

# Effect of feeding protein and phosphorus reduced feeds on performance of white and brown laying hens in aviary systems

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The purpose of this study was to evaluate the influence of feeding for ecological reasons protein and phosphorus reduced feeds on laying performance of white and brown layers.

In a first trial 2860 LSL-hens were put in place in two different aviary systems. In a second trial 1872 LSL resp. 1872 Hyline-brown hens were kept in a floor system with elevated perches. All layer feeds were formulated to an energy content of 11.6 MJ and same level of amino acids, but they differed in raw protein (RP, g/kg) and phosphorus (P, g/kg). Feed treatments were control (= St, RP 180, P 6.0), phase feeding (= Ph, RP 180/160, P 6.0/5.5), nitrogen and phosphorus reduced feed (= NPr, RP 170/150, P 4.8). Feeding phase 1 lasted from week 21-44 and phase 2 from week 45-64.

In trial 1 hens resulted with good laying performances during 336 days. There were no significant differences in performance between feed treatments (control resp. phase feeding).

Trial 2 lasted over 11 laying periods (322 days). There was a significant difference in laying performance between feed treatments. Hens with feed "NPr" reached a significant higher laying performance than hens with phase feeding. The average egg weight of hens with feed "NPr" was significant lower than these of hens fed "control" feed. There was no difference in feed consumption.

These two trials showed that a reduction of raw protein and phosphorus contents didn't result in negative effects on performance compared to control feed.

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**Keywords:** phase feeding; nitrogen-phosphorus-reduced feed; laying performance

## Introduction

During the last years, in Swiss egg production ecological aspects gained in importance. Under Swiss law egg production farms have to fulfil a balanced nutrient in and output of N and P. In the same time production methods were diversified. In rearing and layer husbandry, different housing techniques and feeding strategies are used. In consequence considerable differences in utilisation of nutrients and amount and content of excrements are identifiable.

Potential to reduce phosphor and nitrogen amount in the excrements lies in the use of phase feeding programmes or in nitrogen and phosphor reduced feeds supplemented with phytases. Kim et al. (2006) recorded that several nutritional strategies independently have the potential to reduce nitrogen excretion and emission, a combination of strategies (synthetic amino acid supplementation of low protein diets, hydroxyl-analogues or keto acids supplementation of low protein diets) may be more effective in achieving an optimum reduction of nitrogen excretion and emission in manure while maintaining poultry performance. Summers (1993) stated a marked potential for reducing nitrogen excretion of the laying hen without any major reduction in egg mass output. Renault et al. (2001) confirmed a reduction of protein level in layer feed down to 15.5% CP with no detrimental impact on performance.

The purpose of this study was to evaluate the influence of feeding - for ecological reasons - protein and phosphorus reduced feeds on laying performance of white and brown layers under Swiss husbandry practice conditions.

## Material and Methods

All pullets were reared at Aviforum and transferred to the layer house at the age of 18 weeks.

In a first trial 2860 LSL-hens were put in place in two different aviary systems (Rhis Boleg II, Globogal Voletage) with access to exterior area (EA). Half of the hens had access to pasture (PA).

In a second trial 1872 LSL resp. 1872 Hyline-brown hens were kept in a floor system with elevated perches (A-Reuter), automatic chain feeders, nipple drinkers and colony nests.

All layer feeds were produced in commercial feed mills. Feeds were formulated to an energy content of 11.6 MJ and equal level of amino acids. They differed in raw protein (RP, g/kg) and phosphorus (P, g/kg) (table 1). Feed treatments were control (RP 180, P 6.0), phase feeding in feeding phase 2 (RP 180/160, P 6.0/5.5) and nitrogen and phosphorus reduced feed (= NPr, RP 170/150, P 4.8). Feeding phase 1 lasted from week 21-44 and phase 2 from week 45-64.

In the first trial all hens got feed “control” in the first feeding phase and in the second feeding phase half of them the feed “phase 2”.

In the second trial one third of the hens of each hybrid was allocated to the feeding treatment “control”, one third to feed “phase 2” and one third to feed “NPr”.

**Table 1: Calculated nutrient content of diets**

	Trial 1		Trial 2			
	Control	Phase 2	Control	Phase2	NPr	
					Phase 1	Phase 2
CP (%)	18.0	16.0	18.0	16.0	17.0	15.0
ME (MJ/kg)	11.6	11.6	11.6	11.6	11.6	11.6
Ca (%)	3.75	3.75	3.60/3.70	3.98	3.60	3.99
P (%)	0.60	0.55	0.60	0.55	0.48	0.48
Available P (%)	0.30	0.25	0.38	0.34	0.28	0.28
Met (%)	0.40	0.35	0.41	0.33	0.44	0.35
Met + Cys (%)	0.75	0.67	0.74	0.62	0.74	0.62
Lys (%)	0.80	0.72	0.82	0.72	0.81	0.71

Daily feed consumption, egg production and mortality were investigated. Egg grading in categories <53g, 53-70g and >70g and egg weights were recorded monthly. Hen’s feather condition was scored according to the method of Tauson et al. (2005) at day 141, in laying period 6 and before end of trial on a score from 4 (good feather cover) to 1 (severe damages).

Data were analysed by factorial analysis of variance (GLM-ANOVA) using the NCSS statistical package (Number Cruncher Statistical Systems, 2004). Significant differences between treatments were assessed by using the Bonferoni test. Statements of significance were based on  $p \leq 0.05$  and statements of tendency were based on  $p < 0.1$ .

## Results and Discussion

In trial 1 hens reached good laying performance during 336 days (table 2). There were no significant differences in performance between feed treatments “control” and “phase” feeding. Having access to pasture or only to an exterior area had no significant influence on laying rate, egg weight or feed conversion ratio (FCR). But having access to a pasture resulted in a significant higher amount of small eggs (<53g) and in tendency to a smaller proportion of large eggs (>70g) than with access to exterior area only.

Trial 2 lasted over 11.5 laying periods (322 days). There was a significant difference in laying performance between feed treatments (table 3). Hens with feed “NPr” reached a significant higher laying performance than hens with “phase feeding”. There was no difference in feed consumption. The average egg weight of hens with feed “NPr” was significant lower than of hens with feed “control”. In

tendency this difference could be stated in egg grading results. Eggs from hens with feed “NPr” had a higher proportion of normal eggs (53-70g) and a higher proportion of large eggs (>70g). As expected significant differences in performance could be stated between hybrids.

**Table 2: Impact of different feeds and housing on laying performance, feed conversion ratio (FCR), egg weight and egg grading results in trial 1 (LSL-hens, week 21-68)**

		Laying rate (%)	FCR (kg/kg)	Average egg weight (g)	Egg grading		
					<53g (%)	53-70 (%)	>70g(%)
Feeding	Control	90.85	2.080	61.52	11.39	84.81	3.80
	Phases	90.64	2.058	61.53	11.00	85.09	3.91
Housing	Exterior area	90.16	2.063	61.65	10.91	84.98	4.11
	Pasture	91.33	2.075	61.40	11.48	84.92	3.60
Sign. <sup>1</sup>	Feeding	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
	Housing	n.s.	n.s.	n.s.	*	n.s.	n.s.
	FxH	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

<sup>1</sup> \* = p < 0.05, + = p < 0.1, n.s. = not significant

**Table 3: Impact of different feeds and hybrids on laying performance, feed conversion ratio (FCR), egg weight and egg grading results in trial 2 (LSL and HB hens, week 21-66)**

		Laying rate (%)	FCR (kg/kg)	Average egg weight (g)	Egg grading		
					<53g (%)	53-70 (%)	>70g(%)
Feeding	Control	87.50 <sup>ab</sup>	2.055	64.56 <sup>a</sup>	4.25	83.38	12.63
	NPr	88.00 <sup>a</sup>	2.066	63.47 <sup>b</sup>	4.63	86.50	9.00
	Phases	86.63 <sup>b</sup>	2.074	63.88 <sup>ab</sup>	4.63	84.50	10.75
Hybrid	LSL	90.08	2.024	62.64	6.50	87.58	5.92
	HB	84.67	2.106	65.29	2.50	82.00	15.67
Sign. <sup>1</sup>	Feeding	*	n.s.	*	n.s.	+	+
	Hybrid	*	*	*	*	*	*
	FxH	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

<sup>1</sup> \* = p < 0.05, + = p < 0.1, n.s. = not significant, means with different superscripts in the same row differ significantly

In trial 1 feeding treatments had no significant influence on feather condition scoring (table 4). At the end of trial 2 hens of feed “control” were in a significant better feather condition than hens of feed “NPr”.

**Table 4: Impact of different feeds reduced in N and P on feather condition scoring in laying period 6 and end of trial on a score from 4 (good feather cover) to 1 (severe damages)**

		Trial 1		Trial 2	
		LP6	End of trial	LP6	End of trial
Feeding	Control	3.78	2.97	3.69	3.15 <sup>a</sup>
	NPr	--	--	3.39	2.75 <sup>b</sup>
	Phases	--	2.98	--	2.94 <sup>ab</sup>
Significance <sup>1</sup>		--	n.s.	n.s.	*

<sup>1</sup> \* = p < 0.05, + = p < 0.1, n.s. = not significant

In trial 1 no differences between feeding treatments in performance as well as in feather condition could be stated. But in trial 2 with feed “NPr” (RP 17.0/15.0% and phosphor reduction) resulted a significant higher laying performance with smaller egg weights compared to feed “control”. This small increase in laying performance correlated with results of Summers (1993) who stated an increase in laying rate and a decrease in egg weights with a protein reduction from 19 to 17 %. Renault et al. (2001) couldn't observe an increase in laying performance with a reduction of raw protein content from 17.5 to 16.5% and presented equal egg mass production. In trial 2 feeding of feed “NPr” resulted

in tendency in a higher part of normal eggs (53-70g) and a smaller part of large eggs (>70g). It can be concluded that feed “NPr” allows optimizing egg grading results. On the other hand “NPr” feed resulted in poorer feather conditions compared to control feed. This finding is interesting as feeds were formulated on same amino acid contents and with the same feed raw materials.

These two trials showed that a reduction of raw protein and phosphorus contents didn't result in negative effects on performance compared to control feed.

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