

PER value of four egg protein sources

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SUMMARY

A study was carried out to determine the protein efficiency ratio (PER) of four egg protein sources.

PER (as g body weight gain per g protein intake) was determined with male broiler chickens from 7-17 days of age according to a standardised experimental protocol. The experimental mash diets were standardised at 9% crude protein with the test product as the sole protein source. The broilers were housed in battery cages and each treatment replicated six times (a cage being a replicate). At 7 days of age, birds were divided over six different weight classes. Subsequently, 15 birds per weight class were placed in one battery cage per treatment. Production performance of the broiler chickens was measured during the 10-day experimental period.

Mortality was low during this experiment. The PER values of the test products varied between 4.68 and 5.06. The PER value of group 3 (5.06) was significantly better than of the other groups (4.68-4.77). The PER value of group 3 indicated that this was a good quality egg protein. Therefore, the protein quality of all four tested products was considered to be good to moderate protein sources.

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1 INTRODUCTION

1.1 Study justification

The composition of (super) premium pet food diets is optimised based on the nutritive value of raw materials. However, the digestibility of protein can be rather variable between different batches of an ingredient, despite a great similarity in nutrient compositions on paper. To maintain constant protein quality in pet food, the protein efficiency ratio (PER) is generally accepted as tool for evaluation. PER is a production performance test based on diets with adequate nutrient levels, but limiting in protein. Under these circumstances the rate of gain of fast growing broilers is limited by the protein quality. Using the test feedstuff as the sole protein source enables to evaluate the protein quality from the PER value (body weight gain divided by protein intake).

1.2 Objectives

The aim of the current experiment was to determine the protein quality of four egg protein sources by the protein efficiency ratio (PER).

1.3 Sponsor

The study was carried out on request of and sponsored by:

Schaffelaarbos
Industrieweg 20
3771 MD Barneveld
The Netherlands

2 MATERIALS AND METHODS

2.1 Site of the trial

ID Lelystad
Runderweg 2
8219 PK Lelystad
The Netherlands

2.2 Time schedule

Date of start animal experiment: 17 April 2001
Date of end animal experiment: 4 May 2001

2.3 Human resources

Name of the investigator: J.D. van der Klis
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Name of the site supervisor: W.G.M. Hiskemuller
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8219 PK Lelystad, The Netherlands

2.4 Experimental treatments

This experiment comprised four treatments (Table 1):

Table 1: Experimental treatments and protein analyses of test products

Experimental Group	Protein Source	
	Sample Number ²	Analysed ¹ protein content (g/kg)
1	0	461
2	2	496
3	3	466
4	4	480

¹ Analysed by ID Lelystad BV

² 0= Schaffelaarbos 2; 2 = Competitor A; 3 = Schaffelaarbos 1; 4 = Competitor B (the PER test was carried out with coded samples; origin of protein sources was specified by Schaffelaarbos to Feed Innovation Services as the study intermediate)

The experiment consisted of a pre-experimental period of 7 days and an experimental period of 10 days. The experimental diets were fed to broilers from 7 to 17 days of age according the PER protocol of ID TNO Animal Nutrition. Each treatment was tested with 6 cages (= replicates). Experimental treatments were tested as

2.5 Experimental procedures

2.5.1 Test substances

The four protein sources were delivered via FIS and coded as sample 0, 2, 3 and 4.

2.5.2 Test system/broilers

Species	: Broiler
Strain	: Ross 308
Gender	: Male
Source	: Pronk, Meppel, The Netherlands
Number of birds at arrival	: 540
Age period	: 0-17 days of age

2.5.3 Housing

During the pre-experimental period from 0 to 7 days of age, the birds were raised in a large floor pen on wood shavings as bedding material. During the experimental period from 7 to 17 days of age, the birds were housed in 3-tier battery cages (surface area 0.45 m²). Both the battery cages and the floor pen were located in a fully climate controlled animal room (room #8) of poultry house 160 of the ID-Lelystad facilities.

Each cage has one feed bin and two drink cups. Ambient temperature was gradually decreased from 33 °C at arrival to 23 °C at day 17. During the experiment 23 hours of light was alternated with 1 hour of darkness. Light intensity was gradually decreased with age to prevent feather picking.

2.6 Animals

In total 540 male Ross 308 one-day-old broilers were bought and raised during the pre-experimental period. At 7 days of age all birds were individually weighed. Subsequently, healthy birds were selected and divided in six different weight-classes. Birds out of each weight class were allotted to one cage per treatment, which resulted in four groups of 15 birds with an equal body weight distribution. The two classes with the lowest mean body weights per treatment were allotted to the eight battery cages on the upper tier; the two classes with the highest body weights to the eight battery cages on the lower tier; and the remaining two classes to the eight battery cages on the middle tier. Mean body weights per cage at the start of the experiment are given in Table 3 and Appendix 1.

2.7 Vaccination

The broilers were vaccinated according to routine site practices: at day old against New Castle Disease (NCD) and Infectious Bronchitis (IB). Batch numbers identification and expiration dates of the vaccines used are included in the study file at ID TNO Animal Nutrition.

2.8 Diets

During the pre-experimental period a pelleted corn/soy diet, without a coccidiostat and growth promoter was fed (AMEn 12.37 MJ/kg; 222 g/kg cp; 83 g/kg cfat; 10.8 g/kg digestible lys and 7.8 g/kg digestible met+cys). The experimental diets were standardised at 9% crude protein based on the protein analyses of the test source as sole protein delivering material. A basal diet without protein was formulated with adequate levels of vitamins and minerals. The basal diet was made as one batch. This batch was divided into four sub-batches to which the calculated amount of test product was added (in exchange for cornstarch) and mixed. Composition of the experimental diets is given in table 2. All diets were prepared by Research Diet Services BV. Water and feed were supplied for ad libitum intake.

Table 2. Composition of experimental diets

Ingredient	g/kg
Corn oil	50.0
Dextrose	300.0
Minerals	63.6
Vitamins premix	10.0
Test product	x ¹
Corn starch	576.4 - x
	1000.0
<u>Estimated Values</u>	
Crude protein	90 g/kg
Crude fat	approx. 50 g/kg

¹ varied depending on analysed protein content from 181.5 to 195.2 for these egg powders

2.9 Measurements and recordings

The following parameters were recorded.

- Total body weight per cage at day 7
- Individual body weight at day 17
- Individual body weight of any animal found dead or removed due to poor health
- Feed delivered per cage at day 7
- Feed left per cage at day 17

The health of the birds was checked daily and any aberrations were recorded. The possible cause for each animal found dead was also recorded. Temperature and humidity in the animal room were recorded. The data are included in the dossier file at ID TNO Animal Nutrition.

2.10 Criteria studied

During this experiment the following measurements were carried out:

- Body weight gain for each cage from 7 to 17 days of age
- Feed intake for each cage from 7 to 17 days of age
- Feed conversion ratio for each cage calculated as g feed intake per g body weight gain
- Protein efficiency ratio calculated as g body weight gain per g protein intake
- General state of health and mortality rate

2.11 Statistical analyses

Response parameters were analysed statistically by an ANOVA (analyses of variance) according Genstat 5, release 4.1, using weight-class as a block factor and diet as treatment in the statistical model.



3 RESULTS

The average body weight of the one-day-old broilers was 43.3 g with a standard deviation of 3.9 g.

3.1 Mortality

Mortality during this experiment was low: 0.3% during the pre-experimental and 0.8% during the experimental period. During the experimental period mortality did only occur in group 2, but the number of dead birds was too small to relate to the dietary treatment.

3.2 PER results

Results of the dietary protein analyses are given in Table 3.

Table 3. The analysed protein contents in the experimental diets.

Experimental group	crude protein content (g/kg)
1	87
2	93
3	92
4	95

Dietary protein contents were close to the calculated value, although in diet 4 the analysed value was higher than expected.

The performance results are given in Table 4. PER values were calculated based on 90 g protein per kg diet (results based on analysed values are given in Appendix 2). PER values of protein sample 3 was significantly higher than for the other samples. The other samples (0, 2 and 4) did not differ significantly and the PER value was approximately 7% lower than of sample 3 (4.68-4.77 vs. 5.06). As the PER value is based on the feed conversion ratio (FCR), the mean values for FCR resembled those of the PER. The 7% better FCR of group 3 was the result of a high body weight gain with a moderate feed intake.

Table 4. Results of the PER study per dietary group

	BW 17 days		vc BW 17 days		FI		BWG		FCR		PER value		BW 7 days	
	g	rel.	%	rel.	g	rel.	g	rel	g/g	rel.	g/g	rel.	g	sd.
Group 1	243.9	100.0	10.5 ab	100.0	267.4 a	100.0	113.1	100.0	2.365 b	100.0	4.70 a	100.0	130.8	9.3
Group 2	247.5	101.5	8.9 a	85.6	272.5 ab	101.9	117.2	103.7	2.334 b	98.7	4.77 a	101.5	130.2	9.2
Group 3	255.9	104.9	10.5 ab	100.4	274.5 abc	102.6	125.5	111.0	2.200 a	93.0	5.06 b	107.7	130.4	9.4
Group 4	251.8	103.2	11.8 b	113.2	287.3 c	107.4	120.9	106.9	2.381 b	100.7	4.68 a	99.6	130.8	8.9
P (group)	0.17		0.04		0.03		0.15		0.03		0.02			
LSD (p=0.05)	11.3		1.92		13.0		11.1		0.128		0.26			

BW = body weight; vc = variation coefficient; FI = feed intake; BWG = body weight gain; FCR = feed conversion ratio; sd = standard deviation

4 CONCLUSIONS

The PER values of the test products varied between 4.68 and 5.06. The PER value of group 3 (5.06) was significantly better than of the other groups (4.68-4.77). Egg powder 3 was classified as good, while the other products were considered to be moderate to good for use in pet food.

Appendix I: Experimental raw data

Cage	Tier level ¹	Weight Class	Diet-no	Start	End			7-17 days				
				24-Apr indiv. BW (g)	4-May avg. BW (g)	4-May sd. BW (g)	4-May vc. BW (%)	Mortality (n)	avg. Daily FI (g)	avg. FI (g)	avg. BWG (g)	avg. FCR (g/g)
102	b	K1	13	119.3	224.5	23.0	10.3	0	24.5	245.2	105.1	2.332
107	b	K2	13	123.1	237.0	27.3	11.5	0	26.3	262.6	113.9	2.305
110	m	K3	13	127.6	236.7	28.4	12.0	0	26.3	263.1	109.1	2.412
121	m	K4	13	132.3	242.2	28.3	11.7	0	26.3	263.1	109.9	2.394
118	o	K5	13	138.5	251.5	15.3	6.1	0	27.2	271.7	113.0	2.405
112	o	K6	13	143.9	271.5	30.3	11.2	0	29.9	298.7	127.5	2.342
101	b	K1	14	119.1	220.7	17.4	7.9	0	25.2	251.9	101.6	2.480
119	b	K2	14	121.8	223.6	20.9	9.3	2	24.7	246.6	101.8	2.422
103	m	K3	14	127.5	247.0	27.2	11.0	1	27.6	275.8	119.5	2.308
115	m	K4	14	132.3	245.6	24.4	9.9	0	25.8	258.2	113.3	2.280
117	o	K5	14	138.1	275.9	20.3	7.4	0	30.1	301.4	137.8	2.187
105	o	K6	14	142.7	272.1	22.1	8.1	0	30.1	301.1	129.5	2.326
120	b	K1	15	117.5	217.5	27.4	12.6	0	23.1	230.9	99.9	2.311
108	b	K2	15	123.5	250.9	26.6	10.6	0	26.8	268.1	127.4	2.104
109	m	K3	15	128.3	254.5	20.3	8.0	0	27.7	276.7	126.3	2.192
116	m	K4	15	132.8	240.5	31.3	13.0	0	25.5	254.7	107.7	2.364
123	o	K5	15	136.5	280.9	25.0	8.9	0	30.7	307.0	144.3	2.127
111	o	K6	15	143.9	291.3	28.7	9.9	0	30.9	309.5	147.3	2.100
114	b	K1	16	119.3	239.3	28.5	11.9	0	27.7	276.7	120.1	2.304
113	b	K2	16	123.6	249.2	32.7	13.1	0	28.2	281.8	125.6	2.244
104	m	K3	16	129.4	236.8	30.4	12.8	0	28.2	281.6	107.4	2.622
122	m	K4	16	131.3	242.5	25.4	10.5	0	26.4	263.7	111.2	2.372
106	o	K5	16	138.7	268.0	24.2	9.0	0	30.4	304.0	129.3	2.351
124	o	K6	16	142.8	274.7	37.4	13.6	0	31.6	315.7	131.9	2.394

¹ Tier; 0 = first tier, m = second tier, b = third tier

Appendix II: PER values based on analysed crude protein contents

Experimental group	Sample number	PER value (g/g)
1	0	4.86 ab
2	2	4.62 a
3	3	4.95 b
4	4	4.43 a
P		0.002
LSD		0.25