Nutrition of domestic geese

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In the UK, geese are produced principally for the Christmas market. The goslings are hatched between April and mid-July and at slaughter their ages range from about 22 to 38 weeks. However, geese can be processed at various ages depending on their feather production. They may be killed at 9 weeks when their first set of feathers has formed, at 16 weeks when they have replaced their initial feathers, or after 20 weeks when the second moult is completed. Attempts to process the carcasses at other times have proved to be difficult and uneconomical.

Research into the nutrition of both the breeding and growing goose has been limited compared to the wealth of information which is available for laying hens, broilers and turkeys. In addition, a great deal of the emphasis has been on the growing goose. It is intended to deal mainly with this topic, but the work carried out on the breeding goose will be mentioned briefly.

Nutrition of the breeding goose

Virtually all the information available on the breeding goose is from the USSR and Poland. Geese kept under natural daylight will produce a seasonal laying performance, commencing lay during February–March and completing their laying cycle in July. Manipulation of daylength to facilitate egg production throughout the year has been reviewed by Saleyev (1975). Using a variable artificial-lighting system and restricting food intake, the number of eggs produced per goose over a 3-year period was increased (Table 1).

Breeding geese have been maintained on pasture, but to ensure a greater production of eggs supplementary feeding of a poultry ration containing about 150 g crude protein (CP, nitrogen × 6·25)/kg has been recommended (McArdle, 1972). Saleyev (1975) has suggested the following dietary requirements for parent stock geese in the USSR (g/kg dry feed): 10·6 MJ metabolizable energy (ME), 160 CP, 66 crude fibre, 21 calcium, 8 phosphorus, 4 sodium, 7·2 lysine, 2·9 methionine, 2·4 cystine, 2·0 tryptophan, 9·7

Table 1. *Egg production (eggs/goose) from two breeds of geese kept under different management systems (from Saleyev, 1975)*

Year	Breed	Management system	
		Natural light	*Artificial regimen
1	Chinese	36	–
	Kholmogory	23	–
2	Chinese	44	74
	Kholmogory	24	50
3	Chinese	40	60
	Kholmogory	27	50

*Two laying cycles per year induced by daylength manipulation and a limited period of food restriction.

Table 2. *Live weights of geese and ganders reared on pasture and subjected to different dietary regimens (from Wright & Dudley, 1941–2)*

Age (weeks)	Ganders			Geese		
	*1	†2	‡3	1	2	3
26	4·02	3·97	3·97	3·42	3·49	3·49
30	4·12	4·15	4·00	3·52	3·51	3·59
32	4·37	4·02	4·02	3·80	3·50	3·62
34	4·23	4·00	3·97	3·65	3·44	3·55

*Fed on chick mash from week 5.
†Fed from 26 to 34 weeks of age on mash and potatoes.
‡Fed from 30 to 34 weeks of age on mash and potatoes.

arginine, 3·8 histidine, 10·8 leucine, 7·2 isoleucine, 7·1 phenylalanine, 6·3 threonine and 7·6 valine. More recently, Jamroz *et al.* (1985) have compared diets varying in CP content from 110 to 170 g/kg combined with three levels of ME from 9·41 to 11·5 MJ/kg. In one trial the diet with 150 g CP and 10·5 MJ ME/kg gave the best laying performance, while in the second trial all groups of White Italian geese behaved similarly. They concluded that protein could be reduced to 130 g/kg without any loss of performance, and ME concentration should be between 10·5 and 11·1 MJ/kg.

Different breeds are likely to have different requirements, and to optimize the egg laying capacity of the various goose breeds which are in existence, additional research is required in this area.

Nutrition of the growing goose

Goslings grow much more rapidly than chicks or turkeys, especially during their first few weeks of life. From a study of the growth rates of forty-five different bird species, Björnhag (1979) has concluded that geese grow 1·7 times faster than the mean of all other birds. Not all strains of geese grow at the same rate. For example, the Chinese goose weighs 3·31 kg at 8 weeks of age (Fortin *et al.* 1983), whereas the Italian Legarth gosling is 5·43 kg at the same age (Stevenson, 1985). Depending on the age at which the goose is to be slaughtered, the feeding management may be varied.

(1) *Extensive rearing of goslings.* Geese can be grown entirely, though slowly, on pasture, provided it is available in sufficient quantities and is of good quality (Wright & Dudley, 1940–1, 1941–2; Aitken *et al.* 1962). The birds thus reared are somewhat yellow in the flesh and the marketable quality after processing is generally not considered satisfactory (Snyder *et al.* 1955). The introduction of supplementary feeding during the final stages of production was studied by Wright & Dudley (1941–2). Feeding goslings either chick mash from 5 weeks of age or mash and potatoes for 4 or 8 weeks before slaughter produced geese and ganders with almost identical live weights (Table 2). There was little advantage to be gained by feeding concentrate to goslings throughout the growing period, provided they had access to grazing. From a limited assessment of the carcass composition (two birds from each group), there appeared to be practically no difference in the amount of edible protein per kg plucked goose produced under the different dietary regimens, but differences in the proportion of fat were considerable.

Snyder *et al.* (1955) and Kivimae (1976) have reported lower growth rates for grazing geese receiving supplementary feed compared with geese without access to pasture. The pasture-reared groups required less feed per unit gain and had 146 g fat in the body cavity

compared to 466 g for those reared intensively without pasture (Kivimae, 1976). Economically, it could be more beneficial to use pasture as part of the feeding system.

According to Clemens *et al.* (1975), the rate at which particulate matter passes through the digestive tract of the goose is largely controlled by gastric emptying time, and studies on the rate of flow of digesta have suggested that it may pass through the gut in about 2 h (Mattocks, 1971). Degradation in the stomach is largely mechanical, and the success of the goose as a grazing animal is due to the efficient manner in which the gizzard breaks down the plant cell walls, so allowing digestion of the cell contents (Hallsworth & Coates, 1962). Fibre does not appear to affect the passage rate of feedstuffs, since maize, oats and rice hulls having low, intermediate and high fibre contents respectively, all have similar rates of passage (Storey & Allen, 1982). In general, from the determination of the true ME value of feedstuffs, it appears that geese derive the same amount of energy from feedstuffs as chickens (Storey & Allen, 1982). However, because of their capacity to consume large amounts of feed they can derive their nutrient requirements from high-fibre feeds such as grass.

(2) *Intensive rearing of goslings.* An alternative to the extensive grazing system is the intensive rearing of goslings. This practice has received little attention in the UK, but is used elsewhere in Europe (Bielinska *et al.* 1969, 1979, 1980, 1983; Saleyev, 1975; Jeroch *et al.* 1978). Geese grown intensively can achieve marketable body-weights in 8–10 weeks.

Saleyev (1975) and Allen (1983) have reviewed the information available on goose meat production in the USSR and USA respectively. CP requirements of growing goslings have been reported to vary from 160–220 g/kg in the starter diet given from 0 to 4 weeks, and from 140 to 200 g/kg in the grower diet. Allen (1983) suggests from his own results that dietary CP contents should be 200, 160 and 140 g/kg for the periods from 0 to 4, 5 to 6 and 7 to 9 weeks respectively. These recommendations are somewhat lower than those of Saleyev (1975) who suggested that CP content and apparent ME (AME) should be 200 g and 11·6 MJ/kg respectively up to 3 weeks of age, and from then to 9 weeks should be 180 g and 12·2 MJ/kg respectively. Recently, the lack of response in weight gain of Embden geese fed on diets varying in protein concentration from 180 to 220 g/kg

Table 3. *Comparison of calculated amino acid composition (g/kg) of goose diets and Agricultural Research Council (ARC) (1975) recommended levels*

Amino acid (g/kg)	Starter diet* (0–4 weeks)	Grower diet* (5–9 weeks)	ARC† (1975)
Arginine	13·7	11·3	7·6
Glycine + serine	17·3	16·0	5·3
Histidine	5·7	4·0	3·6
Isoleucine	9·7	6·5	6·4
Leucine	20·1	12·3	10·7
Lysine	13·7	8·6	8·0
Methionine	5·2	4·0	3·6
Methionine + cystine	8·8	6·1	6·7
Phenylalanine	12·0	8·0	6·4
Phenylalanine + tyrosine	20·3	11·5	11·6
Threonine	8·8	6·1	5·3
Tryptophan	2·4	1·7	1·5
Valine	10·5	7·7	7·1

*Starter diet 2, grower diet 2 (Stevenson, 1985).
†For geese from 4 to 8 weeks inclusive.

has led Summers *et al.* (1987) to conclude that CP has not been a limiting factor in most goose nutrition studies.

The work of Roberson & Francis (1963) would suggest that geese respond more to changes in energy concentration of the diet than to dietary protein levels. However, Stevenson (1985) found no significant effect on the weight gain of Italian Legarth goslings fed on starter and grower diets with ME concentrations ranging from 11 to 13 MJ/kg.

Estimates of the amino acid requirements of the goose are sparse. Roberson & Francis (1963) have suggested that the dietary methionine requirement for the White Chinese goose is 3·4 g/kg, while Znaniecka *et al.* (1975) considered that a level of 4·4–5·4 g/kg was needed for the larger White Italian goose.

The lysine requirement of the White Chinese goose has been reported to be 9 g/kg with a diet containing 200 g CP/kg (Roberson & Francis, 1966). In the recent report of Summers *et al.* (1987) the lysine requirement of Embden geese for maximum live-weight gain did not exceed 8 g/kg once the goslings were at least 3 weeks of age.

Information on the requirements of the other amino acids is lacking and Agricultural Research Council (1975) have estimated requirements for amino acids other than lysine using chick requirements. Diets with calculated amino acid compositions shown in Table 3 have supported good rates of growth in Italian Legarth goslings (Stevenson, 1985). Nevertheless, it is possible that these levels are too high, and different breeds because of their varying growth rates may have different requirements.

As with the amino acids, studies on mineral and vitamin requirements are limited. Saleyev (1975) has recommended that diets for growing geese should contain (g/kg diet) 11 Ca, 8 P, 4 Na. The vitamin which appears to be most crucial for goose nutrition is nicotinic acid, a lack of which causes leg weakness (Battig *et al.* 1953). Ewing (1966) reported that addition of 40 mg nicotinic acid/kg diet prevented leg problems, while Agricultural Research Council (1975) suggests that starting and growing diets should contain 65 mg nicotinic acid/kg. Information on the other vitamins is minimal. According to Ewing (1966) 'other than the information that good chick starter rations supplemented with niacin produce good gains in goslings, there is a real deficiency of nutrition research data with geese'. Some 20 years later, this statement is still relatively true.

Although it is recognized that geese are fast-growing birds, the efficiency with which they convert their food to weight gain diminishes rapidly with age (Stevenson, 1985). A large proportion of the weight gain is skin and body fat (Nitsan *et al.* 1981; Fortin *et al.*
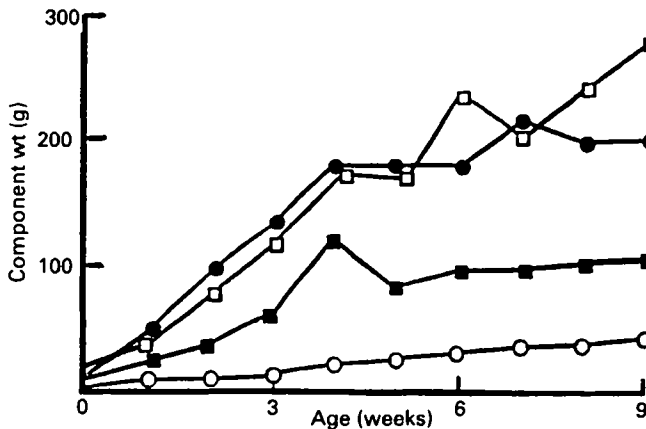

Fig. 1. Gizzard (●), liver (■), heart (○) and alimentary tract (□) weights (g) of goslings from 0 to 9 weeks of age.

1983; Stevenson, 1985; Summers *et al*. 1987). In the intensively-reared bird, carcass components and the chemical composition of the plucked carcass are relatively unaffected by dietary treatment (Stevenson, 1985; Summers *et al*. 1987).

In an attempt to clarify the extent of protein and fat deposition with age, the weekly development of carcass components and the chemical composition of geese has been studied. Italian Legarth goslings were reared from 0 to 4 weeks of age on a starter diet (214 g CP/kg, 12 MJ ME/kg) and then fed to 9 weeks of age on a grower ration (151 g CP/kg, 12 MJ ME/kg). Eight goslings (four each sex) were killed weekly, and the carcass components and chemical composition of the plucked carcass were assessed, feed having been removed from the alimentary tract before analyses. Some results are presented here.

The live weights of the goslings were similar to those achieved in a previous experiment (Stevenson, 1985), and as expected the males were heavier than the females. The gizzard and alimentary tract weights increased rapidly up to 4 weeks of age (Fig. 1). Thereafter, the gizzard weight tended to plateau. Beyond 4 weeks, the response in alimentary tract with age was somewhat variable. Liver weight increased during the first 6 weeks and then remained fairly constant, while heart weight sustained a steady increase throughout the 9-week period of the experiment. When these weights were expressed as g/kg live weight (Fig. 2), the weight of the alimentary tract decreased from hatching. The very marked decline during the first week may have been due to the high value at week 0, which included the remains of the yolk sac. Liver and gizzard weights increased during week 1 and then decreased while heart weight remained fairly static beyond week 1. According to Hallsworth & Coates (1962), the rapid growth rate of the digestive system after hatching enables the gosling to deal with the large quantities of nutrients necessary for the growth of other systems.
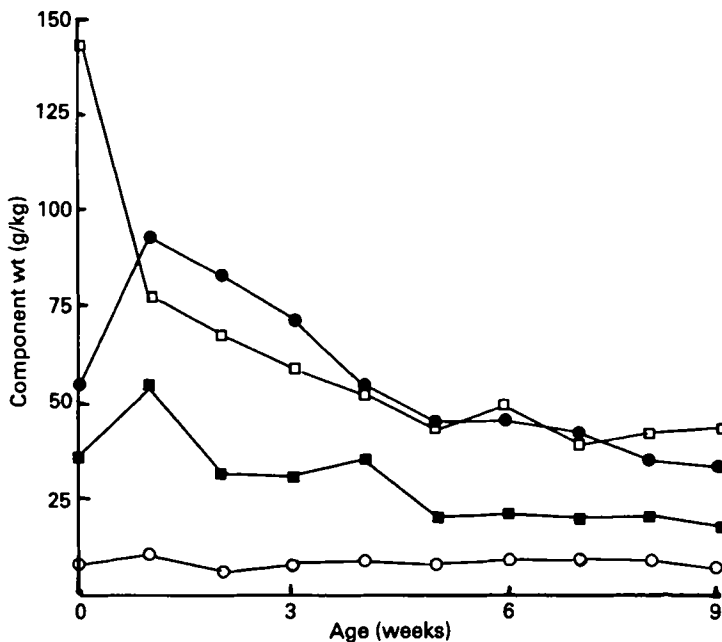

Fig. 2.   Gizzard (●), liver (■), heart (○) and alimentary tract (□) weights (g/kg live weight) of goslings from 0 to 9 weeks of age.
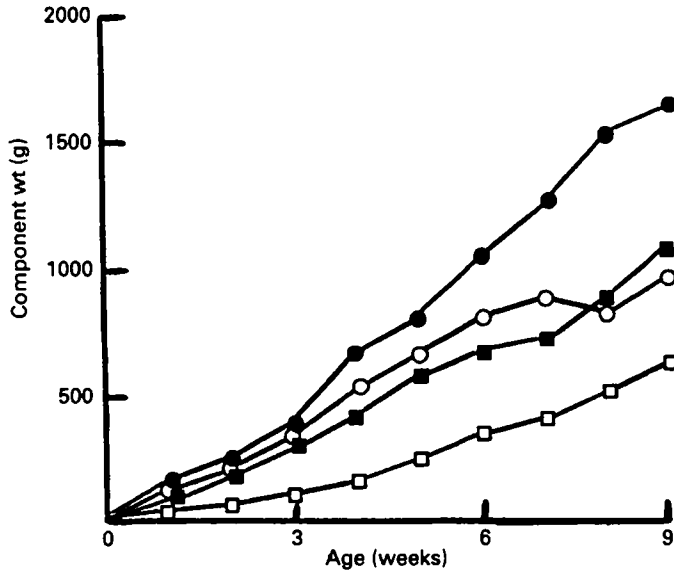
Fig. 3.   Bone (○), meat (●), fat (abdominal fat + fat adhering to meat) (□) and skin + adhering fat (■) weights (g) of goslings from 0 to 9 weeks of age.

By the end of 9 weeks, the skin and fat together contributed as much to the total carcass weight as did the total meat (Fig. 3). It is impossible to separate the skin from the underlying layer of fat, so a large proportion of the skin weight is fat. For the first 3 weeks, deposition of abdominal fat and breast meat was minimal (Fig. 4). Thereafter, both increased quite considerably, and a large part of the total fat in the carcass (Fig. 3) was abdominal fat.
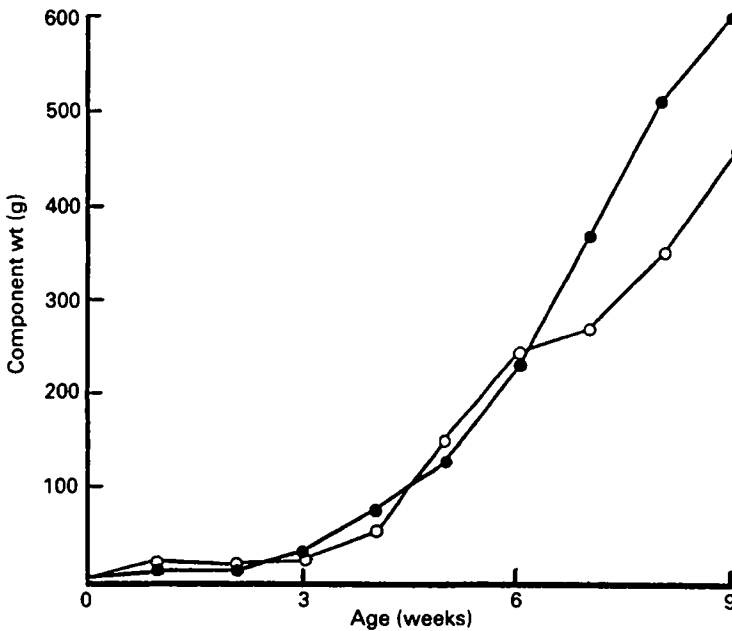

Fig. 4.   Abdominal fat (○) and breast meat (●) weights (g) of goslings from 0 to 9 weeks of age.
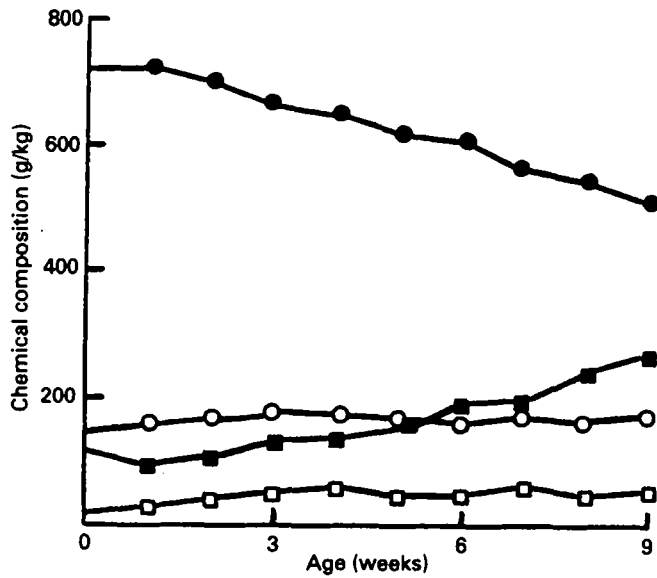
Fig. 5. Chemical composition (g/kg) of goslings from 0 to 9 weeks of age. (○), Crude protein (nitrogen × 6·25); (●), moisture; (□), ash; (■), fat.

As the gosling aged, CP and ash concentrations remained fairly constant, while moisture decreased and fat increased throughout the 9-week period (Fig. 5).

Calculation of the weekly protein and fat deposition in the carcass would suggest that protein deposition remained fairly static after 4 weeks (Fig. 6). Only about 30% of the CP intake appeared to be deposited as carcass protein, suggesting that the CP
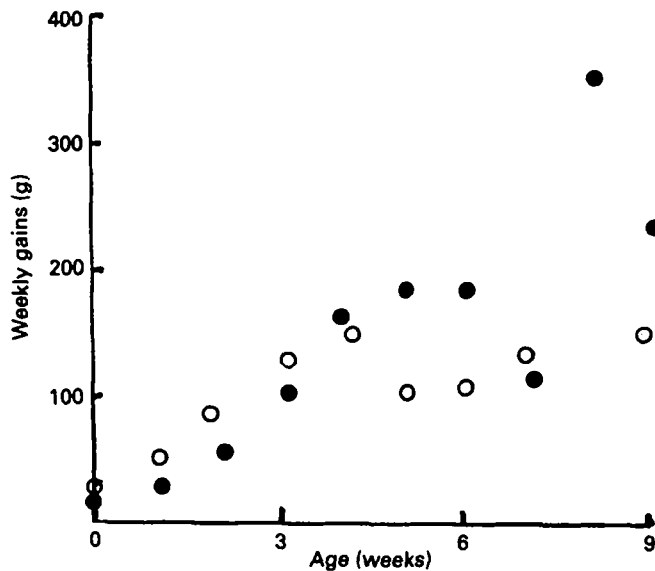

Fig. 6. Weekly crude protein (nitrogen × 6·25) (○) and fat (●) deposition (g) in goslings from 0 to 9 weeks of age.

concentration of the diet from 4 weeks onwards was in excess of that required by the gosling. This would substantiate the suggestion of Summers *et al.* (1987) that most experimental diets appear to contain excess protein. Using a factorial approach, an attempt has been made to calculate the CP requirement of goslings between 5 and 9 weeks of age. The following assumptions have been made.

Weekly CP deposition in carcass (Fig. 6)	120 g
Weekly CP deposition in feathers (Nitsan *et al.* 1981)	6 g
Weekly maintenance requirement (Agricultural Research Council, 1975)	28 g
CP availability	70%
CP digestibility (Marriott & Forbes, 1970)	75%
Weekly food intake	2·8 kg
Dietary CP concentration	105 g/kg

Nitsan *et al.* (1981) have reported a deposition of 89·8 g CP in feathers of goslings between 4 and 7 weeks of age. However, the protein gain was based on an increase in feather weight of 165 g over this period of time. For the Italian Legarth goslings used in this experiment, weekly feather gain was approximately 10 g. Agricultural Research Council (1975) have suggested that 4 g feed protein/d would meet the maintenance requirement of a 5 g cock and, in the absence of any other available information, this value has been used in the previously-stated calculation. Further experimentation would be required to confirm if the dietary requirement of 105 g CP/kg is realistic.

The response in weekly fat deposition is not clearly defined because of the spurious results at weeks 7 and 8 (Fig. 6). However, the indications are that fat deposition may be slowing down as the gosling ages.

Conclusions

Goose-meat production could provide an alternative enterprise to broiler and turkey production. Before production efficiency can be maximized, there is considerable scope for the nutritionist to optimize the requirements of the breeding flock and the intensively- or extensively-reared broiler gosling.

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