THE EFFECT OF ADDING SOYBEAN OR RAPESEED GUMS TO THE DIET ON THE PERFORMANCE OF LAYING HENS

By H.W. Hulan and F.G. Proudfoot
Agriculture Canada, Research Station, Kentville, Nova Scotia. Contribution No. 1634

INTRODUCTION

Gums or phosphotids are natural lipid components of soybean and rapeseed oils. They consist primarily of phospholipids together with smaller amounts of triglycerides and non-lipid material (Weenink and Tulloch, 1966). Both soybean oil and rapeseed oil is degummed prior to refining. It is customary in the soybean industry to separate the lecithin from soybean gums for use as an emulsifying agent (Carr, 1976). However, gums derived from rapeseed oil are not used for this purpose. It is the practice during the production of rapeseed meal to add the gums back to the meal component in order to provide a pollution-free method for their disposal (Leeson et al. 1977), and to make the meal more attractive and less dusty (Salmon, 1970).

The question has been raised as to whether the relatively high incidence of mortality observed with certain strains of laying hens fed diets containing rapeseed meal might in fact be due to the presence in the meal of the added gums. Although studies have been reported on the feeding value of soybean lecithin for broilers (Lipstein and Bornstein, 1975) and of rapeseed gums (RSG) for growing chickens and turkeys (Salmon, 1970), there appears to be only one report in the literature on the performance of laying hens fed diets containing RSG (Leeson et al, 1977). Unfortunately experimental sample size of the latter study did not permit an adequate evaluation of the effect of treatment on mortality. It was therefore considered necessary to investigate the effects of the addition of soybean gums (SBG) or RSG per se to practical layer diets on mortality and general performance of two commercial layer genotypes.

MATERIALS AND METHODS

Samples of SBG and RSG were obtained from C.S.P. Foods Ltd., Saskatoon, Saskatchewan, and incorporated in the diets by first dissolving them in 95% ethanol and then by blending the resulting mixture at 10% by weight, with soybean meal. Alfa Floc (AF) (pure wood cellulose) was added at 2% by weight to help absorb the added gums. The composition of the all-mash experimental layer diets is shown in Table 1.

TABLE 1

COMPOSITION OF EXPERIMENTAL DIETS

	Diet Number (Kg/Tonne)		
Ingredient	1	2	3
Ground Corn	330	330	330
Ground Wheat	324	324	324
Soya Meal + 2% AF	204	-	-
Soya Meal + 2% AF+10% SBG	-	224	-
Soya Meal + 2% AF+10% RSG	-	-	224
Poultry Grease	30	10	10
Limestone	80	80	80
Dicalcium Phosphate	20	20	20
Iodized Salt	2.5	2.5	2.5
Vitamin-Mineral Premix	9.5	9.5	9.5

Thus the diets contained 2% by weight SBG or RSG, some 5 times the level of gums normally added to a diet by way of rapeseed meal.

In order to keep the diets isocaloric and isonitrogenous, SBG and RSG replaced an equal amount of poultry grease in diets 2 and 3.

A total of 1824 Single Comb White Leghorn hens of two commercial genotypes were fed the experimental diets. The birds were randomized from the rearing pens to laying cages, with 1 bird/cage (20 cm x 40 cm cage) or 2 birds/cage (25 cm x 40 cm cage), in a completely randomized design. The house where the birds were kept was windowless with controlled ventilation and a daily photoperiod of 14h at a light intensity of 10 lux. Fourteen replicate groups of 16 birds per group or 4 replicate groups of 20 birds per group of both commercial genotypes were fed each diet. All data was recorded and computed on a per replicate basis. Feed intake was measured for each 28 day period. Other parameters studied were: mortality (140-497 days); age at 50% production; hen housed egg production; feed efficiency; individual body weights; egg weights; specific gravity of eggs and Haugh Units at three specified times during the study; yolk color as measured by the Roche color fan at 294d and 455d. At the end of the trial, six birds from each of two replicate groups of both genotypes on each diet were killed by cervical dislocation and their hearts, livers and thyroids were removed and weighed. Analyses of variance was conducted on all data and differences between control and treatment means were determined using the t-test (Steel and Torrie 1960).

RESULTS AND DISCUSSION

The effects of dietary treatment on the performance of the hens are presented in Tables 2-6.

Genotypic ($P<0.001$) differences were observed for mortality, age at 50% production, mean hen housed egg production and feed efficiency (Table 2).

TABLE 2

EFFECT OF THE ADDITION OF SBG OR RSG TO THE DIET OF LAYING HENS ON MORTALITY, AGE AT 50% PRODUCTION, HEN HOUSED EGG PRODUCTION AND FEED EFFICIENCY

Strain	Diets	Mortality %	Age at 50% Prod. (days)	Mean Hen Housed Egg Prod. No.	Feed Effic. (Feed/doz eggs) Kg
	Control	2.14^{ae}[1]	171	233	1.81^{e}
A+B	+ SBG	7.08^{bc}	166	229	1.85^{f}
	+ RSG	4.28^{df}	169	227	1.87^{f}
A		6.69^{a}	178^{a}	211^{a}	1.89^{a}
B		2.30^{b}	159^{b}	248^{b}	1.79^{b}

[1]Means with a common superscript letter or without a superscript letter within a column and group (A+B or A,B) are not different a, b ($P<0.001$); c, d ($P<0.01$); e, f ($P<0.05$).

Mortality was higher for hens fed SBG ($P<0.001$) and RSG ($P<0.05$) compared to that of hens fed the control diet. Mortality of hens fed SBG was higher ($P<0.01$) than for hens fed RSG. The major cause of mortality was diagnosed as fatty liver syndrome.

Age at 50% production and mean hen-housed egg production was not affected by dietary treatment (Table 2). On the other hand, addition of gums to the diet, increased the amount of feed required to produce a dozen eggs, i.e., lowered feed efficiency. These observations are contrary to those of Leeson et al. (1977). They reported that the addition of 1.5% SBG or RSG to either soybean meal or rapeseed meal had no effect on feed intake or egg production. It should be noted, however, that the level of RSG fed in the study reported here was 5 times greater than the level fed by Leeson et al.

Genotypic differences ($P<0.001$) were observed for both mean body and mean egg weights (Table 3).

TABLE 3

EFFECT OF THE ADDITION OF SBG OR RSG TO THE DIET OF LAYING HENS ON MEAN BODY WEIGHTS AND MEAN EGG WEIGHTS

Strain	Diet	Mean body weights (g) 154d	360d	462d	Mean egg weights (g) 168d	301d	462d
	Control	1445	1794^{ac}[1]	1946	49.54	61.24^{ce}	63.28
A+B	+ SBG	1460	1858^{be}	1951	49.73	62.00^{df}	63.37
	+ RSG	1452	1830^{df}	1955	49.36	61.72^{g}	63.21
A		1356^{a}	1744^{a}	1847^{a}	47.27^{a}	60.54^{a}	62.44^{a}
B		1549^{b}	1911^{b}	2054^{b}	51.81^{b}	62.77^{b}	64.13^{b}

[1]Means with a common superscript letter or without a superscript letter within a column and group (A + B or A,B) are not different a, b ($P<0.001$); c, d ($P<0.01$); e, f, g ($P<0.05$)

The body weights of hens fed SBG or RSG tended to be heavier compared with hens fed the control diet. These differences were significant for the 360 day record only. The effect of diet on mean egg weight was not consistent. However, at 301 days the mean egg weight from hens fed SBG or RSG were significantly heavier than the mean egg weight of hens fed the control diet. These results are also in conflict with those of Leeson et al. (1977) who reported that the addition of RSG or SBG to the diet of laying hens had no effect on body weight but resulted in significantly smaller eggs. The effect of gums on body weight and egg size observed in the current study may in fact be an indication of the "extra-caloric" effect of gums (Lipstein and Bornstein, 1975).

A genotypic difference ($P<0.001$) for shell strength as measured by specific gravity was observed in the latter part (295 days onward) of the experiment (Table 4).

TABLE 4

EFFECT OF THE ADDITION OF SBG OR RSG TO THE DIET OF LAYING HENS ON SHELL STRENGTH AS MEASURED BY SPECIFIC GRAVITY

Strain	Diet	Specific Gravity 205d	295d	448d
	Control	1.090^{c}[1]	1.087	1.081^{c}
A+B	+ SBG	1.090^{c}	1.087	1.081^{c}
	+ RSG	1.089^{d}	1.087	1.082^{d}
A		1.090	1.088^{a}	1.082^{a}
B		1.090	1.086^{b}	1.080^{b}

[1]Means with a common superscript letter or without a superscript letter within a column and group (A+B or A,B) are not different a,b ($P<0.001$); c,d ($P<0.05$)

Shell strength of eggs from hens fed RSG was weaker at 205 days but stronger at 448 days than for eggs from hens fed either the control diet or the diet containing SBG.

No genotypic differences were observed for yolk color (as measured by the Roche color fan) but differences were observed for Haugh Units (Table 5).

Yolk color of eggs from hens fed SBG was lighter than the yolks of eggs from hens fed either the control diet or the diet containing RSG. This difference however, was detected only during the latter part (455 days) of the test. On the other hand Haugh Units were not affected by dietary treatments.

TABLE 5

EFFECT OF THE ADDITION OF SBG OR RSG TO THE DIET OF LAYING HENS ON YOLK COLOR AND INTERIOR EGG QUALITY AS MEASURED BY HAUGH UNITS

Strain	Diet	Yolk Color		Haugh Units		
		294 d	455d	202d	292d	448d
	Control	4.90	5.23[c1]	88.13	82.87	74.56
A+B	+ SBG	5.19	4.51[d]	87.84	81.57	73.49
	+ RSG	5.24	5.10[c]	87.81	82.68	74.53
A		5.09	4.88	86.06[a]	79.68[a]	71.52[a]
B		5.12	5.01	89.79[b]	85.07[b]	76.86[b]

[1]Means with a common superscript letter or without a superscript letter within a column and group (A+B or A, B) are not different a, b ($P<0.001$); c, d ($P<0.05$).

Genotypic differences were observed for heart and liver weights but not for thyroid weights (Table 6).

Hearts of hens fed RSG were lighter than the hearts of hens fed either the control diet or the diet containing SBG. Similarily, livers of hens fed either SBG or RSG were lighter than livers of hens fed the control diet. The weight of the thyroid was not affected by the dietary treatment.

TABLE 6

EFFECT OF THE ADDITION OF SBG OR RSG TO THE DIET OF LAYING HENS ON HEART, LIVER AND THYROID WEIGHTS

Strain	Diet	Mean Organ Weights		
		Heart (g)	Liver (g)	Thyroid (mg)
	Control	6.66[e1]	47.71[e]	123
A+B	+ SBG	6.26[e]	41.36[f]	116
	+ RSG	5.88[f]	41.10[f]	124
A		5.89[a]	39.60[c]	112
B		6.65[b]	47.18[d]	129

[1]Means with a common superscript letter or without a superscript letter within a column and group (A+B or A, B) are not different a, b ($P< 0.001$); c, d ($P<0.01$); e, f ($P<0.05$).

In summary, although low levels (0.4% by weight) SBG and RSG in the diet appear to have no deleterious effects on the performance of laying hens

(Leeson *et al.* 1977), the results reported here indicate that at higher levels(2.0% by weight) both SBG and RSG can have a deleterious effect on performance by significantly increasing mortality, lowering egg production and increasing the amount of feed required to produce a dozen eggs.

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