

Enzyme Activity in Pancreata of Hens Fed Raw Soybean Meal

A. J. SALMAN AND J. MCGINNIS¹

INTRODUCTION

Numerous studies have been reported on the response of the laying hen to feeding raw soybean meal. (4,5,13,14,16).

Saxena et al. (14) showed that with 0.5% added methionine to a soybean meal diet only slight pancreatic hypertrophy was observed. This is contrast with other workers (3,10,11,16) who observed an enlargement in the pancreata of hens fed the unheated soybean meal. Although some work has been done on some enzymes of the enlarged pancreas, in the case of the chick, (1,9,12) no such studies were conducted with the hen. The objective of the experiment to be reported herein is to examine some enzyme levels in pancreata of hens fed autoclaved or raw soybean meal.

MATERIALS AND METHODS

Sixteen S.C. white leghorn hens were used in this study. They were divided into two groups and fed diets identical to that of Saxena et al. (15) containing raw and autoclaved soybean meal as a source of protein, plus 2.5% limestone, for 4 weeks, after which the hens were fasted for 16 hours. Four hens of each treatment were sacrificed after the fast and the other four were resumed on their respective diet for six hours then sacrificed. After body weight and pancreata size were measured, amylase, trypsin and chymotrypsin activities were determined in the pancreata.

Amylase activity was determined by the 3,5 dinitrosalicylate method of Bernfeld (2). Trypsin and chymotrypsin activities were estimated according to Hummel (7) using TAME, (tosyl-arginine-methyl-ester) and BTEE (benzoyl-tyrosyl-ethyl-ester) as specific substrates for trypsin and chymotrypsin respectively. Definitions of units of enzyme activity and procedure of activation of trypsinogen and chymotrypsinogen in the homogenates of the pancreata were as described by Salman et al. (12). Protein was determined in the homogenates by measuring the absorbancy at 280 mm and 260 mm to correct for nucleic acids as described by Layne (8).

¹A. J. Salman, Faculty of Agriculture, University of Libya, Tripoli, Libyan Arab Republic and J. McGinnis Department of Animal Science, Washington State University, Pullman, Washington, U.S.A.

RESULTS AND DISCUSSION

Enlargement of the pancreas of the hens fed raw soybean meal was evident, where values of 4.75 gm and 3.40 gm were found for the raw and autoclaved soybean meal (Table 1). This enlargement was not as pronounced as that observed in the chick (15), despite the high level of protein from the raw soybean meal.

Table 1 Pancreatic enlargement in hens fed autoclaved or raw soybean meal.

Soybean meal	Pancreas size	
	<i>Wt. in gm</i>	<i>Wt. in gm/100 gm body wt.</i>
Raw	4.75a	0.240a
Autoclaved	3.40b	0.165b

The specific activity of amylase and chymotrypsin were depleted at a faster rate when the autoclaved soybean meal was fed. However, this was not the case with trypsin specific activity. Chymotrypsin and trypsin specific activities were higher in pancreata of fasted hens previously fed unheated soybean meal. Amylase specific activity in the fasted birds was not much different where either diet was previously fed (Table 2).

Table 2 Enzyme specific activity in pancreata from hens fed raw or autoclaved soybean meal.

Soybean meal	Amylase		Trypsin		Chymotrypsin	
	fasted ¹	fed ²	fasted ¹	fed ²	fasted ¹	fed ²
Raw	7.2	6.4	29.8	23.4	417.2	259.2
Autoclaved	6.8	3.8	21.6	20.0	364.6	177.4

The total pancreatic activity of amylase, trypsin and chymotrypsin was always higher in the enlarged pancreata, in fasted hens, and hens fed 6 hours after the fast. This increased activity may be related to an increased number of acinar cells in the pancreas as was shown for the chick's pancreas by Salman et al. (13). They have indicated that the increase in size was a result of hyperplasia. The amount of enzyme discharged by the pancreas was higher in amylase when autoclaved soybean meal was fed. This was true for trypsin and chymotrypsin when unheated soybean meal was fed for 6 hours (Table 3).

Table 3 Total enzyme activity in pancreata from hens fed raw and autoclaved soybean meal.

Soybean meal	Amylase 10 ³		Trypsin 10 ⁴		Chymotrypsin 10 ⁴	
	fasted ¹	fed ²	fasted ¹	fed ²	fasted ¹	fed ²
Raw	16.8	14.6	8.3	6.1	119	69.1
Autoclaved	8.7	5.3	4.2	3.6	72.3	33.2

¹ Hens fasted for 16 hours after being on feed for 4 weeks.

² Hens fed their respective diets after 16 hours of fast.

Trypsin specific activity was less than the activity observed with young chicks (12). This may be due to a decreased sensitivity or increased resistance of the adult bird to inhibitors in soybean meal. The levels of amylase and chymotrypsin specific activity were comparable to those found in the chick. The response for pancreatic secretion was slower in the hen as a result of feeding as compared with the chick (12).

SUMMARY

Pancreata of hens fed raw soybean meal developed enlargement with amylase and chymotrypsin activity comparable to that of chicks as observed by Salman et al. (12). However, trypsin activity was lower than that found in chicks indicating a possible partial resistance of the adult bird to soybean inhibitors.

LITERATURE CITED

1. Applegarth, A., F. Furuta and S. Lepkovsky 1964. Morphology, response, gross and microscopic of pancreas of chickens on raw and heated soybean diets. *Poultry Sci.* 43:733-739.
2. Bernfeld, P., 1955. Amylase, alpha and beta in S.P. Colowick and N. O. Kaplan (eds). *Methods in Enzymology*, I. Academic Press, Inc., New York, p. 149.
3. Bray, D. J., 1964. Pancreatic hypertrophy in laying pullets induced by unheated soybean meal. *Poultry Sci.* 43:382-384.
4. Carver, J. S., J. McGinnis, C. F. McClary and R. J. Evans 1964. The utilization of raw and heated soybean oil meal for egg production and hatchability. *Poultry Sci.* 25:239.
5. Fisher, H., D. Johnson Jr. and S. Ferdo 1957. The utilization of raw soybean meal protein for egg production in the chicken. *Journal of Nutrition.* 61:611-621.
6. Hill, F. W. and R. Renner 1963. Effects of heat treatment on the metabolizable energy value of soybeans and extracted soybean flakes for the hen. *Journal of Nutrition.* 80:375-380.
7. Hummel, B. C. W. 1959. A modified spectrophotometric determination of chymotrypsin and thrombin. *Can. J. Biochem. Physiol.* 37:1393.
8. Layne, E. 1957. Spectrophotometric and turbidimetric methods for measuring proteins, in Colowick, S. P. and Kaplan, N. O. (eds). *Methods in Enzymology*, III. Academic Press Inc., New York, p. 447.
9. Lepkovsky, S., T. Koike, M. Suguira, M. K. Dimick and F. Furuta 1966. Pancreatic amylase in chickens fed on soybean diets. *Brit. J. Nutrition* 20:421-437.
10. Rogler, J. E. and C. W. Carrick 1964. Studies on raw and heated unextracted soybeans for layers. *Poultry Sci.* 43:604-612.
11. Salman, A. J. and J. McGinnis 1968. Effect of supplementing raw soybean meal with methionine on performance of layers. *Poultry Sci.* 47:247-251.
12. Salman, A. J., G. Dal Borgo, M. H. Pubols, and J. McGinnis 1967. Changes in pancreatic enzymes as a function of diet in the chick. *Proc. Soc. Expt. Biol. and Med.* 126:694-698.
13. Salman, A. J., M. H. Pubols and J. McGinnis 1968. Chemical and Microscopic nature of pancreata from chicks fed unheated soybean meal. *Proc. Soc. Exp. Biol. and Med.* 128:258-261.
14. Saxena, H. C., L. S. Jensen, J. V. Spencer and J. McGinnis 1963. Production,

- interior egg quality and some physiological effects of feeding raw soybean meal to laying hens. *Poultry Sci.* 42:291-293.
15. Saxena, H. C., L. S. Jensen and J. McGinnis 1962. Influence of dietary protein level in chick growth depression by raw soybean meal, *Journal of Nutrition*, 77:241-244.
 16. Summers, J. D., J. C. Conachie, S. J. Slinger and W. F. Pepper 1965. The value of raw unextracted soybeans for laying hens. *Poultry Sci.* 45:165-168.