of the weight increase promoted by increasing levels of sodium was due to higher water retention (Table 9).

Maiorka et al. (2003), evaluating the effect of DEB increment (from 100 to 300meq/kg) on chicken performance, identified, by regression equation, the values of 174 and 163meq/kg for feed consumption and weight gain.

Vieira et al. (2003), using two values of DEB, observed that 240meq/kg promoted better weight gain and feed conversion than 160meq/kg.

But these advantages were limited to the first four days of age. Mongin (1981) suggested that the

| APS (micra) | 437 | 635 | 780 | 866 | 970 |
|---|---|---|---|---|---|
| Protein | 97.5 | 102.8 | 104.8 | 143.3 | 114.3 |
| Calcium | 97.5 | 106.5 | 112.3 | 115.3 | 120.3 |
| Phosphorus | 87.5 | 98.8 | 104.8 | 113.8 | 108.3 |
| Sodium | 92.3 | 101.3 | 111.5 | 120.8 | 122.8 |
| APS | 59.3 | 56.8 | 52.8 | 47.8 | 44.8 |

***Table 11. Change in the percentage of the nutritional composition as a function of diet average particle size (APS) after 12 hours in the feeder. Adapted from Krabbe, 2000.***

The doubt on the humidity of the excreta of chickens submitted to increasing levels of sodium, not addressed by Britton (1992), was evaluated by Maiorka et al. (2003) and Vieira et al. (2003).

These authors found that the dietary level of sodium in the first week did not influence water excretion and brings the discussion of the paradigm relating that bad litter quality is due to the increase in sodium supplementation (Table 8).

If water intake increased with the increase of sodium supplementation, and the percentage of water in the excreta did not change, where did this water go to?

Vieira et al. (2003) evaluated carcase dry matter of four and seven day old chicks fed increasing levels of sodium (0.12, 0.24, 0.36 and 0.48%), and found that the increase in sodium levels promoted a decrease in carcase dry matter, identifying that water retention increased with increasing dietary levels of sodium.

best ratio for broilers would be 250meq/kg.

All of these findings, suggesting a need for more sodium at first week of age, corroborate with Stevens et al. (1984) who hypothesised that the low glucose and methionine absorption of chicks after hatch can be due to a low level of sodium in the yolk.

As carbohydrates and amino acid carriers depend on sodium, its lack compromises these two groups of molecules absorption.

### ● Average particle size in pre-starter diets.

There is an ongoing discussion on which is the average particle size (APS) recommended for chicks during the first week of life. NIR et al. (1994) showed that seven day old chicks preferred coarsely ground diets than finely ground diets.

This was not corroborated by Krabbe (2000). Evaluating different particle sizes in pre-starter diets, the author found that too small or too large particles can impair chicken performance (Table 10).

This disadvantage in body weight was maintained until the broilers were 21 days of age, despite the fact that they had eaten the experimental diets for only seven days.

The same author did not identify any effect of APS on water consumption during the first seven days of age.

However, he verified that the increase in APS promoted an increase in the relative gizzard weight and in relative intestinal length, effects which disappeared when the broilers reached 14 days of age.

Krabbe (2000) evaluated the change in the ratio of nutrient intake as a function of diet APS.

On the fourth day of the experiment, samples of the feeders were collected 12 hours after feed was offered. As shown in Table 11, the birds ingested lower amounts of protein, calcium, phosphorus, and sodium when offered higher APS diets.

Evaluating the effects of the particle size in diets, Krabbe (2000) verified that the finely ground diet (561 micra) impaired nutrient metabolism. Table 12 shows that particle size influences metabolisable energy, nitrogen retention and dry matter retention.

| APS (micra) | AMEn (kcal/kg) | Nitrogen retention (%) | Dry matter retention (%) | Faeces dry matter (%) |
|---|---|---|---|---|
| 561 | $2780^{b}$ | $50.2^{c}$ | $72.3^{c}$ | 24.3 |
| 783 | $2787^{b}$ | $56.6^{b}$ | $75.1^{b}$ | 24.2 |
| 997 | $2843^{a}$ | $58.6^{a}$ | $76.7^{a}$ | 24.7 |
| Probability | 0.006 | 0.001 | 0.001 | 0.79 |

***Table 12. Effect of APS on the metabolic responses of seven day old broilers. Adapted from Krabbe (2000).***

### ● Protein in pre-starter diets.

Jensen et al. (1987) studied the effect of different protein and lipid levels in iso-caloric diets used during the first week of age of broilers on abdominal fat deposition at slaughter. After the first week of age, all broilers were fed the same grower, final and finisher feeds.

The authors did not find any difference in weight at 7, 28 and 49 days of age. However, the addition of protein and fat to pre-starter diets promoted some variation in the abdominal fat percentage of 49 day old broilers (Table 13).

Schutte et al. (1997) suggested that chicken diets, based on corn and soybean meal, should not have less than 21% protein because glycine + serine become limiting. Glycine + serine requirement for young broilers was estimated as 1.85%.

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| Treatments Protein (%) | Fat (low/high) | Abdominal fat (% of weight) |
|---|---|---|
| 18 | Low | 1.52b |
| 18 | High | 1.65b |
| 23 | Low | 1.53b |
| 23 | High | 1.79ab |
| 28 | Low | 2.05a |
| 28 | High | 2.04a |

***Table 13. Effect of protein level and fat addition in first week diets of broilers on abdominal fat percentage of 49 day old broilers. Adapted from Jensen et al., 1987. P<0.05.***

***Table 14. Effect of water restriction on feed consumption, weight gain and feed conversion of the chicks at seven days of age. Adapted from Viola et al. (2003).***

| Treatments | Feed consumption (g) | Weight gain (g) | Feed conversion (g/g) |
|---|---|---|---|
| 0% | $173^{a}$ | $140^{a}$ | $1.24^{ab}$ |
| 10% | $136^{b}$ | $119^{b}$ | $1.14^{b}$ |
| 20% | $129^{bc}$ | $108^{b}$ | $1.20^{ab}$ |
| 30% | $117^{c}$ | $91^{c}$ | $1.29^{a}$ |
| 40% | $100^{d}$ | $77^{c}$ | $1.30^{a}$ |
| VC (%) | 6.2 | 7.5 | 4.9 |
| Prob. ≤F | 0.0001 | 0.0001 | 0.002 |
| Regression | Linear | Linear | Linear |
| R2 | 0.84 | 0.91 | 0.22 |
| Prob. ≤F | 0.0001 | 0.0001 | 0.009 |

| Treatments | Heart | Liver | Intestines | Proventriculus + gizzard | Leg |
|---|---|---|---|---|---|
| 0% | 1.64[a] | 7.79[a] | 13.03[a] | 9.52[a] | 4.86[a] |
| 10% | 1.59[a] | 7.02[a] | 11.95[ab] | 8.78[ab] | 4.21[b] |
| 20% | 1.49[a] | 6.89[a] | 11.47[bc] | 8.53[b] | 3.82[bc] |
| 30% | 1.25[b] | 5.97[b] | 10.09[c] | 7.53[c] | 3.28[cd] |
| 40% | 1.15[b] | 5.26[b] | 8.59[d] | 7.01[c] | 2.94[d] |
| VC (%) | 13.2 | 11.9 | 11.4 | 8.9 | 13.4 |
| Prob. ≤ F | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0001 |
| Regression | Linear | Linear | Linear | Linear | Linear |
| R2 | 0.48 | 0.54 | 0.57 | 0.55 | 0.62 |
| Prob. ≤ F | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |

***Table 15. Effect of water restriction on organ and tissue weight (g) of the chicks at seven days of age. Adapted from Viola et al. (2003).***

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This value is much higher than 1.25% proposed by the NRC (1994).

**Water in pre-starter period.** On a practical basis, water consumption has not been considered as an important aspect of digestive tract integrity, digestion and absorption of the nutrients and poultry performance.

Most of the time, it is considered that the broilers are not maintained on water restriction.

However, the water consumption is not always measured to confirm this. To confirm this, Counotte (2003) has indicated that problems with water supply can reduce the growth, increase the weight variation and favour health problems.

Bailey (1999) observed that broilers submitted to water restriction had shown an increase of uric acid, urea, total protein, sodium, potassium, chlorine and hematrocrit of the blood and a reduction of glucose. Nilipour and Butcher (1998) have said that if the broilers lose from 10 to 20% of their body water they can die.

Viola et al. (2003), studying the effect of water restriction, observed that the water consumption linearly affects the feed consumption and, as a consequence, affects the broiler performance (Table 14). They verified that the more intense the water restriction, the worse the performance parameters, the smaller the organs and tissues are (Table 15) and it was found to affect the villi height (Table 16).

The authors observed that the water restricted chicks had changed their behaviour, when compared with the non restricted ones. During water restriction they did not go for food. They stayed in a rest position most of the time and the human presence made them agitated.

The restricted water supply chicks drank as much water as the crop could handle and frequently they regurgitated part of the water drank.

***Table 16. Effect of water restriction on villi characteristics of the chicks at seven days of age. Adapted from Viola et al. (2003).***

| Treatments | Number | Height (mm) | Crypt depth (µm) |
|---|---|---|---|
| 0% | 12.9 | 1340 | 86 |
| 10% | 11.9 | 1137 | 82 |
| 20% | 12.1 | 1134 | 82 |
| 30% | 12.1 | 1100 | 81 |
| 40% | 12.2 | 1064 | 79 |
| VC (%) | 16.1 | 10.5 | 18.9 |
| Prob. ≤ F | 0.91 | 0.76 | 0.96 |
| Regression | NS | NS | NS |

## *Conclusion*

Based on these observations, it is possible to conclude that the chickens' needs in the first week of life must be supplied to get the best performance response afterwards.

The anatomical, physiological and nutritional aspects are so different during this short period of time but can be mandatory for their entire lives.

From a nutritional point of view, it is important to take into account that feed consumption is fundamental and how much the water consumption can affect it.

At least, levels of energy, sodium and protein must be well checked at this age and the particle size can also influence chick performance. ■

*References are available from the author on request.*