Proceedings 3rd World Rabbit Congress, 4-8 April 1984, Rome – Italy, Vol. 1, 408-414

COMPARATIVE EFFECTS OF COTTONSEED, SOYBEANS, SAFFLOWER SEEDS AND FLAX SEEDS ON THE PERFORMANCE OF RABBITS AND GUINEA PIGS

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Introduction

The rabbit is an important source of food in many countries of the world and the guinea pig is, as well, in Peru, Bolivia, Ecuador, and Colombia. These two animals whose outward appearance differs considerably have a similar type of digestive system which is characterized by an enlarged cecum. They are both classified as monogastric herbivores. Though their digestive systems may be similar, the apparent ability of the rabbit and guinea pig to utilize nutrients of certain feedstuffs seems to differ considerably. This was shown by Slade and Hintz (1969) who compared the abilities of the two species to digest alfalfa hay pellets. The rabbit digested a significantly ($P<.05$) greater percentage of crude protein and a significantly lower proportion of organic matter, crude fiber, nitrogen free extract and energy. Ether extract digestion was similar. Maynard and Loosli (1969) also reported that the rabbit digested significantly less crude fiber than the guinea pig.

This study was designed to compare the effects of various oil bearing seeds on the performance of the two monogastric herbivores. Those seeds examined were soybeans, cottonseed, flax, and safflower. Cheeke and Amberg (1972) found that soybean meal based rations yielded signifcantly greater rabbit growth than those based on cottonseed meal unless the latter ration was supplemented with methionine and lysine. No studies were found that compared the oil seeds or their by-product meals one with another as to their effects on guinea pigs.

Materials and Methods

Feeding trials were conducted to compare the effects of soybeans, cottonseeds, safflower seeds, and flax seeds on the lactation and growth of rabbits and guinea pigs. In addition, a dietary preference study was pursued with the guinea pig.

In the rabbit phase, six Rex does and their litters were placed at kindling on each of the experimental diets (Table 1). Prior to the mixing, the oil seeds were passed through a Triple F extruder at approximately 123° C. Forty-four percent of the dietary protein was supplied by suncured alfalfa meal. The remainder of the protein was supplied by a combination of wheat and the oil seed. Neither safflower seed (16.4% protein) nor flax seed (22% protein) were sufficiently high in protein to be used alone with wheat, and some added soybean meal was necessary to supply the difference. The doe and her litter were fed ad libitum. The young were weaned at five weeks of age and

continued on ad libitum feeding. Body weights, feed consumption, and feed conversion were determined at three and eight weeks of age.

Upon farrowing, six sow guinea pigs, their litters, and pen boars were placed upon each of the experimental diets used in the rabbit phase. Observations were made of body weights and feed consumption at three, five, and nine weeks of age. Feeding was ad libitum.

For the guinea pigs, a palatability study was conducted to determine the taste preference for each of the experimental diets. Eleven adult guinea pigs were placed in a floor pen where they had simultaneous access on ad libitum basis to the five experimental diets for a period of 30 days. The total feed consumption was observed for each feed for the duration of the experiment.

Results and Discussion

Since the young rabbit relies solely upon the milk of the doe for its nutrition for the first three weeks of life, the three week body weights were used as a measure of the effect of diet on lactation. All the diets appeared effective in supporting lactation (Table 2). There were no significant differences between any of the parameters for the three week observations. Numerically, however, rabbits consuming cottonseeds seemed somewhat less effective in supporting the body weight of their young. Even though some of the diets contained appreciable amounts of fat (i.e. flax 15%), there were no differences in feed conversion.

The eight week weights were used as an indication of the direct effect of diet on the growth of the progeny (Table 3). The diets were statistically similar in stimulating growth. As with lactation, cottonseed was less effective than the other diets on the growth of the young. This trend supports the findings of Cheeke and Amberg (1972) who found that feeding soybean meal based rations resulted in significantlly larger rabbits than cottonseed meal.

Unlike rabbits, newly farrowed guinea pigs can eat and drink independent of the sow. However, since the nursing activity is very intense during the early weeks of the young pig's life, the three week weights were used as a measure of diet on lactation (Table 4). Using this criterion for evaluating milk production, soybean and soybean meal based diets were far more effective in stimulating the sow to synthesize milk. The progeny of pigs fed soybeans were significantly ($P < .05$) larger at three weeks than those fed all diets except soybean meal.

The growth of the young through five weeks (Table 6) and nine weeks (Table 7) seemed to follow the same pattern as that at three weeks. Feeding soybeans or soybean meal resulted in significantly ($P<.05$) greater body size at both intervals than did feeding the other diets. Feeding the cottonseed-based diet at three, five, and nine weeks resulted in the numerically smallest weights and least efficient conversions of feed to gain. Through nine weeks of age, cottonseed-fed pigs required significantly ($P<.05$) more feed per unit of gain than those fed any of the other treatments.

When given simultaneous access to all of the diets, guinea pigs significantly ($P<.05$) preferred soybean and soybean meal based diets (Table 7). Only

relatively small amounts of either the cottonseed or safflower diets were consumed in each of three replicates. This apparent lack of palatability for the cottonseed diet seemed to account for some of the inefficiency of conversion of feed to gain from its use. The pigs would thrash at their feed rather than willingly eat it.

The two species of monogastric herbivores reacted quite differently to the same diet. With rabbits, lactation and growth were statistically similar from feeding any of the experimental diets. There was perhaps some adverse effect on both parameters from feeding cottonseeds. The lactation and growth of guinea pigs was severely impaired from feeding cottonseeds. The methionine-cystine and lysine levels of the cottonseed diet were similar to those of the soybean and soybean meal diets, so it doesn't appear likely that depressive effect was due to amino acid deficiencies. When gossypol is heated in the presence of moisture, the gossypol containing glands are disrupted and cause the conversiion of much of the free gossypol to bound forms (Singleton and Kratzer, 1973). The extrusion process at 123°C may have been insufficient in converting much of the gossypol from the free to the bound form. Eagle (1960) stated that guinea pigs are more sensitive to gossypol toxicity than rabbits. Neither flax nor safflower promoted growth or lactation acceptably as compared to soybeans or soybean meal.

References

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Table 1. Experimental Diets

Oil Seed Sources

Ingredients	Cottonseed %	Safflower Seed %	Soybeans %	Flax Seed %	Soy Meal %
Wheat	5.7	5.4	28.5	8.2	33.7
Flax				39.2	
Soybean			20.1		
Cottonseed	43.0				
Safflower Seed		33.8			
Soybean Oil Meal		9.5		1.2	15.0
Alfalfa Meal	50.0	50.0	50.0	50.0	50.0
Safflower Meal					
Premix	1.0	1.0	1.0	1.0	1.0
Salt	.3	.3	.3	.3	.3
D L Methionine		.02		.1	.02
Monosodium Phos.	.38	.39	.86	.62	.86
Ascorbic Acid	.1	.1	.1	.1	.1
Analysis					
Protein (%)	18.0	18.0	18.0	18.0	18.0
Fat (%)	11.4	11.6	5.5	15.0	2.1
Energy (TDN%)	69.2	68.1	66.7	78.1	65.0
DE (K cal/kg)	2812.0	2482.0	2504.0	2972.0	2437.0
Calcium (%)	.76	.81	.76	.79	.75
Phosphorus (%)	.41	.4	.4	.4	.4
Fiber (%)	20.0	22.4	14.6	15.5	14.0
Meth-Cys (%)	.62	.6	.6	.6	.6
Lysine (%)	.88	.8	.87	.65	.88

[1]The trace mineral and vitamin mix contributes per kilogram of ration the following amount: vitamin A, 7128 IU; vitamin D, 1979.208 ICU; niacin, 41.58 mg; d-pantothenic riboflavin, 7.128 mg; sodium bisulfite, 4.752 mg; folic acid, 0.594 mg; thiamine, 1.188 mg; pyridoxine hydrochloride, 1.188 mg; BHT, 47.52 mg; choline chloride, 1.278 mg; manganese, 5.4781 mg; zinc, 5.2654 mg; iron, 1.8266 mg; copper, 0.2285 mg; iodine, 0.114 mg; cobalt, 0.0457 mg; methionine, 30.0 gm.

Table 2. Effect of oil seed source on three week rabbit performance

Seed Source	Three Week Performance		
	Body Weight (kg)	Feed Cons. (kg)	Feed Conv. (feed/gain)
Soybean meal	.319	1.140	3.57
Soybeans	.305	.950	3.11
Cottonseed	.284	.972	3.42
Safflower seed	.307	1.010	3.29
Flax seed	.305	1.090	3.57

Table 3. Effect of oil seed source on eight week rabbit performance

Seed Source	Eight Week Peformance		
	Body Weight (kg)	Feed Consumption (kg)	Feed Conversion (feed/gain)
Soybean meal	1.56	4.44	2.84
Soybeans	1.50	4.34	2.89
Cottonseed	1.39	4.95	3.50
Safflower seed	1.52	5.03	3.30
Flax seed	1.49	5.12	3.45

Table 4. The effect of oil seed sources on guinea pig performance from 0 to 3 weeks of age

Seed Sources	Average Performance (0-3 weeks)		
	Body Weight Grams	Feed Consumed Kilograms	Feed Conversion Feed/Gain
Soybean meal	384 ab	2.9	7.6
Soybean	398 a	2.5	6.3
Cotton	318 c	4.0	12.5
Safflower	334 bc	3.4	10.2
Flax	305 c	3.1	10.2
Average	347.8	3.2	9.4

Means followed by different letters are signifcantly different at the .05 level

Table 5. The effect of oil seed on the performance of guinea pig 0 to 5 weeks of age

Seed Sources	Average Performance (0-5 weeks)		
	Body Weight Grams	Feed Consumed Kilograms	Feed Conversion Feed/gain
Soybean meal	546 ab	5.3	9.7
Soybean	572 a	4.6	8.0
Cotton	413 c	6.3	15.3
Safflower	469 bc	5.5	11.7
Flax	435 c	5.1	11.7
Average	487	5.4	11.3

Means followed by different letters are significantly different at the .05 level.

Table 6. The effect of oil seed sources on guinea pig performance from 0 to 9 weeks of age

Seed Source	Average Performance (0-9 weeks) Body Weight Grams	Feed Consumed Kilograms	Feed Conversion Feed/gain
Soybean meal	837 a	7.1 b	8.5 a
Soybean	820 a	6.1 b	7.4 a
Cotton	542 c	9.5 a	17.5 c
Safflower	644 bc	6.6 b	10.3 b
Flax	670 b	6.5 b	9.7 ab
Average[1]	702.6	7.2	10.7

Table 7. Preference of different type of diets by guinea pigs

Seed Source	Average Feed Consumed/Guinea Pig (30 Days) (Gm) Group 1	Group 2	Group 3	Average
Soymeal	720	911	809	813 a
Soybeans	582	673	891	715 a
Cottonseed	27	16	11	18 b
Safflower Seed	64	2	37	34 b
Flax Seed	48	125	155	109 b

Means followed by different letters are significantly different at the 0.5 level.

SUMMARY

The effect of feeding diets whose protein segment is based upon soybean meal, cottonseeds, flax seeds, or safflower seeds on the lactation and growth of rabbits and guinea pigs was studied. The oil seeds were all extruded. For rabbits, feeding any of the diets based upon the above protein sources resulted statistically similar observations for lactation and growth. Though not statistically different, feeding cottonseed did result in comparatively depressed results for both parameters.

For guinea pigs, feeding soybeans resulted in significantly ($P<.05$) more milk produced than feeding cottonseed, safflower, or flax. Results were similar to those from feeding soybean meal. Through 9 weeks of age, feeding cottonseed yielded significantly ($P<.05$) less growth and promoted significantly ($P<.05$) less efficient conversion of feed to gain than feeding the other diets. When offered all five of the diets simultaenously, guinea pigs significantly ($P<.05$) preferred soybean meal and soybeans. Only relatively small amounts of cottonseed and safflower based diets were consumed.

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RESUMEN

Se estudiaron los efectos de la alimentación en conejos y cuis, especialmente la lactación y crecimiento, basándose en dietas cuyos segmentos proteicos se derivaron de harina de frijol soya, algodón, lino y semillas de girasol (mirasol). Se extrajo el aceite de las semillas.

La alimentación de los cuis con frijol soya, resultó en una producción más elevada de leche; cuando se les alimentó con semilla de algodón, girasol y lino hubo aumento también en el crecimiento. Los resultados fueron similares cuando se les alimentó con harina de frijol soya.

Cuando alcanzaron la edad de nueve semanas, la alimentación con semilla de algodón produjo una disminución marcada en el crecimiento (PL 0.5) y aceleró la disminución en la conversión de alimento a peso ganado, comparada con las otras dietas. Es decir, cuando se ofrecieron todas las dietas simultáneamente, los cuis prefirieron la harina de soya en lugar del frijol soya entero. Se consumieron montos relativamente pequeños de dietas basadas en girasol y semillas de algodón.