COMPARATIVE EVALUATION OF DIFFERENT SOYBEAN MEAL AND THE REPLACEMENT USING PEANUT, RAPESEED AND FISH MEAL FOR BROILERS

BUDI TANGENDJAJA and I. A. K. BINTANG

Research Institute for Animal Production
P.O. Box 221, Bogor 16002, Indonesia

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ABSTRAK

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Dua percobaan telah dilakukan untuk mengevaluasi bungkil kedelai yang berasal dari negara berbeda (lokal, India dan Amerika) dan mengetahui pengaruh substitusi menggunakan bungkil kacang tanah (10%), *rapeseed* (5%) dan tepung ikan (5%). Percobaan pertama menggunakan pola faktorial (3x4) yang diulang 6 kali dan masing-masing terdiri dari 6 ekor anak ayam. Faktor pertama adalah sumber penghasil bungkil kedelai dan faktor kedua adalah jenis sumber protein (bungkil kacang tanah, *rapeseed* dan tepung ikan). Percobaan dilakukan selama 4 minggu. Pakan yang mengandung bungkil kedelai berasal dari India memberikan pertambahan bobot badan yang nyata lebih rendah (1.000g) daripada pakan yang mengandung bungkil kedelai dari lokal atau Amerika (masing-masing 1.037g dan 1.023g). Tidak ada perbedaan yang nyata terhadap pertambahan bobot badan, konsumsi pakan dan konversi pakan pada perlakuan substitusi. Rataan konsumsi dan konversi pakan adalah berturut-turut 1.535 g dan 1.569 g. Pada percobaan kedua digunakan 1.500 anak ayam pedaging yang dipelihara dalam sistem kandang dengan lantai sekam. Ada 6 perlakuan dalam pola faktorial (3x2) yang diulang 5 kali dan masing-masing terdiri dari 50 ekor/ulangan. Faktor pertama adalah sumber penghasil bungkil kedelai dan faktor kedua adalah tingkat substitusi dengan bungkil kacang tanah (0 dan 10%). Percobaan dilakukan selama 6 minggu. Hasil yang sama tanpa perbedaan yang nyata diperoleh pada semua parameter pada semua perlakuan. Bobot badan dan konversi pakan ayam diberi pakan mengandung bungkil kedelai dari lokal, India dan Amerika masing-masing adalah 1.662, 1.641 dan 1.669g serta 2,043; 2,051 dan 2,035. Analisis biaya menunjukkan bahwa biaya pakan yang menggunakan bungkil kedelai lokal lebih tinggi daripada yang menggunakan bungkil kedelai India atau Amerika.

Kata kunci : Bungkil kedelai, bungkil kacang tanah, bungkil *rapeseed*, tepung ikan, ayam pedaging

ABSTRACT

TANGENDJAJA, B. and I. A. K. BINTANG. 1996. Comparative evaluation of different soybean meal and the replacement using peanut, rapeseed and fish meal for broilers. *Jurnal Ilmu Ternak dan Veteriner* 2 (2): 96-101.

Two feeding experiments have been conducted to test the different sources of soybean meal (local, India, USA) and the partial substitution with peanut meal (10%), rapeseed meal (5%) and fish meal (5%) in the diet for broiler. The first feeding experiment was carried out on broiler starter for 4 weeks in wire cages. Twelve rations in factorial design (3 x 4) were conducted using 6 birds/cage and replicated 6 times. Birds fed India soybean meal had significantly less body weight (1,000 g) than those fed local or USA soybean meals (1,037 and 1,023 g, respectively). Partial substitution with peanut, rapeseed or fish meal did not affect body weight, feed consumption or feed/gain ratio. The average consumption and feed/gain were 1,535 g and 1,569, respectively. In second experiment, one thousand five hundred broiler chicks were allocated in 6 dietary treatments in factorial design (3 x 2). Factor one was different sources of soybean meal (local, India and USA) and factor two was the inclusion of peanut meal at 0 and 10%. Birds were kept on litter system for 6 weeks. Each treatment used 5 replicates and 50 birds/replicate. The results show no effect of the treatment to any parameter measured. Body weight of bird fed local, India and USA soybean meal were 1,662, 1,641 and 1,669 g and feed/gain were 2.043, 2.051 and 2.035, respectively. Cost analysis indicates that ration uses local soybean meal gives a higher cost than those of India and USA soybean meals.

Key words : Soybean meal, peanut meal, rapeseed meal, fish meal, broiler

INTRODUCTION

Indonesia is one of the fast growing nations in Asia with the population of 180 millions with average income per capita at US $ 884/year and broiler consumption at about 5 kg/year. The increase in broiler production is estimated more than 10%/year. Most of broilers and layers of modern strains are fed commercial feed produced from more than 15 major feedmills. Annual poultry feed production is more than 4.5 million tons.

One of the protein sources for feed is soybean meal. This kind of ingredient is produced locally or imported from India and USA. The difference in quality between different sources of soybean meal have been noticed from the proximate analysis (CRESWELL, 1992a). The average protein content of local, India and USA (Hipro) soybean meal are 42, 44 and 48%, respectively (RPAN, 1993). The biological test of different soybean meals using broiler has not been reported.

Due to the cost of local soybean meal, Indonesia also imports many alternative protein sources from oilseed

such as peanut meal, repeseed meal, etc. Many other alternatives of soybean meal have variable qualities and have been reported to have lower amino acid digestibility. It is possible that broiler rations developed from such ingredients although have sufficient total protein/amino acid, have lower digestible amino acids.

The value of the composition of those oil seed meal and fish meal can be found in several publications such as AJINOMOTO (1992), RPAN (1993), NRC (1994), DE GUSSA (1995), FEEDSTUFFS (1995). The digestibility figure for those ingredients are also included in PARSON (1995). One of major problems on the use of oil seed meal including soybean meal variability on quality which can be influenced by agronomic back ground and processing factor. SWICK and TAN (1995) recently gave a several consideration on the use of protein resources in Asia countries. Besides the availability of the supplies, quality factors have to be considered on the use of other oilseed meal or fish meal besides soybean meal.

The experiment, therefore, was designed to evaluate the nutritive value of soybean meal from different sources and its substitute for broilers. Several publications (KRATZER *et al.*, 1990, PARSONS *et al.*, 1991, HAFFERMANN *et al.*, 1993; ZHANG and PARSON, 1994), indicated that over processing of oil seed may decrease the digestibility of their amino acid and finally influence the performance of poultry.

MATERIALS AND METHODS

Broiler feeding experiments were carried out at Research Institute for Animal Production, Ciawi-Bogor. Location was 300 m above sea level with the average ambient temperature 28-30°C. Two feeding experiments were conducted. First feeding experiment was done in a closed building. Broilers were placed in wire cages (60 x 45 cm) 80 cm above the concrete floor. Four hundred and thirty two male broiler chicks (India River Strain) were allocated randomly in cages with 6 birds/cage. Twelve different treatments (3 x 4) in a factorial design were used in this experiment. Factor one was the source of soybean meal (SBM) *i.e.*, from Indonesia (local), India and USA and factor two was inclusion of protein substitute *i.e.* 10% peanut meal in the diet, 5% rapeseed meal and 5% fish meal. Diet with no substitution is considered as control. Each treatment was replicated 6 times (cages). The ration formulation was calculated on the basis of similar protein and caloric value and also similar in amino acid digestible value based on the suggestion of Rhone Poulenc Animal Nutrition Guide (RPAN, 1993). The formula and the calculated composition are presented in Table 1a, 1b, and 1c.

Local soybean meal was obtained from Indonesia soybean meal factory. India and USA soybean meals were imported, in which the USA soybean meal was Hipro

Table 1a. Dietary formula of broiler starter containing local soybean meal and other protein substitute (peanut meal, rapeseed meal, fish meal)

Ingredient %	SBM Local	Peanut Meal	Rapeseed Meal	Fish Meal
Corn, Yellow	54.306	54.158	54.113	60.876
SBM Local	37.25	25.889	31.324	28.043
Peanut meal (PM)	-	10.000	-	-
Rapeseed meal (RM)	-	-	5.0	-
Fish meal (FM)	-	-	-	5.0
Crude palm oil	3.38	3.973	3.951	1.497
Corn gluten meal	1.0	2.0	2.0	2.0
Dicalcium phosphate	1.588	1.991	1.59	0.918
Limestone	1.152	0.920	1.115	0.829
Salt	0.42	0.414	0.408	0.408
Lysine-HCl	0.030	0.209	0.098	0.051
D.L Methionine	0.209	0.225	0.187	0.172
Premix*	0.208	0.208	0.208	0.208
Calculated composition :				
Metabolizable energy (kcal/kg)	2,950	2,950	2,950	2,950
Crude Protein (%)	21	21	21	21
Digestible Lysine (%)	1.00	1.00	1.00	1.00
Digestible Methionine (%)	0.50	0.51	0.50	0.51
Digestible Meth.+ Cys.(%)	0.75	0.79	0.79	0.79
Digestible Tryptophan (%)	0.22	0.20	0.21	0.20
Cost (Rp/kg)	561.8	558.9	554.0	554.8

* To contain vitamin mix, mineral mix, salinomycin (60 ppm) bacitracin methylene disalicylate (20 ppm)
SBM = soybean meal
Meth. = methionine
Cys. = cystine

Table 1b. Dietary formula of broiler starter containing India soybean meal and other protein substitute (peanut meal, rapeseed meal, fish meal)

Ingredient %	SBM India	+	Peanut Meal	+	Rapeseed Meal	+	Fish Meal
Corn, Yellow	55.829		54.06		53.93		60.666
SBM India	36.845		27.626		33.256		30.072
Peanut meal (PM)	-		10.0		-		-
Rapeseed meal (RM)	-		-		5.0		-
Fish meal (FM)	-		-		-		5.0
Crude palm oil	3.227		4.0		4.0		1.571
Corn gluten meal	0.223		0.267		0.01		-
Dicalcium phosphate	2.081		2.189		2.03		1.162
Limestone	0.954		0.852		0.925		0.737
Salt	0.419		0.426		0.413		0.407
Lysine-HCL	-		0.143		0.023		-
D.L Methionine	0.214		0.229		0.206		0.178
Premix*	0.208		0.208		0.208		0.207
Calculated composition :							
Metabolizable energy (kcal/kg)	2950		2950		2950		2950
Crude Protein (%)	21		21		21		21
Digestible Lysine (%)	1.00		1.00		1.00		1.00
Digestible Methionine (%)	0.50		0.50		0.50		0.50
Digestible Meth.+ Cys.(%)	0.80		0.79		0.80		0.79
Digestible Tryptophan (%)	0.22		0.21		0.22		0.21
Cost (Rp/kg)	527.20		532.40		525.30		524.00

* To contain vitamin mix, mineral mix, salinomycin (60 ppm)
bacitracin methylene disalicylate (20 ppm)
SBM = soybean meal
Meth. = methionine
Cys. = cystine

Table 1c. Dietary formula of broiler starter containing USA soybean meal and other protein substitute (peanut meal, rapeseed meal, fish meal)

Ingredient %	SBM USA	+	Peanut Meal	+	Rapeseed Meal	+	Fish Meal
Corn, Yellow	61.885		58.583		58.847		64.938
SBM USA	32.192		23.945		30.145		27.123
Peanut meal (PM)	-		10.0		-		-
Repeseed meal (RM)	-		-		5.0		-
Fish meal (FM)	-		-		-		5.0
Crude palm oil	0.988		2.319		2.197		-
Corn gluten meal	1.0		1.0		-		-
Dicalcium phosphate	1.877		2.168		1.799		1.094
Limestone	1.045		0.85		1.025		0.801
Salt	0.419		0.426		0.413		0.407
Lysine-HCL	-		0.136		-		-
D.L. Methionine	0.387		0.208		0.367		0.341
Premix*	0.208		0.208		0.207		0.208
Calculated composition :							
Metabolizale energy (kcal/kg)	2950		2950		2950		2950
Crude protein (%)	21		21		21		21
Digestible Lysine (%)	1.01		1.00		1.01		1.04
Digestible Methionine (%)	0.69		0.65		0.67		0.67
Digestible Meth.+ Cys.(%)	0.79		0.79		0.79		0.79
Digestible Tryptophan (%)	0.22		0.20		0.21		0.21
Cost (Rp/kg))	534.2		539.1		531.2		533.6

* To contain vitamin mix, mineral mix, salinomycin (60 ppm)
bacitvaci vlene disalicylate (20 ppm)
SBM = so meal
Meth. = m ine
Cys. = cy

grade. Other protein substitutes were imported except fish meal which was obtained locally from steam processed sardine. All diets contain salinomycin, bacitracin methylene disalicylate, coccidiocide and growth promotant and was in the mash form. Heating was provided for 3 weeks using infra red lamp and the birds were vaccinated againts Newcastle and Infectious Bursal Diseases. The body weight and feed consumption were measured after 4 weeks of experiment. At end of experiment samples of bird fed local soybean meal and rapeseed meal were slaughtered and the thyroid glands, liver and kidney weight were measured.

formula for starter was similar to that of the first feeding experiment and the grower diet formulas were presented in Table 2.

Starter feed were given from 0 - 28 days and grower feed from 29 - 41 days. Heating is provided using infra red lamp for 3 weeks. Feed was provided in hanging type feeders and water was provided in bell type drinkers. Vaccination was similar to the first experiment. Measurements were done on body weight, feed consumption and feed/gain ratio. All data were subjected to statistical analysis using MSUSTAT program with Multifactorial Design.

Table 2. Dietary formula of broiler finisher containing different soybean meal and peanut meal

Ingredient %	Dietary treatment					
	SBM Local		SBM India		SBM USA	
	0% PM	10% PM	0% PM	10% PM	0% PM	10% PM
Corn, Yellow	58.55	57.05	54.83	58.60	52.06	50.54
SBM Local	32.97	19.67	-	-	-	-
SBM India	-	-	31.03	22.36	-	-
SBM USA	-	-	-	-	24.54	16.32
Peanut meal (PM)	-	10.0	-	10.00	-	10.00
Rice bran	1.27	3.79	6.70	1.46	15.00	13.54
Corn Gluten meal	-	2.00	-	-	2.00	2.00
Crude palm oil	4.00	4.00	4.00	4.00	2.97	4.00
Dicalcium phosphate	1.40	1.61	1.81	1.91	1.55	1.68
Limestone	1.03	0.91	0.87	0.77	1.00	0.90
Salt	0.42	0.43	0.42	0.43	0.42	0.43
Methionin D.L	0.17	0.18	0.16	0.18	0.29	0.27
Lysine-HCL	-	0.19	-	0.11	-	0.15
Premix*	0.18	0.18	0.18	0.18	0.18	0.18
Calculated composition:						
Metabolizable energy (kcal/kg)	3000	3000	3000	3000	3000	3000
Crude Protein (%)	19.0	19.0	19.0	19.0	19.0	19.0
Digestible Lysine (%)	0.88	0.86	0.88	0.86	0.86	0.86
Digestible Methionine (%)	0.43	0.44	0.42	0.43	0.47	0.54
Digestible Meth.+ Cys.(%)	0.70	0.70	0.70	0.70	0.70	0.70
Digestible Tryptophan (%)	0.19	0.17	0.19	0.19	0.18	0.17
Cost (Rp/kg)	534.6	525.3	502.2	507.0	503.2	507.6
Price (Rp/Kg)	650		585		650	

* To contain vitamin mix, mineral mix, salinomycin (60 ppm)
bacitracin methylene disalicylate (20 ppm)
SBM = soybean meal
Meth. = methionine
Cys. = cystine

The second feeding experiment was done in an open sided house with concrete floor system. Rice hull (6cm thickness) was used for litter as normally practiced at commercial farms. The house was divided into 30 pens with size of 3 x 3 m. One thousand five hundred broiler chicks (all males Arbor Acre strain) were allocated into 30 pens containing 50 birds in each pen as replicate. There were 6 dietary treatments, *i.e.*, combination of 3 different soybean meals (local, India and USA) and without or with peanut meal at 10% level without fish meal. Dietary

RESULTS AND DISCUSSION

Body weight of broilers fed ration containing a combination of different soybean meals and protein substitutes include peanut meal, rapeseed meal and fish meal is presented in Table 3. There is a significant effect ($P<0.05$) due to the soybean meal with the India soybean meal resulted in a lower body weight than the local or USA soybean meal. There is no effect of partial substitution of soybean meal with other protein sources on body weight

of broilers. The reason for less body weight of broilers fed the Indian soybean meal is not known since all feed formulation were based on digestible amino acid. SWICK (personal communication) indicated that the higher level of potassium may contribute to the less body weight. Further studies are necessary to elucidate this problem.

Table 3. Effect of soybean meal from local, India and USA and other subtitute of protein sources on body weight (g) of broilers at 4 weeks of age

Protein Substitute	Effect of soybean meal			
	Local	India	USA	Averaqe
Control	1,046	986	1,028	1,020
Peanut meal 10%	1,042	1,007	1,021	1,023
Rapeseed meal 5%	1,040	992	1,021	1,018
Fish meal 5%	1,022	1,015	1,021	1,019
Average*	$1,037^{B}$	$1,000^{A}$	$1,023^{AB}$	-

* Different superscripts are siqnificant difference ($P < 0.05$)

Results on the effect of rations on feed consumption and feed conversion ratio are presented in Table 4. There is no significant effect of all treatments on feed consumption or feed/gain ratio. The formulation of ration based on a similar digestible amino acid should give a similar performance to birds although rapeseed meal, for example, has been reported to have a lower digestible amino acid value as compared to soybean meal (RPAN, 1993).

Table 4. Effect of soybean meal (SBM) from local, India and USA and protein substitute on feed consumption and feed/gain of broilers at 4 weeks of age

	Feed consumption (g)	Feed/gain
SBM local	1,590	1.582
+ Peanut meal 10%	1,483	1.482
+ Rapeseed 5%	1,584	1.584
+ Fish meal 5%	1,544	1.572
SBM India	1,506	1.596
+ Peanut meal 10%	1,493	1.548
+ Rapeseed meal 5%	1,566	1.629
+ Fish meal 5%	1,511	1.550
SBM USA	1,536	1.555
+ Paenut meal 10%	1,574	1.606
+ Rapeseed meal 5%	1,563	1.584
+ Fish meal 5%	1,475	1.523

SBM = soybean meal

One of the limitation to use rapeseed meal is the glucosinolate content. Several researchers indicated that this toxic component will affect performance of birds by interfering the thyroid glands. However, the level up to 5% in the diet of this experiment (Table 5) did not show any significant effect to the thyroid weight of birds for 4 weeks of feeding. Higher glucosinolate level in the diet by feeding a higher percentage of rapeseed meal seems to be necessary to get an effect on the thyroids. The liver and kidney of birds are also not affected by inclusion of 5% rapeseed meal as expected. Review from SALMON and CLANDININ (1991) indicated that maximum tolerance to glucosinolate content in the ration for poultry is 5.0 umol/g. Novus International Ingredient assay indicated that glucosinolate content of rapeseed from India is 100-140 umol/g. Therefore, maximum inclusion of rapeseed meal from India would be 3-5% without any problem. Canola meal from Canada which has only 8 umol of glucosinolate/g has been recommended to be used up to 20% in ration (ROBBLEE *et al.*, 1989).

Table 5. Effect of rapeseed meal (RSM) on liver, kidney and thyroid weight of broilers at 4 weeks of age

Rapeseed	Liver (g)	Kidney (g)	Thyroid (g)
Control (0 % Rapeseed meal)*	24.4	8.5	0.21
+ 5 % Rapeseed meal *	25.0	9.1	0.21
Standard Error	0.7	0.5	0.01

* From average body weight 1,020g

Performance of broilers fed different soybean meals with and without peanut meal is presented in Table 6. A significant effect of different soybean meal on body weight of broilers found in the first experiment is not detected in the second experiment up to 6 weeks of trial. Although on average, the body weight of birds fed India soybean meal is less at approximately 20 - 30 gram than that of birds fed local or USA soybean meal. Perhaps, the effect is only significant to young birds rather than to older birds. Inclusion of 10% peanut meal also did not affect performance of birds which supports the first experiment. These results clearly indicated that partial substitution of

Table 6. Effect of soybean meal (SBM) and peanut meal (PM) on bodyweght, feed consumption and feed/gain of broiler grown on litter at 6 weeks of age.

	Body weight (g)	Feed consumption (g)	Feed/gain
SBM Local	1,665	3,397	2.048
+ PM 10%	1,659	3,382	2.039
SBM India	1,642	3,363	2.048
+ PM 10%	1,640	3,364	2.054
SBM USA	1,666	3,404	2.042
+ PM 10%	1,672	3,390	2.028

SBM = soybean meal

soybean meal by other protein source did not affect broiler performance as long as the difference in amino acid digestibilities are considered. Calculated total lysine content in broiler starter and finisher were 1.15 to 1.16 and 0.99 to 1.00% which is very little different among the treatments. These results may imply that diet formulation based on its digestible amino acid or total amino acid will give little difference.

The cost of feeds per kg are presented in Table 1 and 2. For broiler starter inclusion of the local soybean meal give the highest cost of feed as compared to that of USA or India soybean meal. Inclusion of USA soybean meal is approximately Rp 7/kg more expensive than that of India soybean meal. However, higher body weight at approximately 20 g for broiler fed USA soybean meal will have a better economic return because it will give an extra return of Rp 46 with the price of broiler at that time of experiment was Rp 2,300/kg while starter feed consumed was only 1.5 kg, resulted on extra cost of Rp 10.5. Inclusion of rapeseed meal at 5% always gives a lower cost of feed but inclusion of peanut meal may not always give a lower cost. For broiler finisher, inclusion of peanut meal reduces only the cost of local soybean meal diet but not that of other diets. Inclusion of local fish meal will reduce the cost (Rp 11) if using local soybean meal which has only 42% protein. However, when high protein soybean meal such as from USA is used, the cost reduction is minor which also has been raported by CRESWELL (1992b).

In conclusion, broilers fed India soybean meal performed slightly less than those fed local or USA soybean meal. Partial substitution of soybean meal with peanut meal (10%), rapeseed meal (5%) and fish meal (5%) did not affect the performance of the bird as far as the ration was formulated based on digestible/total amino acids.

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