Efficiency of soybean meal replacement by rapeseed meal and/or canola seeds in commercial layer diets

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SUMMARY

A total of 432 Roso SL 2000 commercial layers (supplied by Avicola Bucureşti SA) were used over the age periods 40-47 and 51-58 weeks to test the effects of using rapeseeds meal (experiment 1) or canola seeds (experiment 2) as soybean meal replacers. The layers were assigned to three groups for each experiment as follows: a control (C) group and 2 experimental (E) variants with 24 replicates each (one replicate consisted in a cage with 3 layers). The layers were kept in a two-tier battery, with free access to the feed and water. Throughout the experimental period light was provided by light bulbs using a 16h regimen, between 0430 and 2030 hrs. Each experiment used 3 compound feeds formulations, a corn, soybean meal-based control diet and two experimental diets in which 52.38% and 72.86% of the soybean meal was replaced by rapeseed meal, replacing 34.32% and 45.74% of the dietary crude protein, respectively in experiment 1 and 18.31% and 30.32% of the soybean meal was replaced by canola seeds, replacing 17.40% and 22.45% of the dietary crude protein, respectively in experiment 2. All diets were isocaloric, isoprotein and had similar levels of sulphur amino acids, calcium and available phosphorus, and were in agreement with the feeding requirements recommended for the intensive rearing of the commercial layers. The experimental results show that rapeseed meal can be used up to a level of 15% in the compound feed formulation for commercial layers, replacing up to 50% of the soybean meal. Canola seeds can be used up to a level of 20% in the compound feed formulation replacing 25-30% of the dietary soybean meal, without significantly affecting the laying performance and egg quality.

Keywords: soybean meal, rapeseed meal, canola seeds, layers, performance, egg quality, feed conversion ratio, feeding cost

INTRODUCTION

Researchers have been concerned over the recent years to find feeding solutions for poultry feeding which to support high layer performance on lower

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feeding costs. Poultry feeding uses two main types of ingredients: cereal grains and vegetal industrial by-products. Corn is the most important feed ingredient due to its high level of total nutrients, providing thus a high energy input. Corn protein has a low biological value, though, because two of the amino acids essential to non-ruminant feeding, lysine and tryptophan, are in very low levels, hence the need to supplement the compound feed formulations with ingredients of high biological value. Soybean meal is the main source of vegetal protein used in poultry feeding because of the high protein level (44% not dehulled and 46-50% dehulled), because of the balanced composition of essential amino acids and to the highest lysine digestibility (91%) of all the available protein sources.

The compound feed industry uses partially defatted and full fat soybean meal. Although regarded as a strategic feed ingredient in many countries in Europe and Asia, soybean meal is imported, hence the need to find alternative vegetal protein sources.

Rapeseed meal and/or canola seeds are potential alternative vegetal sources for poultry feeding, allowing cutting the feeding cost, provided the compound feed was formulated adequately.

The rapeseed meal made from whole seeds contains about 40% crude protein (on a DM basis). Rapeseed meal protein is less digestible than that of the soybean meal (72% vs. 88%), but the amino acids balance is similar, even better than in the soybean meal (for the sulphur amino acids) (Summers et al., cited by Koreleski, 1993). Considering the high level of insoluble polyosides and tannins (from the teguments), the metabolisable energy is quite low and is one of the problems of this meal, next to the presence of glucosynolates. Many studies conducted during the previous decades (Cowan et al., 1994; Khattak et al., 1996; Miles, 2002) have shown that the addition of enzymatic preparations has improved the efficiency of rapeseeds meal nutrient utilization. However, the rapeseed meal has a higher vitamin content (choline, biotin and folic acid) than the soybean meal (Bell, 1984 cited by Koreleski, 1993).

Experiments conducted on broilers in the National Research Development Institute for Animal Biology and Nutrition (IBNA) Balotesti have shown that rapeseed can be used in compound feeds formulation for broilers replacing up to 25% of the soybean meal without affecting broiler performance. Compound feeds supplementation with the enzyme complex Kemzyme VP Dry (beta-glucanase, endo-beta-glucanase, alpha-amylase, bacillolysine and endo-beta-xylanase) didn’t influence significantly broiler performance (Vasile et al., 2005).

Canola is a rapeseed variety superior nutritionally, with 20-22% crude protein and 40-42% fat, with low levels of glucosynolates and erucic acid (Swick and Tan, 1997). Compared to the soybean meal, canola has a higher level of calcium and phosphorus, but about 65% of the phosphorus is as phytates, thus unavailable. The sulphur content also is higher than in the soybean meal (1.1% vs. 0.4%), which may cause leg defects (Larbier and Leclercq, 1994, Charlton, P., 1997).

MATERIAL AND METHODS

The trials for rapeseed meal (experiment 1) and canola seeds (experiment 2) utilization were conducted on 432 Roso SL 2000 commercial layers supplied by SC Avicola Bucureti SA. The layers, over the age periods 40-47 and 51-58 weeks, were assigned to three groups for each experiment as follows: a control (C) group and 2 experimental (E) variants with 24 replicates each (one replicate consisted in a cage with 3 layers).

Each experiment used 3 compound feeds formulations, a corn, soybean meal-based control diet and two experimental diets in which 52.38% and 72.86% of the soybean meal was replaced by rapeseed meal, replacing 34.32% and 45.74% of the dietary crude protein, respectively in experiment 1 and 18.31% and 30.32% of the soybean meal was replaced by canola seeds, replacing 17.40% and 22.45% of the dietary crude protein, respectively in experiment 2. All diets were isocaloric, isoprotein and had similar levels of sulphur amino acids, calcium and available phosphorus, and were in agreement with the feeding requirements recommended for the intensive rearing of the commercial layers.

The rapeseed meal had the following chemical composition: 90% dry matter; 34.45% crude protein; 2.60% ether extractives; 11.0% crude fiber; 7.0% ash; 1790 kcal/kg metabolisable energy. The canola seeds had the following chemical composition: 93.18% dry matter; 17.42% crude protein; 40.58% ether extractives; 9.17% crude fiber; 9.02% ash; 3900 kcal/kg metabolisable energy. All analyses were performed within IBNA Balotesti.

Tables 1 and 2 show compound feed formulation. The layers were kept in a two-tier battery, with free access to the feed and water. Throughout the experimental period light was provided by light bulbs using a 16h regimen, between 0430 and 2030 hrs.

Production parameters that were monitored:

- Laying percentage, monitored daily;
- Average egg weight, determined by weighing all eggs for four consecutive days, at the end of each 4-week period;
- Proportion of egg components (yolk, white and shell egg), determined by weighing all eggs produced daily, for one week at the end of the experiment;
- Feed intake, recorded daily, for each replicate separately, calculated per layer per day;

• Live layer weight, determined by individual weighing of the layers at the beginning and end of the experiment;

Table 1. Compound feeds formulation

Structure / ingredients	Control, soybean meal	Experiment 1, rapeseed meal	
		E 1	E 2
Corn	64.00	58.30	56.60
Soybean meal (44% CP)	20.81	10.00	6.40
Rapeseed meal (34,45% CP)	-	15.00	20.00
Corn gluten (60% CP)	2.00	2.00	2.00
Oil	2.00	3.60	4.10
Monocalcium phosphate	1.00	1.00	1.00
Calcium carbonate	8.70	8.60	8.53
Salt	0.30	0.30	0.30
Vitamin-mineral mix A5	1.00	1.00	1.00
DL - methionine	0.19	0.11	0.07
TOTAL	100	100	100
CF cost (% of control)	100	89.59	86.03
Analyzed:			
ME (MJ/kg)	11.92	11.92	11.90
Crude protein	15.50	15.50	15.52
Ether extractives (total)	4.93	2.94	3.02
Gross fiber	2.84	7.07	2.99
Methionine + Cystine	0.66	0.66	0.66
Lysine	0.75	0.77	0.78
Tryptophan	0.15	0.16	0.16
Calcium	3.55	3.55	3.55
Available phosphorus	0.32	0.32	0.33

Table 2. Compound feeds formulation

Structure / ingredients	Control, soybean meal	Experiment 2, canola seeds	
		E 1	E 2
Corn	64.00	53.29	50.90
Soybean meal (43% PB)	20.81	17.00	14.50
Canola seeds (17,42% PB)	-	15.00	20.00
Corn gluten (60% PB)	2.00	2.00	2.50
Oil	2.00	1.60	1.00
Monocalcium phosphate	1.00	1.00	1.00
Calcium carbonate	8.70	8.70	8.70
Salt	0.30	0.30	0.30
Vitamin-mineral mix A5	1.00	1.00	1.00
DL - methionine	0.19	0.11	0.10
TOTAL	100	100	100
CF cost (% of control)	100	94.95	92.99
Analyzed:			
ME (MJ/kg)	11.92	11.97	11.92
Crude protein	15.50	15.48	15.45

Ether extractives (total)	4.93	9.89	10.20
Gross fiber	2.84	3.62	3.78
Methionine	0.39	0.34	0.35
Methionine + Cystine	0.66	0.66	0.66
Lysine	0.75	0.81	0.80
Tryptophan	0.15	0.16	0.14
Calcium	3.55	3.55	3.57
Available phosphorus	0.32	0.32	0.33

At the end of the experiment we calculated:

- Egg mass production (g egg /layer /day);
- Feed conversion into eggs (g feed /g egg);
- Feeding cost (economic efficiency, %).

The eggs with abnormal morphology or shell defaults (broken or cracked shells, shell-less eggs, deformed eggs) and mortalities were monitored on a daily basis.

The experimental data were processed statistically by variance analysis using the Fisher test. The Student – t test was used to evaluate the significance of differences between the experimental groups. The differences were considered statistically significant for P<0.05.

RESULTS AND DISCUSSION

Experiment 1

The statistical calculation of the data on the laying percentage, egg weight, production of egg mass, feed conversion into eggs and egg component indices (Table 3) have shown no significant differences between the groups up to 52.38% soybean meal replacement by rapeseed meal, the resulting average values being similar to those of the control group (P>0.05). Exceeding this level of replacement significantly depressed layer performance (P<0.05).

Table 3. Effects of the level of soybean meal replacement by rapeseeds meal on the laying percentage and egg quality over the age period 40 -47 weeks

Performance parameters	Control, soybean meal	Experimenta1, rapeseeds meal	
		E 1	E 2
Egg production:			
- laying percentage (%)	88.97^{a}	88.39^{a}	87.11^{b}
- egg mass (g/layer/day)	53.31^{a}	52.43^{a}	50.38^{b}
Egg weight (g)			
- initial	56.80^{a}	57.20^{a}	56.92^{a}
- final	59.92^{a}	59.32^{a}	57.83^{b}
Daily feed intake (g)	121.73^{a}	118.92^{a}	116.26^{b}
Feed conversion (g feed/g egg)	2.28^{a}	2.27^{a}	2.31^{b}
Live body weight (g)	2143.24^{a}	2186.90^{a}	2161.54^{a}
Yolk weight (g)	17.98	17.73	17.00

Egg white weight (g)	36.35	36.14	35.36
Egg shell weight (g)	5,59	5,52	5,47

a, b – different superscripts show significant differences (P<0.05)

Experiment 2

Table 4 displays the experimental data which show no significant differences from in the group where 30.32% of the soybean meal has been replaced by canola seeds, the average values being similar to those of the control group (P>0.05). These results are in agreement with the data of Elwinger and Saeterby, 1986; Leeson et al., 1987; Rachwal et al., 1989; Smulikowska and Buraczewski, 1991; Zglobica and Wezyk, 1991 cited by Koreleski 1993, who reported that a 25% replacement of the soybean meal by canola seeds in protein and energy balanced diets didn't affect layer performance, nutrient deposition and bone mineralization.

Table 4. Effects of the level of soybean meal replacement by canola seeds on the laying percentage and egg quality over the age period 51-58 weeks

Performance parameters	Control, soybean meal	Experimenta1, rapeseeds meal	
		E 1	E 2
Egg production:			
- laying percentage (%)[1]	79.79	79.68	78.69
- egg mass (g/layer/day)[1]	51.65	51.26	50.93
Egg weight (g)			
- initial[1]	62.87	62.12	62.56
- final[1]	64.63	64.33	64.72
Daily feed intake (g)	121.73	119.92	119.26
Feed conversion (g feed/g egg)	2.35	2.33	2.34
Live body weight (g)[1]	2276.48	2230.43	2224.00
Yolk weight (g)	18.98	18.75	18.97
Egg white weight (g)	38.85	38.83	38.86
Egg shell weight (g)	6.90	6.75	6.89

1 – not significant differences (P>0.05)

CONCLUSIONS

The experimental results show that:

- rapeseeds meal and/or canola seeds can be used as potential alternative sources of vegetal protein for commercial layer diets
- rapeseed meal can be used up to a level of 15% in the compound feed formulation for commercial layers, replacing up to 50% of the soybean meal;
- canola seeds can be used up to a level of 20% in the compound feed formulation replacing 25-30% of the dietary soybean meal, without significantly affecting the laying performance and egg quality.

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