

*Director's  
Digest*



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THE IN VITRO PROTEIN DIGESTION OF MEAT AND BONE MEAL  
TO DETERMINE PROTEIN QUALITY

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DR. CRAIG N. COON HAS COMPLETED A LONG TERM STUDY DESIGNED TO DEVELOP AN IN VITRO PROTEIN DIGESTION ASSAY THAT WAS SIMPLE, QUICK AND HIGHLY CORRELATED TO PROTEIN QUALITY FOR MEAT AND BONE MEAL (MBM).

FOR THE PAST SEVERAL YEARS DR. COON HAS BEEN WORKING WITH 17 MBM SAMPLES OBTAINED FROM DR. KNABE AT TEXAS A&M THAT WERE TESTED IN SWINE FOR ILEAL AND FECAL NITROGEN DIGESTIBILITY IN A PREVIOUS F.P.R.F. RESEARCH PROJECT.

SUMMARY

MEAT AND BONE MEAL SAMPLES OBTAINED FROM DR. KNABE AT TEXAS A&M WERE UTILIZED TO COMPARE 3 DIFFERENT IN VITRO PROCEDURES FOR 4, 8, AND 16 HOUR INCUBATION PERIODS. AN ACID BLANK WAS UTILIZED WITH EACH IN VITRO ASSAY IN ORDER TO DETERMINE NITROGEN SOLUBILITY WITH AND WITHOUT AN ACID CORRECTION. THE TWO PREVIOUS PROGRESS REPORTS DISTRIBUTED TO THE MEMBERSHIP PROVIDED SLIGHTLY DIFFERENT RESULTS REGARDING THE BEST CORRELATION OF SWINE ILEAL AND FECAL NITROGEN DIGESTIBILITY OF TEST MEAT AND BONE SAMPLES WITH THE UNIVERSITY

OF MINNESOTA IN VITRO DIGESTION ASSAYS. THE PROGRESS REPORT IN OCTOBER 1989 SUGGESTED THE IN VITRO .002% PEPSIN PROCEDURE FOR THE 4, 8, AND 16 HOUR TIME PERIODS CORRELATED THE HIGHEST WITH SWINE ILEAL NITROGEN DIGESTIBILITY FOR 10 MEAT AND BONE SAMPLES. THE IN VITRO TEST UTILIZING .2% PEPSIN-5X PANCREATIN ASSAY FOR A 4-HOUR INCUBATION PERIOD ALSO HAD A GOOD CORRELATION. IN THE MAY 1990 PROGRESS REPORT THE SWINE ILEAL NITROGEN DIGESTIBILITY OF ELEVEN ADDITIONAL MEAT AND BONE MEAL SAMPLES FROM TEXAS A&M WERE COMPARED TO IN VITRO DIGESTION VALUES OBTAINED FOR THE 3 PROCEDURES. THE HIGHEST CORRELATION OF .74 WAS WITH .2% PEPSIN-5X PANCREATIN PROCEDURE FOR A 4-HOUR INCUBATION PERIOD. THE SECOND HIGHEST CORRELATION WITH THE PIG ILEAL NITROGEN DIGESTIBILITY VALUES WAS .66 FOR THE IN VITRO DIGESTION ASSAY UTILIZING THE .002% PEPSIN PROCEDURE FOR A 4-HOUR INCUBATION PERIOD.

IN DR. COON'S FINAL PROGRESS REPORT, HE COMPARED THE ILEAL NITROGEN DIGESTIBILITY FROM PIGS FOR 17 MEAT AND BONE MEAL SAMPLES FROM TEXAS A&M WITH THE 3 IN VITRO NITROGEN SOLUBILITY ASSAYS. HIS LABORATORY ALSO DETERMINED THE AMINO ACID DIGESTIBILITY OF 14 OF THE TEXAS A&M SAMPLES UTILIZING ROOSTERS AND COMPARED THE ROOSTER AMINO ACID DIGESTIBILITY VALUES WITH THE PIG ILEAL AND FECAL NITROGEN DIGESTIBILITY VALUES FROM TEXAS A&M. THE AMINO ACID DIGESTIBILITY VALUES DETERMINED AT THE UNIVERSITY OF MINNESOTA ARE HIGHER THAN THOSE REPORTED FROM TEXAS A&M WHICH REPRESENTED ILEAL AMINO ACID DIGESTIBILITY VALUES. THE UNIVERSITY OF MINNESOTA AMINO ACID DIGESTIBILITY VALUES ARE BASED ON FECES COLLECTION AND NOT SAMPLES OBTAINED AT THE ILEAL. THE COMPARISON OF THE 17 MEAT AND BONE MEAL SAMPLES EVALUATED SUGGEST THE .002% PEPSIN PROCEDURE WITH AN INCUBATION PERIOD OF 16 HOURS PRODUCED A .68% CORRELATION COEFFICIENT WHEN COMPARING THE TEXAS A&M NITROGEN ILEAL DIGESTIBILITY VALUES WITH THE PERCENT SOLUBLE NITROGEN ASSAY. THERE WAS LITTLE DIFFERENCE BETWEEN THE CORRELATION OF .002% PEPSIN WITH 16-HOUR INCUBATION UTILIZING THE ACID-CORRECTED NITROGEN VALUE OR THE NON-ACID CORRECTED NITROGEN VALUE. THERE TENDED TO BE A STRONGER CORRELATION OF THE .2% PEPSIN ASSAY WITH FECAL NITROGEN DIGESTIBILITY VALUES THAN WITH THE ILEAL NITROGEN DIGESTIBILITY VALUES. ALSO, UTILIZING THE .2% PEPSIN-5X PANCREATIN PROCEDURE, THE CORRELATION WAS HIGHER FOR THE FECAL NITROGEN DIGESTIBILITY FOR PIGS ( $r=.74$ ) COMPARED TO THE CORRELATION OF THE PANCREATIN ASSAY WITH THE ILEAL NITROGEN DIGESTIBILITY VALUE ( $r=.52$ ).

THE HIGHEST CORRELATION OF CHICKEN AMINO ACID DIGESTIBILITY ( $r=.75$ ) TO THE IN VITRO PROCEDURES WAS WITH THE .002% PEPSIN ASSAY UTILIZING A 4-HOUR INCUBATION PERIOD. THE CHICKEN AMINO ACID DIGESTIBILITY VALUES CORRELATED MUCH CLOSER TO THE .2% PEPSIN ASSAY AND THE .2% PEPSIN-5X PANCREATIN ASSAY THAN DID THE ILEAL NITROGEN DIGESTIBILITY VALUES FOR PIGS. THE SAME IN VITRO ASSAYS CORRELATED HIGHLY WITH THE FECAL NITROGEN DIGESTIBILITY VALUES WITH PIGS.

IN SUMMARY, THE SWINE ILEAL NITROGEN AND FECAL NITROGEN DIGESTIBILITY FOR MEAT AND BONE MEAL SAMPLES HAD A CORRELATION OF .49 AND .78, RESPECTIVELY, WITH THE % AMINO ACID DIGESTIBILITY WITH CHICKENS. THE LYSINE DIGESTIBILITY DETERMINED AT THE ILEUM FOR PIGS AND THE LYSINE DIGESTIBILITY DETERMINED WITH CHICKENS HAD A VERY HIGH CORRELATION OF .75. IN DR. COON'S OPINION THESE RESULTS INDICATE THE DIGESTIBILITY VALUES OBTAINED FOR CHICKENS MAY BE HIGHLY CORRELATED TO THE AMINO ACID VALUES OBTAINED AT THE ILEUM FOR PIGS.

### OBJECTIVE

TO DEVELOP AN IN VITRO PROTEIN DIGESTION ASSAY THAT IS SIMPLE, QUICK, AND HIGHLY CORRELATED TO PROTEIN QUALITY FOR MEAT AND BONE MEAL.

EXPERIMENTAL DESIGN: SEVENTEEN MEAT AND BONE MEAL SAMPLES WITH DIFFERENT PROTEIN DIGESTIBILITIES WERE OBTAINED FROM TEXAS A&M AND UTILIZED TO EVALUATE 3 IN VITRO DIGESTION TECHNIQUES. THE 3 IN VITRO PROTEIN DIGESTION ASSAYS EVALUATED WERE THE AOAC .2% PEPSIN SOLUBLE NITROGEN ASSAY, THE .002% PEPSIN SOLUBLE NITROGEN ASSAY, AND THE UNIVERSITY OF MINNESOTA IN VITRO DIGESTION ASSAY CONSISTING OF .2% PEPSIN -5X PANCREATIN COMBINATION. THE 3 IN VITRO DIGESTION ASSAYS WERE INCUBATED FOR 4, 8, AND 16 HOURS AND THE PERCENT SOLUBLE NITROGEN FOR THE 17 SAMPLES WERE DETERMINED WITHOUT AN ACID BLANK AND ALSO THE SOLUBLE NITROGEN PERCENT WAS CORRECTED WITH AN ACID BLANK.

FOURTEEN OF THE SEVENTEEN MEAT AND BONE MEAL SAMPLES FROM TEXAS A&M WERE FORCE-FED TO LEGHORN ROOSTERS TO DETERMINE THE AMINO ACID DIGESTIBILITY AS DESCRIBED BY SIBBALD (POULTRY SCIENCE 58:668-675, 1979). EACH OF THE MEAT AND BONE MEAL SAMPLES WERE FED TO 6 ADULT LEGHORN ROOSTERS AND THE EXCRETA COLLECTED OVER A 48-HOUR PERIOD. THE ROOSTERS WERE PREVIOUSLY FASTED FOR 48 HOURS PRIOR TO THE FEEDING OF THE TEST MEAT AND BONE MEAL SAMPLES. EACH ROOSTER

UTILIZED FOR TESTING THE MEAT AND BONE MEAL SAMPLES WAS DEFEATHERED AROUND THE CLOACA IN ORDER TO ATTACH A COLOSTOMY BAG FOR TOTAL COLLECTION OF THE EXCRETA. THE COLLECTION OF THE EXCRETA IN COLOSTOMY BAGS PREVENTS THE CONTAMINATION FROM FEATHERS, SCALES, FEED, AND OTHER COMPONENTS THAT AFFECT AMINO ACIDS FOUND IN THE EXCRETA SAMPLES. THE EXCRETA SAMPLES WERE DRIED IN A FREEZE DRIER, WEIGHED, AND GROUND IN PREPARATION FOR AMINO ACID ANALYSIS. EACH MEAT AND BONE MEAL AND EXCRETA SAMPLE WAS OXIDIZED WITH PERFORMIC ACID PRIOR TO HYDROLYSIS OF EACH SAMPLE WITH HYDROCHLORIC ACID FOR A 24-HOUR REFLUX PERIOD. SAMPLES WERE CONCENTRATED WITH A ROTARY EVAPORATOR, MIXED WITH A SODIUM CITRATE BUFFER, AND ANALYZED IMMEDIATELY.

THE SOLUBLE NITROGEN VALUES DETERMINED BY THE 3 DIFFERENT IN VITRO PROTEIN DIGESTION ASSAYS WERE TESTED FOR CORRELATION TO THE ILEAL NITROGEN DIGESTIBILITY VALUES AND THE FECAL NITROGEN DIGESTIBILITY VALUES PREVIOUSLY DETERMINED AT TEXAS A&M UNIVERSITY. THE DIGESTIBILITY VALUES DETERMINED BY TEXAS A&M UNIVERSITY TIMES THE TOTAL LYSINE CONTENT PRODUCED A DIGESTIBLE LYSINE VALUE WHICH WAS ALSO ANALYZED FOR CORRELATION TO THE UNIVERSITY OF MINNESOTA NITROGEN SOLUBILITY VALUES.

THE SOLUBLE NITROGEN VALUES DETERMINED BY THE 3 DIFFERENT IN VITRO PROTEIN DIGESTION ASSAYS WERE ALSO TESTED FOR CORRELATION TO THE PERCENT TOTAL AMINO ACID DIGESTIBILITY DETERMINED WITH ROOSTERS FOR 14 MEAT AND BONE MEAL SAMPLES. THE IN VITRO SOLUBLE NITROGEN VALUES WERE ALSO TESTED FOR CORRELATION TO THE % LYSINE DIGESTIBILITY WITH ROOSTERS FOR EACH OF THE TEST SAMPLES. THE TOTAL AMINO ACID DIGESTIBILITY VALUES OBTAINED FOR THE 14 MEAT AND BONE MEAL SAMPLES DETERMINED WITH ROOSTERS AT THE UNIVERSITY OF MINNESOTA ARE BASED ON ACTUAL TOTAL AMINO ACIDS DIGESTED BECAUSE EXCRETA NITROGEN (CRUDE PROTEIN) WOULD HAVE NO MEANING BECAUSE OF THE LARGE AMOUNTS OF URIC ACID AND OTHER NITROGEN METABOLITES. TEXAS A&M SWINE ILEAL NITROGEN DIGESTIBILITY VALUES WERE TESTED FOR CORRELATION WITH THE PERCENT TOTAL AMINO ACIDS DIGESTED IN ROOSTERS. THE SWINE ILEAL LYSINE DIGESTIBILITY DETERMINED AT TEXAS A&M WAS ALSO TESTED FOR CORRELATION WITH THE LYSINE DIGESTIBILITY WITH ROOSTERS OBTAINED AT THE UNIVERSITY OF MINNESOTA.

## RESULTS AND DISCUSSION

THE NITROGEN SOLUBILITY DETERMINED BY THE 3 IN VITRO DIGESTION ASSAYS ARE LISTED IN TABLE 1 FOR THE 17 MEAT AND BONE MEAL SAMPLES. THEIR LABORATORY HAS RE-ANALYZED THE IN VITRO NITROGEN SOLUBILITY OF TEST MEAT AND BONE SAMPLES IN ORDER TO STUDY THE FINAL CORRELATION WITH SWINE ILEAL AND FECAL NITROGEN DIGESTIBILITY VALUES DETERMINED AT TEXAS A&M. THE CURRENT IN VITRO NITROGEN SOLUBILITY VALUES WERE ALSO COMPARED TO TOTAL AMINO ACID AND LYSINE DIGESTIBILITY IN ROOSTERS. THE THIRD IN VITRO ASSAY WAS UTILIZED BECAUSE EACH OF THE MEAT AND BONE MEAL SAMPLES WERE TESTED AT ONE TIME AND NOT AT 2 SEPARATE OCCASIONS, THUS ELIMINATING DIFFERENCES IN PERSONNEL CONDUCTING THE IN VITRO SOLUBLE NITROGEN ASSAY AS WELL AS ELIMINATING VARIATION OF THE ENZYME ACTIVITY AND BUFFER SOLUTIONS THAT COULD POTENTIALLY BE DIFFERENT FROM TWO SEPARATE PERIODS OF TIME FOR THE SOLUBILITY ASSAYS. THE ORIGINAL 21 MEAT AND BONE MEAL SAMPLES COULD NOT ALL BE COMPLETED AND ONLY 17 OF THE MEAT AND BONE MEAL SAMPLES COULD BE RE-ANALYZED DURING THE THIRD TIME BECAUSE OF AN INADEQUATE QUANTITY OF SAMPLE LEFT FOR 4 MEAT AND BONE MEALS.

THE CORRELATION COEFFICIENTS FOR THE 3 IN VITRO SOLUBLE NITROGEN ASSAYS (WITH AND WITHOUT A BLANK CORRECTION) FOR THE 4, 8, AND 16 HOUR INCUBATION PERIODS WITH THE TEXAS A&M SWINE ILEAL NITROGEN DIGESTIBILITY, FECAL NITROGEN DIGESTIBILITY, AND DIGESTIBLE LYSINE FOR THE 17 MEAT AND BONE MEAL SAMPLES ARE IN TABLE 2. FOURTEEN MEAT AND BONE SAMPLES WERE UTILIZED TO CORRELATE WITH ROOSTER TOTAL AMINO ACID AND LYSINE DIGESTIBILITY (TABLE 2). THE HIGHEST CORRELATION ( $r=.68$ ) OF AN IN VITRO NITROGEN SOLUBILITY ASSAY WITH THE SWINE ILEAL NITROGEN DIGESTIBILITY OF THE MEAT AND BONE MEAL SAMPLES WAS THE .002% PEPSIN PROCEDURE WITH A 16-HOUR INCUBATION PERIOD. THE ILEAL NITROGEN DIGESTIBILITY FOR THE MEAT AND BONE MEAL SAMPLES ALSO PRODUCED A .66 CORRELATION WITH THE SOLUBLE NITROGEN ACID-CORRECTED VALUES FROM THE .002% PEPSIN ASSAY. EACH OF THE .002% PEPSIN INCUBATION PERIODS WERE SUPERIOR TO THE .2% PEPSIN AND .2% PEPSIN-5X PANCREATIN IN VITRO ASSAYS FOR THE CORRELATION TO THE SWINE ILEAL NITROGEN DIGESTIBILITY STUDIES. IN PREVIOUS PROGRESS REPORTS, THE .002% PEPSIN ASSAY WAS SHOWN TO BE SUPERIOR AFTER CONDUCTING THE IN VITRO ASSAY WITH ONLY 10 OF THE TEXAS A&M SAMPLES. THE FOLLOWING PROGRESS SUBMITTED TO F.P.R.F. IN MAY, 1990 SUGGESTED THE .2% PEPSIN-5X PANCREATIN ASSAY MAY BE AN OPTIMUM PROCEDURE WITH THE .002% PEPSIN PROCEDURE BEING A VERY CLOSE SECOND. DR. COON EVALUATED 17 OF THE MEAT AND BONE MEAL SAMPLES ALL AT ONE TIME IN THIS PROGRESS REPORT AND THE .002% PEPSIN PROCEDURE CLEARLY DEMONSTRATES SUPERIORITY AS FAR

AS RELATING TO THE ILEAL NITROGEN DIGESTIBILITY VALUES.

THE FECAL NITROGEN DIGESTIBILITY FOR THE 17 MEAT AND BONE MEAL SAMPLES CLEARLY SHOWS THE .2% PEPSIN CONCENTRATION AT 4, 8, AND 16 HOURS IS HIGHLY CORRELATED TO THE SWINE FECAL NITROGEN STUDIES. IN CONTRAST, THE .2% PEPSIN PROCEDURE CORRELATION TO THE ILEAL NITROGEN DIGESTIBILITY IS SUBSTANTIALLY LOWER. THE FECAL NITROGEN DIGESTIBILITY FROM THE 17 MEAT AND BONE MEAL SAMPLES FROM PIGS ALSO PRODUCED A .64 SIMPLE CORRELATION WITH THE .002% PEPSIN ASSAY WITH 16-HOUR INCUBATION. THE .002% PEPSIN PROCEDURE CORRELATED BOTH WITH THE ILEAL NITROGEN DIGESTIBILITY AND THE FECAL NITROGEN DIGESTIBILITY VALUES. THE FECAL NITROGEN DIGESTIBILITY OF SWINE ALSO CORRELATED NICELY WITH THE .2% PEPSIN-5X PANCREATIN ASSAY FOR THE 4, 8, AND 16 HOUR INCUBATION PERIODS. IN CONTRAST, THE .2% PEPSIN-5X PANCREATIN ASSAY DID NOT CORRELATE AS CLOSELY TO THE ILEAL NITROGEN DIGESTIBILITY STUDIES. THE FINDINGS THAT THE .2% PEPSIN ASSAY AND THE .2% PEPSIN-5X PANCREATIN ASSAY BOTH CORRELATE MORE CLOSELY WITH THE FECAL NITROGEN DIGESTIBILITY THAN WITH THE ILEAL NITROGEN DIGESTIBILITY IS ALSO SIMILAR TO PREVIOUS OBSERVATIONS IN THE OTHER 2 PROGRESS REPORTS. IT WAS ALSO DETERMINED IN THE PREVIOUS REPORTS THAT THE FECAL NITROGEN DIGESTIBILITY VALUES WITH PIGS ALSO WAS MORE CLOSELY ASSOCIATED WITH THE LONGER INCUBATION AND HIGHER CONCENTRATIONS OF PEPSIN AND THE PEPSIN PANCREATIN ASSAY THAN WITH THE LOWER CONCENTRATIONS OF PEPSIN. IT IS BELIEVED THE HIGH CONCENTRATION OF PEPSIN AND THE PEPSIN-PANCREATIN COMBINATION PRODUCES A MORE THOROUGH DIGESTION OF THE MEAT AND BONE MEAL AND THUS MAY MORE CLOSELY ASSOCIATE WITH THE ADDITIONAL NITROGEN UTILIZED BY THE MICROFLORA IN THE LOWER TRACT OF SWINE.

THE LYSINE CONTENT OF THE MEAT AND BONE MEAL HAS ABSOLUTELY NO CORRELATION WITH ANY OF THE IN VITRO ASSAYS, WHEREAS THE DIGESTIBLE LYSINE FROM THE TEXAS A&M SAMPLES AS DETERMINED AT THE ILEUM FOR SWINE CORRELATE NICELY WITH THE .002% PEPSIN ASSAY WITH A 4-HOUR INCUBATION PERIOD. THE .75 CORRELATION WITH THE .002% PEPSIN PROCEDURE WITH 4-HOUR INCUBATION FOR THE ACID-CORRECTED SAMPLE IS EXTREMELY GOOD.

THE PERCENT AMINO ACID DIGESTIBILITY IN ROOSTERS OF THE 14 TEST MEAT AND BONE MEAL SAMPLES WERE COMPARED TO THE IN VITRO NITROGEN SOLUBILITY ASSAYS SIMILAR TO THE SWINE ILEAL NITROGEN DIGESTIBILITY ANALYSIS. THE PERCENT AMINO ACID

DIGESTIBILITY OF THE TEST MEAT AND BONE MEAL SAMPLES PRODUCED A HIGHEST SIMPLE CORRELATION OF .75 WITH THE .002% PEPSIN ASSAY UTILIZING A 4-HOUR INCUBATION PERIOD. EACH OF THE 3 INCUBATION PERIODS UTILIZING THE .002% PEPSIN ASSAY PRODUCED CORRELATIONS BETWEEN .67 AND .75. THE .2% PEPSIN-5X PANCREATIN PROCEDURE WITH THE 8-HOUR INCUBATION PERIOD ALSO PRODUCED A .70 SIMPLE CORRELATION TO THE CHICKEN AMINO ACID DIGESTIBILITY VALUES FOR THE 14 TEST MEAT AND BONE MEAL SAMPLES.

THE CORRELATION OF THE ILEAL NITROGEN DIGESTIBILITY VALUES DETERMINED WITH SWINE WITH THE CHICKEN AMINO ACID DIGESTIBILITY DETERMINED IN UNIVERSITY OF MINNESOTA STUDIES WAS .49. A HIGHER CORRELATION MAY HAVE BEEN OBTAINED IF ABSOLUTE TOTAL AMINO ACID DIGESTIBILITY WAS DETERMINED AT TEXAS A&M AND NOT A MEASURE OF ILEAL NITROGEN DIGESTIBILITY AS MEASURED BY CRUDE PROTEIN. IN CONDUCTING THIS ASSAY, THEY DETERMINED THE AMINO ACID DIGESTIBILITY BY WEIGHT OF ALL AMINO ACIDS WITH THE EXCEPTION OF TRYPTOPHAN (NOT ANALYZED) AND COMPARED THE TOTAL AMINO ACID DIGESTED IN CHICKENS WITH THE ILEAL CRUDE PROTEIN NITROGEN DIGESTIBILITY. THE CORRELATION OF ACTUAL LYSINE DIGESTED IN THE SWINE ILEAL STUDIES AND THE UNIVERSITY OF MINNESOTA CHICKEN FORCE-FEEDING EXPERIMENTS WAS EXTREMELY HIGH WITH A CORRELATION OF .75. THE DIGESTIBLE LYSINE FOR BOTH SWINE AND PIGS BEING HIGHLY CORRELATED FOR ALL OF THE 14 MEAT AND BONE MEAL SAMPLES SHOWS THE CHICKEN AMINO ACID DIGESTIBILITY PROCEDURE CAN SIMULATE THE RELATIONSHIP OF PROTEIN AND AMINO ACID DIGESTION FOR BOTH SPECIES.

THE DIGESTIBLE LYSINE DETERMINED AT TEXAS A&M BY THE SWINE ILEAL PROCEDURE AND THE DIGESTIBILITY VALUES FOR LYSINE IN CHICKENS ARE SHOWN IN TABLE 5.

IN SUMMARY, THE IN VITRO NITROGEN SOLUBILITY ASSAY UTILIZING .002% PEPSIN WITH A 16-HOUR INCUBATION PERIOD PRODUCED THE CLOSEST CORRELATION TO THE SWINE ILEAL NITROGEN DIGESTIBILITY VALUES FOR THE TEST MEAT AND BONE MEAL SAMPLES. THE .2% PEPSIN-5X PANCREATIN ASSAY WITH THE 16-HOUR INCUBATION PERIOD ALSO PRODUCED THE HIGHEST CORRELATION TO THE FECAL NITROGEN DIGESTIBILITY VALUES DETERMINED WITH SWINE. THE .002% PEPSIN WITH 4-HOUR INCUBATION PRODUCED THE HIGHEST CORRELATION WITH TOTAL AMINO ACID DIGESTIBILITY IN CHICKENS AS WELL AS LYSINE DIGESTIBILITY IN CHICKENS. THE SWINE DIGESTIBLE LYSINE VALUES ALSO TENDED TO CORRELATE MORE CLOSELY WITH THE .002% PEPSIN PROCEDURE WITH ONLY A 4-HOUR INCUBATION PERIOD. THE FECAL NITROGEN DIGESTIBILITY VALUES DETERMINED WITH SWINE WERE MORE CLOSELY ASSOCIATED WITH THE HIGH CONCENTRATION .2% AOAC PEPSIN AND THE .2% PEPSIN-5X

PANCREATIN PROCEDURES AND THESE PROCEDURES TENDED TO BE LESS CORRELATED TO THE ILEAL SWINE NITROGEN DIGESTIBILITY VALUES. THE TOTAL NITROGEN DIGESTIBILITY DETERMINED AT THE ILEUM FOR SWINE HAD A CORRELATION OF .49 TO THE TOTAL AMINO ACID DIGESTIBILITY IN CHICKENS DETERMINED BY UTILIZING ACTUAL EXCRETA INSTEAD OF OBTAINING SAMPLES AT THE ILEUM. THE DIGESTIBLE LYSINE DETERMINED IN THE ILEUM OF PIGS HAD AN EXTREMELY HIGH .75 CORRELATION TO THE DIGESTIBLE LYSINE DETERMINED WITH CHICKENS AND PROVES THE DIGESTIBLE AMINO ACIDS ARE HIGHLY CORRELATED FROM TEST MEAT AND BONE MEAL SAMPLES FOR BOTH SPECIES.

THE FATS AND PROTEINS RESEARCH FOUNDATION RESEARCH COMMITTEE VOTED TO TERMINATE THE PROJECT AS THEY CONCLUDED THERE WAS NOT SUFFICIENT CORRELATION BETWEEN THE THREE IN VITRO PROCEDURES TESTED AND ANIMAL DIGESTION VALUES.



TABLE 1. COMPARISON OF THREE IN VITRO DIGESTIBILITY METHODS UTILIZING SEVENTEEN HEAT AND HOME MEAL SAMPLES FROM TEXAS A&M (cont.).

TEXAS A&M		UNIVERSITY OF MINNESOTA, 1989-1990								
TEXAS A&M SAMPLES	DIGESTIBILITY			SOLUBLE NITROGEN			TOTAL NITROGEN (ACID CORRECTED)			
	ILEAL NITROGEN	FECAL NITROGEN	IN VITRO DIGESTION TIME	0.00	0.20	5X PAN	0.00	0.20	5X PAN	
	(2)	(2)	(HOURS)	(2)			(2)			
N	65	80	4	79.58	94.19	74.06	66.23	90.68	59.10	
			8	88.19	95.44	79.17	79.76	92.00	66.97	
			16	93.43	96.34	80.23	87.39	93.10	68.13	
M	72	83	4	83.12	92.73	77.07	69.42	85.09	78.81	
			8	94.08	93.42	90.31	88.60	87.02	80.07	
			16	91.87	92.99	91.27	82.84	87.72	83.54	
O	66	78	4	63.11	89.95	77.95	37.36	82.51	62.35	
			8	76.49	92.97	77.49	50.71	87.11	60.39	
			16	84.17	94.74	77.43	70.16	88.88	61.44	
Q	58	76	4	62.79	89.92	75.51	49.67	85.65	64.64	
			8	72.94	91.19	77.40	61.14	86.49	65.43	
			16	82.79	92.58	78.65	73.53	87.62	69.39	
R	60	79	4	54.33	88.45	78.28	36.31	84.12	69.61	
			8	64.21	92.23	81.45	48.12	88.69	73.74	
			16	79.69	92.75	79.05	68.01	89.33	67.89	
S	61	82	4	62.97	90.37	82.28	46.20	85.97	74.00	
			8	72.09	93.26	83.68	57.01	88.78	75.67	
			16	81.32	93.87	83.51	68.62	89.58	75.05	
V	71	86	4	76.85	95.25	86.64	63.94	92.89	78.74	
			8	84.00	96.50	88.17	71.13	94.25	81.65	
			16	92.26	96.77	88.48	84.02	93.53	81.34	

TABLE 1. COMPARISON OF THREE IN VITRO DIGESTIBILITY METHODS UTILIZING SEVENTEEN HEAT AND HOME REAR SAMPLES FROM TEXAS A&M.

TEXAS A&M SAMPLES AND FEEDS RECEIVED FROM TEXAS A&M AND UNIVERSITY OF MINNESOTA, 1989-1990

TEXAS A&M SAMPLES	DIGESTIBILITY			SOLUBLE NITROGEN			SOLUBLE NITROGEN (ACID CORRECTED)		
	ILCAL NITROGEN	FECAL NITROGEN		IN VITRO DIGESTION			IN VITRO DIGESTION		
		(%)	(%)	TIME (HOURS)	0.002	0.2	5X PAM	0.002	0.2
A	73	81	4	68.41	90.82	85.27	49.80	86.31	79.63
			8	75.97	93.52	87.33	57.94	89.70	82.12
			16	87.03	93.69	87.81	78.49	87.48	81.70
B	63	81	4	53.55	83.19	78.77	33.74	75.83	67.98
			8	62.77	88.03	82.73	43.46	82.46	74.61
			16	73.95	88.18	81.59	58.35	81.19	73.83
C	60	79	4	60.32	91.78	82.42	33.52	86.12	70.51
			8	69.46	93.97	85.49	46.11	89.30	75.58
			16	79.74	94.92	84.55	59.56	90.17	73.10
D	73	83	4	64.24	92.81	81.33	49.76	89.83	72.10
			8	78.33	92.95	82.21	67.90	92.74	72.87
			16	87.05	96.42	83.35	75.57	93.93	74.05
E	67	77	4	60.87	89.67	73.32	49.57	86.83	66.08
			8	72.66	90.10	78.75	62.43	86.66	72.32
			16	83.17	92.71	77.58	73.98	88.34	71.56
F	57	74	4	46.66	87.25	73.40	29.83	82.83	63.90
			8	56.96	89.03	77.38	40.89	84.91	70.40
			16	69.28	90.52	73.76	54.61	85.78	63.04
G	67	82	4	70.59	92.96	79.55	56.46	89.50	69.33
			8	77.04	93.70	81.97	65.66	90.02	72.57
			16	88.18	94.53	81.14	79.96	90.24	71.24
H	60	81	4	68.65	90.40	74.27	55.66	86.47	63.81
			8	78.89	94.00	77.71	68.15	91.01	66.10
			16	86.19	94.26	77.61	76.73	90.23	68.60
J	-	84	4	73.50	91.18	84.36	62.85	87.73	77.50
			8	80.19	93.52	87.18	70.39	90.50	79.15
			16	86.70	95.01	84.72	78.32	91.31	78.42
K	77	81	4	70.76	91.98	81.65	58.63	88.69	74.18
			8	80.08	93.11	84.28	68.87	89.26	77.87
			16	87.13	94.10	78.47	77.88	89.65	67

TABLE 2. SIMPLE CORRELATIONS FOR THE THREE ENZYMATIC ASSAYS OF SOLUBLE NITROGEN AND SOLUBLE NITROGEN-ACID CORRECTED AND AMINO ACID AVAILABILITIES FOR SEVENTEEN TEXAS A&M HEAT AND HOME NEAL SAMPLES

University of Minnesota December 1970

TREATMENT	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
	SIMPLE CORRELATIONS																	
0.2% PEPSIN, 4 HR.	0.44	0.39	0.50	0.44	0.47	0.49	0.53	0.47	0.69	0.59	0.48	0.52	0.54	0.44	0.48	0.47	0.49	0.44
0.2% PEPSIN, 8 HR.	0.42	0.47	0.62	0.62	0.74	0.53	0.46	0.51	0.72	0.60	0.37	0.48	0.54	0.44	0.48	0.47	0.49	0.44
0.2% PEPSIN, 16 HR.	0.41	0.31	0.49	0.46	0.57	0.48	0.46	0.44	0.63	0.56	0.65	0.61	0.42	0.39	0.48	0.47	0.49	0.44
0.002% PEPSIN, 4 HR.	0.65	0.64	0.67	0.63	0.75	0.62	0.75	0.80	0.76	0.60	0.75	0.75	0.56	0.50	0.60	0.59	0.61	0.50
0.002% PEPSIN, 8 HR.	0.66	0.62	0.61	0.57	0.70	0.60	0.80	0.82	0.74	0.67	0.72	0.71	0.53	0.50	0.60	0.59	0.61	0.50
0.002% PEPSIN, 16 HR.	0.68	0.66	0.64	0.57	0.67	0.53	0.81	0.80	0.79	0.69	0.68	0.69	0.54	0.48	0.60	0.59	0.61	0.50
5X PANCREATIN, 4 HR.	0.45	0.57	0.69	0.69	0.56	0.62	0.10	0.33	0.33	0.43	-0.23	-0.02	-0.01	0.21	0.48	0.47	0.49	0.44
5X PANCREATIN, 8 HR.	0.55	0.47	0.74	0.60	0.70	0.53	0.32	0.20	0.51	0.39	0.02	0.00	0.34	0.26	0.48	0.47	0.49	0.44
5X PANCREATIN, 16 HR.	0.53	0.55	0.76	0.70	0.70	0.58	0.36	0.34	0.53	0.46	0.27	0.14	0.30	0.25	0.48	0.47	0.49	0.44
F&G	0.691																	
H&I	0.753																	
A&C	0.487																	
B&C	0.783																	

A=PERCENT ILEAL NITROGEN DIGESTIBILITY (SWINE, TEXAS A&M)  
 B=PERCENT FECAL NITROGEN DIGESTIBILITY (SWINE, TEXAS A&M)  
 C=AMINO ACID AVAILABILITY (CHICKEN, U OF MN)  
 D=PERCENT SOLUBLE NITROGEN (U OF MN)  
 E=PERCENT SOLUBLE NITROGEN-ACID CORRECTED (U OF MN)  
 F=PERCENT LYSINE DIGESTIBILITY (SWINE, TEXAS A&M)  
 G=PERCENT LYSINE AVAILABILITY (CHICKEN, U OF MN)  
 H=GRAMS DIGESTIBLE LYSINE (SWINE, TEXAS A&M)  
 I=GRAMS LYSINE AVAILABLE (CHICKEN, U OF MN)

TABLE 3. AMINO ACID CONTENT (2) OF MEAT AND BONE MEAL SAMPLES

NO.	CYS	ASP	MET	THR	SER	GLY	PRO	GLU	ALA	VAL	ISO	LEU	TYR	PHE	LYS	HIS	ARG
B	0.90	2.54	0.40	0.69	1.73	4.02	3.49	9.50	4.73	2.31	1.58	3.19	1.05	0.27	2.06	0.57	2.49
C	1.02	1.92	0.49	1.23	2.21	3.65	4.98	11.36	3.60	2.32	1.42	3.08	1.05	0.31	2.38	0.59	2.85
D	0.49	3.72	0.58	1.54	2.34	4.65	3.82	10.10	4.59	2.17	1.26	3.04	1.07	0.25	2.18	0.56	2.28
E	1.16	3.77	0.31	0.94	1.18	3.32	3.85	7.46	3.20	1.15	1.15	2.78	1.04	0.24	2.36	0.50	2.89
F	0.52	2.08	0.20	1.06	1.74	5.16	4.40	11.72	4.96	2.56	1.59	3.04	0.92	0.29	2.65	0.48	2.34
G	0.56	3.51	1.15	1.49	2.64	4.37	3.78	11.04	4.34	2.69	1.67	3.28	1.18	0.38	2.71	0.55	2.68
H	1.10	0.96	0.26	0.73	1.23	2.08	5.20	8.10	3.73	1.83	1.33	2.91	1.03	0.23	2.57	0.41	2.93
I	0.57	3.28	0.68	1.78	3.16	4.18	4.02	11.14	4.64	2.09	1.26	2.73	1.02	0.29	2.17	0.29	2.45
N	0.50	4.76	0.53	1.67	2.98	4.91	1.42	8.77	4.44	2.19	1.26	2.84	0.89	0.32	2.32	0.52	2.30
M	0.78	3.90	0.76	2.04	2.85	5.92	1.90	9.75	4.29	2.37	1.69	3.09	1.23	0.38	2.56	0.47	2.79
P	0.53	3.50	0.91	1.89	1.66	5.22	2.03	11.06	4.67	2.40	1.39	3.04	1.00	0.34	2.38	0.45	2.70
Q	0.39	2.13	0.36	1.37	6.46	4.10	1.87	9.92	3.72	1.72	1.01	2.15	0.73	0.21	1.66	0.40	2.12
S	0.41	4.97	0.97	0.65	5.60	4.82	1.62	10.74	3.55	2.02	1.11	2.48	0.94	0.34	1.90	0.28	2.31
U	0.42	1.32	0.49	1.77	5.26	5.21	1.95	10.28	4.21	2.15	1.33	2.73	0.92	0.31	2.13	0.31	2.53

TABLE 4. AMINO ACID AVAILABILITY (2) OF MEAT AND BONE MEAL SAMPLES.

NO.	CYS	ASP	NET	THR	SER	GLY	PRO	GLU	ALA	VAL	ISU	LEU	TYR	PHE	LYS	HIS	ARG	TOTAL AA
B	66.6	83.4	85.2	79.1	84.5	85.3	78.6	73.8	85.5	83.3	82.1	81.2	92.8	80.9	73.3	80.3	79.4	80.05
C	73.8	75.1	67.0	79.6	89.4	92.4	92.2	91.3	91.1	88.2	82.7	88.7	48.0	74.7	85.3	71.5	86.8	87.22
D	59.5	88.7	72.2	84.1	89.6	92.3	89.1	82.5	91.6	88.4	81.7	89.7	80.2	84.8	83.5	76.1	82.2	85.77
E	85.5	86.1	76.5	78.6	81.7	88.5	86.6	67.8	84.8	79.5	85.3	88.9	80.1	84.8	87.3	81.9	87.1	82.00
F	61.3	102.3	102.0	66.2	68.5	82.9	78.5	66.4	81.3	70.2	66.9	65.7	96.8	83.0	83.9	86.1	51.4	73.00
G	76.2	91.2	96.5	92.7	95.0	95.5	96.2	90.8	94.9	94.4	93.8	94.3	94.5	86.6	92.6	88.3	93.7	93.11
H	78.7	42.0	72.6	75.8	81.0	83.5	97.1	78.6	88.3	85.8	87.2	88.7	81.3	78.5	86.3	70.0	88.6	84.41
K	70.4	84.1	85.3	93.5	96.9	92.7	89.5	86.2	92.2	90.1	88.4	89.6	89.4	94.4	87.5	71.0	87.5	88.91
M	73.3	94.9	88.7	88.5	90.7	92.0	95.6	73.5	92.1	100.8	79.0	94.5	50.7	103.7	86.1	60.2	88.2	86.68
N	82.7	94.3	89.4	92.2	93.2	96.2	97.5	91.2	94.7	93.0	91.9	92.3	85.9	103.7	91.6	86.4	94.2	92.93
P	68.5	91.4	77.1	91.8	89.8	93.0	73.7	83.9	90.0	90.8	88.7	89.3	84.6	74.4	86.3	81.9	86.5	87.08
Q	65.3	81.8	68.5	87.2	91.8	85.0	70.5	72.1	80.0	73.4	78.9	73.2	75.0	90.9	71.0	83.2	69.8	78.50
S	75.2	94.2	87.1	77.8	97.5	94.5	94.3	88.6	91.7	91.3	89.3	90.5	99.6	105.2	86.4	71.1	90.4	91.54
U	52.0	83.4	52.1	85.0	87.1	90.7	89.9	82.1	87.6	85.1	81.1	84.7	71.2	102.8	77.6	52.5	84.9	84.04

TABLE 5. LYSINE CONTENT AND DIGESTIBILITY OF SEVENTEEN MEAT AND BONE MEAL SAMPLES.

SAMPLE NO.	SWINE			CHICKEN		
	LYSINE CONTENT (g/100g)	DIG. LYSINE (ILEAL) (%)	DIG. LYSINE (ILEAL) (g)	LYSINE CONTENT (g/100g)	AVAIL. LYSINE (%)	AVAIL. LYSINE (g)
B	2.50	67	1.68	2.06	73.30	1.51
C	2.88	61	1.76	2.38	85.30	2.03
D	2.72	80	2.18	2.18	83.50	1.82
E	2.63	71	1.87	2.36	97.30	2.06
F	2.58	56	1.44	2.65	63.90	1.69
G	3.47	75	2.60	2.71	92.60	2.51
H	2.88	76	2.19	2.57	86.30	2.22
K	2.63	79	2.08	2.17	87.50	1.90
N	3.15	73	2.30	2.32	86.10	2.00
M	2.65	80	2.12	2.56	91.60	2.34
P	2.20	74	2.00	2.38	86.30	2.05
Q	2.50	65	1.63	1.66	71.00	1.18
S	2.80	63	1.76	1.90	86.40	1.64
U	3.06	60	1.84	2.13	77.60	1.65