Effect of nutrition on the reproductive parameters of geese

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Abstract

Nutrient supply during the rearing period in waterfowl exerts a substantial effect on subsequent reproduction performance parameters. For geese reared and laying under intensive conditions more severe feed restriction is of greater benefit with respect to reproduction performance parameters.

In geese nutrient requirement during the egg production period is dependent upon climatic conditions and green forage supply. Complete omission of the latter, when a diet of increased protein content is fed, results in an improvement in egg production only in one-year-old geese, while causing deterioration in fertility and the loss of 2 to 4 one-day-old goslings.

Geese show poor capacity to maintain their energy intake at a constant level when dietary energy content increases. In the case of concentrated laying diets quantitative feed restriction during the egg production period results in improvement fertility and a 15% saving in production cost.

Key words: goose, nutrient requirement, feed restriction, reproduction performance, rearing period.

Introduction

Examination of the nutritional and physiological characteristics of the various species of waterfowl (domestic duck, Muscovy duck and goose) reveals considerable differences from those of the gallinaceous species. While general correlation and regularities are discovered, it can also be ascertained that, regarding more detailed aspects, there exits differences between the species belonging to this family.

Nutrient supply for breeding waterfowl exerts, in both the rearing and the laying period, a considerable effect on reproduction performance, taking two periods both independently and in relation to each other.

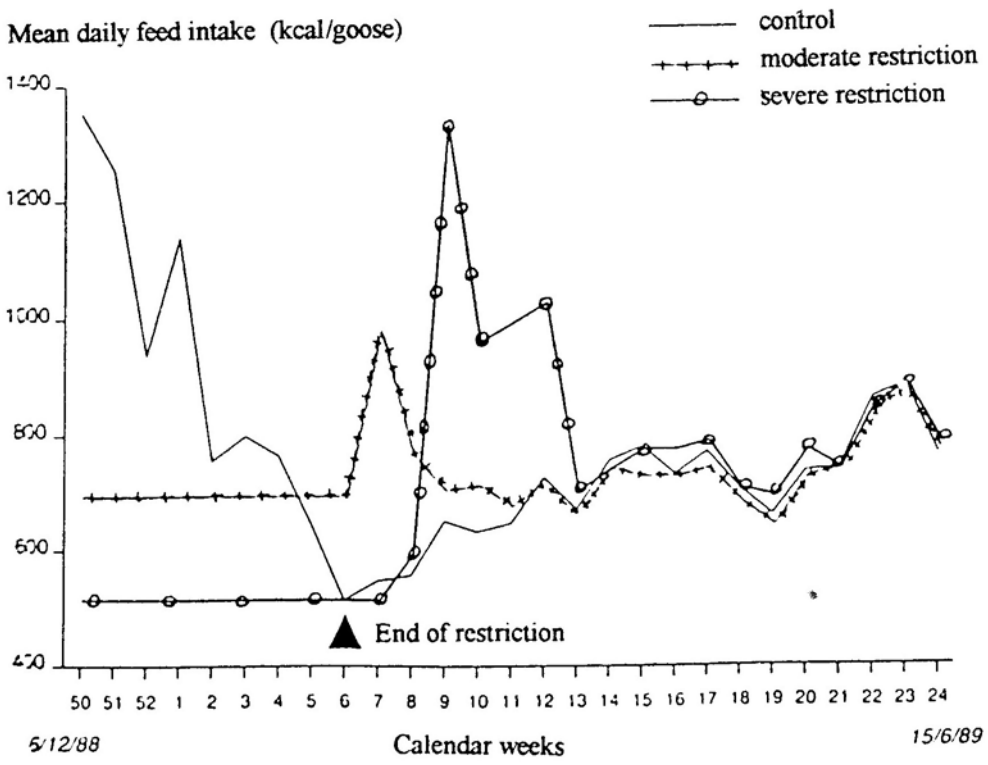
Quantitative feed restriction during the rearing period is general practice for broiler pairs. In the absence of some form of such restriction the birds deposit fat, mortality increases and the sexual organs become covered in fatty tissue, as a result of which egg production is low, while feed consumption during the production period increases in consequence of the higher maintenance requirements of the heavier birds. The literature contains few data relating to the application of feed restriction programmes during the rearing period in waterfowl.

Effect of feed restriction applied during the rearing period on subsequent reproduction performance in the goose species

Geese fall into their own particular category with respect to nutrient supply. One factor in this is that the conditions in which they live differ considerably from those of ducks - even today still largely extensive conditions, indissociable from the climate. Another factor is that green forage plays a substantial role in nutrition in geese. A further significant difference is that goose production tends to be planned for periods of 4 to 6 years; therefore, feed restriction is prevalent not only during the rearing period, but also, in the case of older geese, in the period preceding egg production, the rest period. One of the specific characteristics of geese is that, in a natural keeping system, six weeks prior to the beginning of the egg production period spontaneous over consumption is observed; this can reach 5.44 MJ ME daily, i.e. 600 g of a diet of 9.21 MJ ME/kg energy density (*Sauveur and Rousselot*, 1982). There is presumably a relation between this phenomenon and the nomadic lifestyle of the species. Subsequently feed intake decreases and reaches a nadir precisely at the peak of egg production, then increases again.

Sellier et al. (1994) performed investigations to examine changes in reproduction performance in geese kept in natural keeping systems by the effect of feed restriction applied prior to the egg production period. Grey Landaise geese of between 1 and 3 years of age were used in these experiments. In the first experiment, from allocation into housing (in the middle of November) until the attainment of either the 10% or the 20% egg production level (in the middle of February) restriction of two types was introduced. Moderate restriction entailed 2.93 MJ/day up to 20% egg production intensity, and severe restriction involved 2.18 MJ/day up to the 10% egg production level, then 2.51 MJ/day up to the 20% production level. The results obtained for the groups subjected to such treatment were compared with those obtained for the control group, which was fed ad libitum. *Figure 1* illustrates that in both experimental groups the cessation of feed restriction resulted in a temporary peak in consumption, the intensity and duration of which was in relation to the severity of restriction. Severe restriction delayed the beginning of the egg production period, and decreased its intensity (12 eggs fewer being produced than in the control group), while moderate restriction exerted no significant effect on egg production.

Figure 1 **Changes in daily feed consumption in geese related to nutrition before the egg production period**
(Sellier et al., 1994)



At the same time egg fertility showed a marked improvement under conditions of restriction, particularly when the level of restriction applied was moderate, resulting in four extra day-old goslings per layer (*Table 1*). Restricted feed rationing did not bring about significant change in the other parameters, e.g. egg weight, mortality or the body weight of the birds.

These results were corroborated by the second study on this topic performed by these authors, in which severe restriction was replaced by slight restriction, all other conditions remaining unchanged. Therefore, for a month from the middle of November the geese were given 4.19 MJ per bird daily, and after this period 3.14 MJ. This feeding programme exerted no influence on the body weight of the birds at the beginning of the egg production period or on production results (*Table 1*), while demonstrating the advantages of moderate restriction, which:

- has no detrimental effect on results related to production;
- improves fertility, as a consequence of which the number of day-old goslings per layer increases;
- does not entail a sudden increase in feed consumption when lifted;
- reduces specific feed cost per day-old gosling.

Table 1 **The effect of feed restriction, applied before the egg production period, on performance in geese**
(Sellier et al., 1994)

	Not restricted		Restricted [A]				
			slightly	moderately		severely	
Experiment number	1	2	2	1	2	1	
Number of eggs per layer	42.7[a]	44.4	43.7	40.5[a]	44.5	30.5[b]	* NS
Fertility, %	62.2[a]	63.9[a]	65.1[a]	77.1[b]	73.3[b]	64.1[a]	* *
Number of day-old goslings per layer	22.4[ab]	22.7	23.3	26.4[a]	26.9	16.4[b]	* NS
Mean egg weight, g	175	154	155	173	153	173	NS NS
Mortality, %	3.8	2.0	0.5	4.4	2.0	3.8	NS NS
Mean body weight of females at the end of restriction[B], kg	7.6[a]	6.7[b]	6.6[b]	6.8[b]	6.3[a]	6.2[c]	* *
Mean body weight of ganders at the end of restriction[B], kg	6.9[a]	6.4[b]	6.4[b]	6.4[b]	6.0[a]	6.0[c]	* *

[A] Slight restriction refers to 4.19 MJ, followed by 3.14 MJ/goose/day; moderate restriction, 2.93 MJ/goose/day; severe restriction, 2.18 MJ, followed by 2.51 MJ/goose/day.

[B] At the time of allocation into housing, in the first experiment the body weight of the females was 5.6 kg and that of the ganders 5.8 kg, while in the second experiment these weights were 5.3 kg and 5.9 kg respectively.

Values with different superscripts denote significant difference.

The effect of severe feed restriction on geese reared and laying in *closed, intensive conditions* was investigated by *Bogenfürst et al*. (1997). Feed restriction was introduced in the 10th week, its degree set according to body weight; this resulted in a mean level of 2.44 MJ/goose/day (60% of the ad libitum level traditionally used in goose keeping). Groups were formed on the basis of body weight at sexual maturity. Performance developed differently in each individual group, as illustrated by *Table 2*. With the exception of egg weight, reproduction performance parameters at sexual maturity were more favourable in the group of lower body weight. The data also demonstrate that daily feed consumption did not increase when feed restriction was ceased. Egg production period occurred during the summer and showed a dynamic increase (*Figure 2)*.

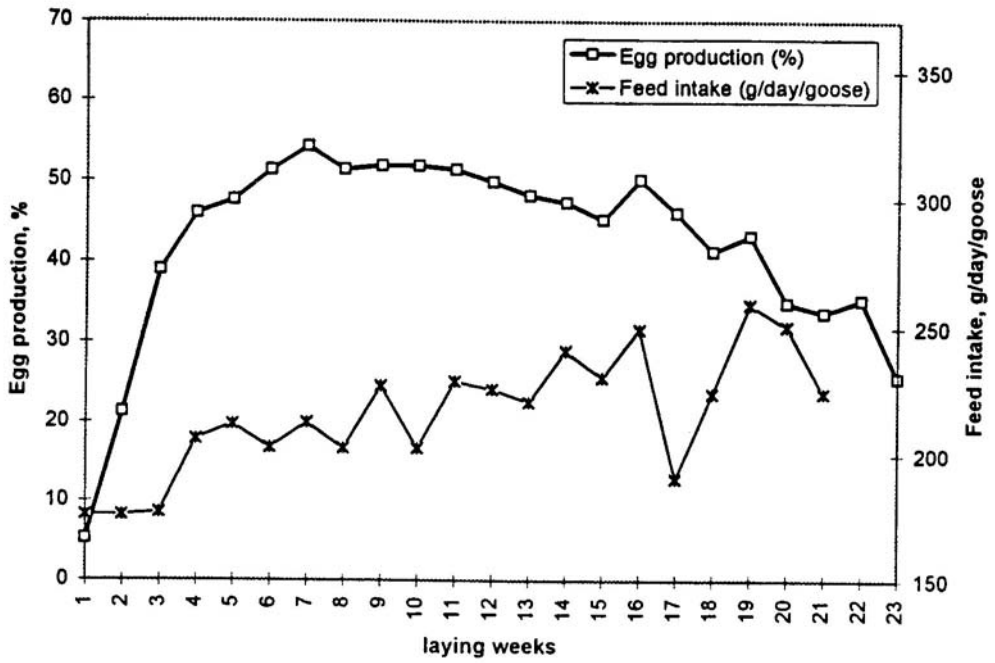
Table 2 **The effect of feed restriction in geese reared in monitored environmental conditions on their performance**
(Bogenfürst et al., 1997)

Live weight kg	No. of eggs per goose	Egg weight g	Daily feed intake g/layer	Feed utilisation g/egg	Fertility % *
below 4.75	71.3[a]	146.4[a]	199.5[a]	451.3[a]	87.7[a]
4.76-5.25	68.1[b]	152.3[b]	219.4[b]	511.8[b]	86.7[a]
over 5.26	68.3[b]	152.4[b]	222.8[b]	525.3[b]	77.41[b]

* males on the basis of body weight

Values with different superscripts denote significant difference ($P < 0.05$)

Figure 2 **Evaluation of egg production and daily feed intake in geese reared with feed restriction and kept under intensive conditions** (Bogenfürst et al., 1997)



Guemené et al. (1998) found an interesting correlation between the nutrient supply during the resting period and the subsequent laying performance. The feed restriction had a positive effect on the brooding of Landaise geese immediately before the 3. laying period. Because of the increased incidence of brooding increased the egg lost from 2,4 to 4,2 per female.
According to Wang-Sheng and Wang (2000) dietary crude protein (15 % or 18 %) in the resting and laying period had no effect on feed intake, fertility, hatchability, number of eggs and goslings/goose.

Effect of nutrient supply during the breeding period on reproduction performance in geese

The precise evaluation of data in the literature relating to the energy and protein requirements of breeding geese during the egg production period is made difficult by the fact that in this species genotype, the age of the birds, climatic conditions, use or non-use of green forage, etc., may all exert a considerable influence on the results obtained.

Goose has an outstanding capacity for the utilisation of grass types (*Cowan*, 1980), although its digestion of fibre is no better than that of the other poultry species. Some goose producers regularly provide their birds with green forage during the egg production period, but in the majority of large-scale goose production units this practice is neglected. The necessity for the provision of green forage is a controversial point (*Delpech et al*., 1969). The effect of the complete omission of *fresh grass* supply was investigated by *Sauveur and Rousselot-Pailley* (1982). In a series of experiments spanning ten years the effect of a control regimen containing 14% crude protein with green forage supplementation was compared with a diet of 18% protein content, without green forage, supplemented with diuretic salts. On evaluating the effect of the latter, based on the results obtained, the following generally valid conclusions were reached:

- Feeding with a diet containing no green forage and of an elevated protein content improves egg production in one-year-old geese, but deteriorates that in geese of more than one year of age: only slightly in the case of grey Landaise geese, but more strongly where Rhine geese are concerned. Taking all ages collectively, total losses in the grey Landaise type amounted to one egg.
- Fertility decreases in every case, in the case of the Landaise type by approximately 6%. This effect is less significant in Rhine geese, at 2%.
- Hatchability in the fertile eggs produced decreases slightly.
- A total loss of 2 to 4 day-old goslings per goose was caused.

There may be a relation between the negative effect on fertility caused by the omission of green forage from the feeding regimen and deficiency of one or more vitamins or possibly trace elements. *Kovács* (1972) demonstrated that non-differentiated vitamin supplementation can improve fertility by 5 to 14%.

Bielinski et al. (1983 and 1984) performed experiments in order to clarify the optimal dietary energy density and protein content. They established that with respect to the majority of reproduction parameters 11.51 MJ ME/kg and 15% crude protein proved to be the most beneficial.

In more recently study *Bielinska et al*. (1993) as well as *Pakulska and Bielinski* (1993) found no adverse effect of low-energy mixture (8.95 MJ ME/kg) on reproductive performance, health condition of birds, feed consumption and body weight in white Italian geese. Their results show that good egg production (up to 70 eggs per layer) and hatchability are favoured during reproductive period by ad libitum consumption of layer feed having a nutritive value of ca. 8.9 MJ ME/kg, 14.6 % crude protein, 0.5 % lysine and 0.5 % methionine with cystine.

Sauveur et al. (1988) sought to clarify energy requirement during the production period in breeding geese by means of five consecutive experiments. They established that breeding geese show a poor ability to maintain their energy intake at a constant level when dietary energy density increases. This is demonstrated by *Table 3,* in which it can be seen that geese fed ad libitum did not consume a proportionately lower quantity of the diet of the highest energy density. In this group the number of eggs produced and their fertility both decreased in comparison with the values obtained for the control group. This result verifies the observations made by *Bielinski* (1980), but deviates totally from other observations relating to

Muscovy ducks (*Sauveur et al*., 1984). The table and data obtained from other studies verify the beneficial effect of feeding with green grass on the both egg production and fertility in the case of feeding regimens of low energy density and also when laying diets of high energy density were fed without restriction.

Table 3 **The effect of the provision of green forage and dietary energy density on performance in breeding geese**
(Sauveur et al., 1988)

Parameters	Experimental groups			
	1 control	2	3	4
Dietary energy density (MJ ME/kg)	8.79	9.63	10.68	11.72
Green forage (fresh grass + dried flour)	+	-	-	-
Dietary protein level (%)	14.1	16.3	18.0	19.8
Feed intake				
g/goose/day (in sex proportion with the feed consumption of the ganders)	340b (+ 650 g fresh grass)	380a	350b	340b
MJ ME/goose/day	2.99 (+ 0.54)*	3.64	3.68	3.98
Number of eggs per layer	47a	41b	44ab	38c
Fertility (%)	86a	85a	77b	72c
Hatchability (for % fertile eggs)	89a	85b	86b	86b
Number of day-old goslings per layer	35a	29b	27bc	22c
Mortality (%)	0	4	0	9

Values with different superscripts are significantly different ($P < 0.05$).

* 544 kJ ME, this being derived from the grass types.

In this series of experiments the protein levels were set in proportion to energy level (*Table 3*). Thus, the feed intake quantity of the birds remained constant when feed consumption was regulated in accordance with energy level. However, the geese used in the study ingested a higher quantity of protein from the diet of the highest concentration, since their regulatory system did not operate perfectly. It has also been observed in other poultry species (hen, guinea fowl and duck) that protein intake above a certain level decreases fertility, the reason for this lying in the negative effect on male birds (*de Reviers,* 1988).

Several authors have reported on the beneficial effect of feed restriction applied during the egg production period. The team of *Sellier et al*. (1994) used two feed restriction programmes to limit consumption in grey Landaise geese in parallel with a decrease in egg production: (1) a level of 2.76 MJ/goose/day maintained until the end of the egg production period and (2) taking into account a decrease in production and rise in temperature (according to the formula elaborated by *Emmans* (1974). The results were compared with those obtained for the control group, which was fed ad libitum (*Table 4*).

Table 4 **The effect of feed restriction introduced during the egg production period (after 23rd March) on reproduction performance in geese**
(Sellier et al., 1994)

Parameters	Control:	Restricted		
	not restricted	constant (2.76 MJ/day)	proportionate (according to Emmans)	
Number of eggs per layer	50.6[a]	44.1[b]	44.0[b]	*
Fertility (%)	65.5[b]	78.5[a]	73.5[a]	*
Day-old goslings hatched per layer	28.6	30.3	27.7	NS
Egg weight (g)	178	175	175	NS
Mortality (%)	3.3	4.4	6.7	NS
Total body weight gain in ganders* (g)	1871[a]	1038[b]	784[b]	*
Total body weight gain in females* (g)	275[a]	-13[b]	-122[b]	*

* between 23rd March and the end of June

Restriction in proportion to performance is a less accurate method than constant restriction. Both types of restriction entail a decrease in egg production, but in the group fed 2.76 MJ/goose/day fertility improved to such a high degree (surpassing that of the control group by 13 %) that the number of day-old goslings produced per layer was higher (although not significantly so), and an improvement in production costs resulted. The ganders fattened to a lesser extent by the effect of feed restriction, a factor which was, evidently, beneficial with respect to fertility.

Bogenfürst (1998) investigated reproduction performance in white meat type geese reared and producing in closed, intensive conditions in a 2x2-factor experiment (ad libitum feeding; ad libitum + Biometin supplementation; 220 g/day restricted; restricted + Biometin supplementation). The composition of this supplement was 11.5 MJ ME/kg, 15.5% crude protein, 0.6% methionine + cystine and 0.35% methionine. Biometin supplementation increased the methionine level by 0.2% and the methionine + cystine level by 0.2%. Feed intake in geese housed in closed conditions and subjected to severe feed restriction prior to the production period was so low at the beginning of production that the effect exerted by restriction was scarcely detectable in mean daily feed consumption. The results (*Table 5*) demonstrate that restriction exerts a beneficial effect on fertility, while causing a decrease in egg production, which can be compensated for by means of supplementation with Biometin. Worthy of note is the low daily feed consumption of geese in closed conditions.

Table 5 **The effect of feed restriction on reproduction performance in geese**
(Bogenfürst et al.,1998)

Method of treatment	1st treatment ad libitum	2nd treatment ad libitum + methionine	3rd treatment restricted	4th treatment restricted + methionine
Mean egg production per layer	72.7[a]	68.9[ab]	65.6[b]	70.0[a]
Feed conversion rate (g/egg)	532[a]	551[a]	577[b]	539[a]
Feed consumption (g/goose/day):				
mean	222	218	216	214
end of egg production	269	255	220	220
Mean fertility (%)	88.3	88.12	91.58	89.9
Total weight gain in females during the production period (g)	303	222	139	107
Total weight gain in ganders during the production period (g)	101	289	88	284

References

1. **BIELINSKA, H., PAKULSKA, E. and BIELINSKI, K.** (1993) Effect of low protein, low energy feed mixtures on egg production in geese. *Roczniki-Naukowe-Zootechniki*. 1983, **20**: 1, 157-165, 15.p.
2. **BIELINSKI, K., BIELINSKA, H., BIELINSKA, K. and FILUS, F.** (1983) The effect of feeding intensity on the performance of egg-laying geese. *Roczniki-Naukowe-Zootechniki*. 1983, **10**: 2, 281-292, 16.p.
3. **BIELINSKI, K., BIELINSKA, H., BIELINSKA, K. and FILUS, F.** (1984) The effect of energy level and protein content in feed on the performance of laying geese. *Roczniki-Naukowe- Zootechniki*. 1984, **11**: 1, 79-90, 16.p.
4. **BIELINSKI, K., ELMINOWSKI, W., BIELINSKA, K. and JAMROZ, D.** (1980) The effect of energy level in complete feed on laying geese productivity. *Rocz. Nauk. Zoot*., **7**, 205-212.p.
5. **BOGENFÜRST F.** (1998) Effect of feed restriction during the laying period on the reproductive performances of geese kept under intensive conditions. *Proceedings of 10th European Poultry Conference Jerusalem* 781-784.p.
6. **BOGENFÜRST F., KARAKAS P., PALMAI L. and TARASZENKÓ, ZS.** (1997) Investigation into the summer egg production of geese under intensive conditions. *Proceedings of 11th European Symposium on Waterfowl. Nantes (France)* - September 8-10, 1997. p. 404-409.
7. **COWAN, P.J.** (1980) The Goose: an efficient converter of grass? A review. *Wld. Poult. Sci. J*., **36**. 112-115.
8. **DE REVIERS, M.** (1988) Facteurs de variation du développement testiculaire et de la production de spermatozoides. In: Sauveur, B. *"Reproduction des volailles et production d'oeufs"*. Chapitre 8, INRA Paris, p. 200.
9. **DELPECH, P., ROUSSELOT, D., and MONACHON, G.** (1969) Le fourrage vert est-il nécessaire á la bonne reproduction de l'oie? In "Journées de l'oie 1967", *Bull. Soc. Sci. Hyg. Alim*., AFTAA et AFZ, 57, 117.
10. **EMMANS, G. C.** (1974) The effect of temperature on the performance of laying hens. In Morris, T. R. Freeman, B. M. "Energy requirements of poultry", *British Poultry Science Ltd*, Edinburgh. 79-90.

11. **GUÉMENÉ, D., SELLILER, N. and LAGÜE M.** (1998) Expression du comportement de Couvaison chez l' oie: constat et incidence 3'emes journées de la recherché sur les palmipédes á foie gras, Bordeaux
12. **KOVÁCS E.** (1972) The effect of different vitamin supplements on fertility of goose eggs. *Baromfiipar*, **19**, 6-9 et Anim. Breed. Abstr. (1974), 42, 1603.
13. **PAKULSKA, E., BIELINSKI, K.** (1993) Effect of reduced level of energy and protein in a feed mixture on reproductive performance of geese. *Roczniki Naukowe Zootechniki*. 1993,
14. **SAUVERUR, B., DE CARVILLE, H. and FERRÉ, R.** (1984) Influence du taux énergétique du regime et de la temperature sur les performances des canes de Barbarie reproductrices. *Arch. Für Geflügelk*., **48**:52. p.
15. **SAUVEUR, B., ROUSSELOT - PAILLEY, D. and LARRUE, P.** (1988) Alimentation énergétique de l'oie reproductrice. *INRA Prod. Anim*., 1988, **1** (3), 209-214.
16. **SAUVERUR, B. - ROUSSELOT - PAILLEY, D. and SELLIER, N.** (1989) The effect of dietary energy level on breeding performance of Landaise geese. *Proceedings of the International Symposium on Waterfowl Production*, Beijing, China 228-232, 3.p.
17. **SAUVEUR, B., ROUSSELOT - PAILLEY, D.** (1982): Suppression de l'apport de verdure dans l'alimentation des oies reproductrices In: "Fertilité et Alimentation des Volailles" I.N.R.A. Edit., Versailles, 1982, pp. 81 á 100.
18. **SELLIER, N., ROUSSELOT - PAILLEY, D. and SAUVEUR, B.** (1994) Rationnement alimentaire de l'oie avant et pendant la ponte. *INRA Prod. Anim*., 1994, **7**(1), 21-28.
19. **WANG, S. D.** (2000) Effects of dietary crude fiber and crude protein on laying performance and blood characteristics of the second laying geese*, Journal of Taiwan Livestock Research*, 2000, **33**:1, 54-62 p.