Director's Digest
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Availability of Energy in Rendered By-Products Used in Poultry Rations

Final Report

Fats and Proteins Research Foundation
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Submitted by:

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1. Introduction

Animal by-product meals are a significant source of several nutrients that are of value to the commercial poultry industry. These include protein and energy. The value of these products is based on the availability of these nutrients in the animal protein meals. Very little information on the available energy content of these meals for utilization by poultry has been collected. Due to this many nutritionists will place relatively low values on energy to avoid the potential for underfeeding of this important nutrient. Determining the correct metabolizable energy values for various by-products will increase the apparent value of these by-products for poultry rations. Use of by-products in rations for poultry has the potential to improve utilization of rendered products. Each 1% increment of rendered by-product use would use as much as 75,000 tons of rendered product in the turkey industry alone. If an increase in the metabolizable energy content of these meals could be demonstrated, a substantial increase in use could occur.

2. Objectives:

To determine the energy availability of different animal by-product sources for turkeys and broilers.

3. Industry Summary

This project was designed to determine the energy availability of different animal by-product sources for turkeys and broilers. Energy analysis of 12 samples of meat and bone meal and 15 samples of poultry by-product meal were conducted using turkeys, broilers and the leghorn rooster as the research animals. Each sample will be analyzed in three different fashions (Zanella et al., 1999). The first of these will be the commonly used True Metabolizable Energy (TME) analysis based on the work of Sibbald (1986) and slightly modified for use in intact turkeys and cecectomized roosters. Briefly, birds will denied access to feed for 36 hrs to clear the gut by being placed in digestibility cages. Each bird (8 replicates) will then be tube fed a quantity of feed equal to approximately 2% of body weight. Feces will then be collected for 48 hrs post feeding. In addition, endogenous feces will be collected from a similar group of birds at the same time with all procedures identical with the exception of the tube feeding. The energy from these feces will be used to correct for fecal energy that would have been excreted regardless of the feed sample being fed. Both feed energy in and fecal energy out (corrected for endogenous loss) will be measured by bomb calorimetry and TME calculated from the difference of these numbers. In the second series of experiments, a modified total collection will be done for determination of Apparent Metabolizable Energy (AME) and a longer term TME valuation. In these experiments, 3 wk old birds will be fed a basal diet and energy value determined. This basal diet will then be diluted (50%) by addition of the products being tested. Birds will be fed for 3 days on the test diet with total feed intake measured as well as total feces collection. Energy determination of feed and feces adjusted for the energy content of the basal ration will be used to determine AME. In a modification of this procedure, birds will be pulled from feed at both the beginning and end of the trial for 24 hrs and endogenous excreta collected for a 24 hr period on day 1 and 3 of the trial. Endogenous loss will be estimated from these birds for the entire collection period and used for adjustment of the AME values. A minimum of 6 pens of birds will be used for each feed determination. The third method will be based on ileal digesta contents. Cromic oxide will be added to diets at .05% of the diet. Poults being fed the test diets will be killed with CO_2 and ileal contents collected from Meckels diverticulum to the ileocolic juncture. Energy will be determined by the differences between cromic oxide concentration in diet and digesta. All data were analyzed for differences due to procedure as well as samples within procedures.

Results of the project are found in the attached tables. Briefly, poultry meal samples ran at book values or somewhat lower. This is primarily due to the increased ash content and decreased fat content found in certain meals. Meals from many plants are showing changes in composition based on the carcass inclusion in the product. This is due to further processing of the chicken versus whole bird production of the past. The variety of assay methodologies utilized showed few differences (11 of 15 were similar) between procedures, indicating that any of the methods used are acceptable. This is as would be expected as each of the procedures should provide similar results. There was a tendency for turkey values to be slightly lower although statistical differences were not found.

Meat meal samples ran at book values or above. Improved processing procedures have probably improved digestibility in the recent past. Differences in procedure were found within samples in some cases. Generally this was manifested in lower values for chick digesta AME's. Chick and turkey values for meat meal samples were very similar within samples.

Overall it appears that any energy analysis method is acceptable, although there were more differences in meat meal samples than in poultry meal samples. There were also few differences between chickens and turkeys in these samples.

Abstract

This project was designed to determine the energy availability of different animal by-product sources for turkeys and broilers. Energy analysis of 12 samples of meat and bone meal and 15 samples of poultry by-product meal were conducted using turkeys, broilers and the leghorn rooster as the research animals. Each sample will be analyzed in three different fashions (Zanella et al., 1999). The first of these will be the commonly used True Metabolizable Energy (TME) analysis based on the work of Sibbald (1986) and slightly modified for use in intact turkeys and cecectomized roosters. Briefly, birds will be denied access to feed for 36 hrs to clear the gut by being placed in digestibility cages. Each bird (8 replicates) will then be tube fed a quantity of feed equal to approximately 2% of body weight. Feces will then be collected for 48 hrs post feeding. In addition, endogenous feces will be collected from a similar group of birds at the same time with all procedures identical with the exception of the tube feeding. The energy from these feces will be used to correct for fecal energy that would have been excreted regardless of the feed sample being fed. Both feed energy in and fecal energy out (corrected for endogenous loss) will be measured by bomb calorimetry and TME calculated from the difference of these numbers. In the second series of experiments, a modified total collection will be done for determination of Apparent Metabolizable Energy (AME) and a longer term TME valuation. In these experiments, 3 wk old birds will be fed a basal diet and energy value determined. This basal diet will then be diluted (50%) by addition of the products being tested. Birds will be fed for 3 days on the test diet with total feed intake measured as well as total feces collection. Energy determination of feed and feces adjusted for the energy content of the basal ration will be used to determine AME. In a modification of this procedure, birds will be pulled from feed at both the beginning and end of the trial for 24 hrs and endogenous excreta collected for a 24 hr period on day 1 and 3 of the trial. Endogenous loss will be estimated from these birds for the entire collection period and used for adjustment of the AME values. A minimum of 6 pens of birds will be used for each feed determination. The third method will be based on ileal digesta contents. Cromic oxide will be added to diets at .05% of the diet. Poults being fed the test diets will be killed with CO_2 and ileal contents collected from Meckels diverticulum to the ileocolic juncture. Energy will be determined by the differences between cromic oxide concentration in diet and digesta. All data were analyzed for differences due to procedure as well as samples within procedures.

Poultry meal samples ran at published values or somewhat lower. The variety of assay methodologies utilized showed few differences (11 of 15 were similar) between procedures, indicating that any of the methods used are acceptable. This is as would be expected as each of the procedures should provide similar results. There was a tendency for turkey values to be slightly lower although statistical differences were not found.

Meat meal samples ran at published values or above. Improved processing procedures have probably improved digestibility in the recent past. Differences in procedure were found within samples in some cases. Generally this was manifested in lower values for chick digesta AME's. Chick and turkey values for meat meal samples were very similar within samples.

Overall it appears that any energy analysis method is acceptable, although there were more differences in meat meal samples than in poultry meal samples. There were also few differences between chickens and turkeys in these samples.

Keywords: Poultry , turkey, broiler, energy, meat meal, poultry meal

Introduction

Animal by-product meals are a significant source of several nutrients that are of value to the commercial poultry industry. These include protein and energy. The value of these products is based on the availability of these nutrients in the animal protein meals. Very little information on the available energy content of these meals for utilization by poultry has been collected. Due to this many nutritionists will place relatively low values on energy to avoid the potential for underfeeding of this important nutrient. Determining the correct metabolizable energy values for various by-products will increase the apparent value of these by-products for poultry rations.

Use of by-products in rations for poultry has the potential to improve utilization of rendered products. Each 1% increment of rendered by-product use would use as much as 75,000 tons of rendered product in the turkey industry alone. If an increase in the metabolizable energy content of these meals could be demonstrated, a substantial increase in use could occur.

The ME and TME systems have been in place for a number of years and are widely used. In the future we may move to net energy systems as a more accurate method of estimating actual energy use by the bird for productive purposes, but this will not happen in the foreseeable future. In the realm of turkey nutrition, there have been few trials to determine the ME or TME content of feeds for turkeys. Most of the energy data has been used based on the broiler or the TME system with the Leghorn rooster (Sibbald, 1986). Analysis of feedstuffs used in our lab have shown significant differences in digestibilities of amino acids as well as energy values between commonly used book values and determined values in turkeys. Determined energy values of corn and soybean meal were lower in ducks than values found in chicken assays (Farhat et al., 1998) which implies that species differences may occur. Ostrowski-Meissner (1984) also reported differences between species. While there is substantial discussion in the literature about correct methodology for energy determinations, it appears that the original TME procedure of Sibbald (1987) is well accepted and that the total collection method of AME determination may be more accurate than the ileal digesta method (Scott et al., 1998) although this can be easily disputed (Zanella et al., 1999). These data should prove useful to the commercial poultry industry.

The objective of these studies was to determine the energy availability of different animal by-product sources for turkeys and broilers.

Procedures

Energy analysis of 12 samples of meat and bone meal and 15 samples of poultry by-product meal were conducted using turkeys, broilers and the leghorn rooster as the research animals. Each sample will be analyzed in three different fashions (Zanella et al., 1999). The first of these will be the commonly used True Metabolizable Energy (TME) analysis based on the work of Sibbald (1986) and slightly modified for use in intact turkeys and cecectomized roosters. Briefly, birds will denied access to feed for 36 hrs to clear the gut by being placed in digestibility cages. Each bird (8 replicates) will then be tube fed a quantity of feed equal to approximately 2% of body weight. Feces will then be collected for 48 hrs post feeding. In addition, endogenous feces will be collected from a similar group of birds at the same time with all procedures identical with the exception of the tube feeding. The energy from these feces will be used to correct for fecal energy that would have been excreted regardless of the feed sample being fed. Both feed energy in and fecal energy out (corrected for endogenous loss) will be measured by bomb calorimetry and TME calculated from the difference of these numbers. In the second series of experiments, a modified total collection will be done for determination of Apparent Metabolizable Energy (AME) and a longer term TME valuation. In these experiments, 3 wk old birds will be fed a basal diet and energy value determined. This basal diet will then be diluted (40%) by addition of the products being tested. Birds will be fed for 3 days on the test diet with total feed intake measured as well as total feces collection. Energy determination of feed and feces adjusted for the energy content of the basal ration will be used to determine AME. In a modification of this procedure, birds will be pulled from feed at both the beginning and end of the trial for 24 hrs and endogenous excreta collected for a 24 hr period on day 1 and 3 of the trial. Endogenous loss will be estimated from these birds for the entire collection period and used for adjustment of the AME values. A minimum of 6 pens of birds will be used for each feed determination. The third method will be based on ileal digesta contents. Cromic oxide will be added to diets at .05% of the diet. Poults being fed the test diets will be killed with CO2 and ileal contents collected from Meckels diverticulum to the ileocolic juncture. Energy will be determined by the differences between cromic oxide concentration in diet and digesta. All data were analyzed for differences due to procedure as well as samples within procedures.

Results

Results for the experiments are presented in the attached tables. Statistical analysis output has also been provided. Poultry meal samples ran at published values or somewhat lower. The variety of assay methodologies utilized showed few differences (12 of 15) between procedures, indicating that any of the methods used are acceptable. This is as would be expected as each of the procedures should provide similar results. There was a tendency for turkey values to be slightly lower although statistical differences were not found.

Meat meal samples ran at published values or above. Improved processing procedures have probably improved digestibility in the recent past. Differences in procedure were found within samples in some cases. Generally this was manifested in lower values for chick digesta AME's. Chick and turkey values for meat meal samples were very similar within samples indicating that broiler or Leghorn rooster values would be acceptable for use in all species.

Discussion

Relatively little work has been done to evaluate the energy content of rendered poultry and meat meals. This study shows that a variety of different analytical methods can be used with similar results. While there have been arguments amongst scientists about analytical methodology, when looked at critically, each of the methods should yield similar results. For example, the standard AME procedure has been criticized as it does not account for endogenous losses as are done in the TME. However, if one feeds sufficient feed, the relative proportion of endogenous loss (which is high in the precision fed assay) becomes quite small and induces little variation as determined by these data.. Thus it can be concluded that all analytical methods are probably acceptable and should be used as appropriate to the conditions available.

Energy contents of meat meal were generally higher than those found by Martosiswoyo and Jensen in 1988, but similar to values determined more recently (Dale, 1997). This may be due to improved process control methods. Energy content of poultry meal samples were similar to below book values. This is a reflection of some of the higher ash contents seen more recently in poultry meals. Dale and coworkers (1993) found average energy values of poultry meals to be over 4600 kcal/kg. However, these were very low ash content samples with fat content averaging over 32%.

Another area of concern is the use of energy values collected from different types/species of birds. Firman and Remus (1993) showed that there are some species differences and the reader should be cautioned that although there were no differences seen with these feedstuffs, other feedstuffs have been shown to differ in energy content between species.

Conclusions

1. Overall it appears that any energy analysis method is acceptable, although there were more differences in meat meal samples than in poultry meal samples.
2. There were also few differences between chickens and turkeys in these samples.
3. Energy content of some meat meal samples were higher than older published values.

Tables

Acknowledgements

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F&P-00 Sample Proximates

Sample	Protein %	Ash %	Fat%	Moisture %	Ca %	P %	Fiber %
2pm	59-61	16-18	13-15	3-5			
4pm	65	11-15	12	3	5	2.4	2.5
5pm	62	16	12	2.75	3	2	3
6pm	67	12	12	5			
7pm	67.4	10.5	11.9	5.2			
8pm	67-69	10-12	11-14	2.5-3.5			
9pm	63.59	18.13	8.69	8.90			0.84
10pm	62.5	18.5	11.5	3.5	6.5	3.25	
11pm	57		10.5	3.5			
12pm	67.5	15	14	3.5			
14pm	68.73	12.33	13.61	5.33			
15pm	62	18	10	12	5-10	2.8	3
16pm	60	20	14	8			
17pm	60.79	21.4	11.05	6.75			0.62
18pm	59-61	16-18	13-15	3-5			
2mbm	52	24.2	12	4.5			
3mbm	50	35	7	10	8-11	4-7	3
5mbm	50		7		7.4-8.8	4	3
7mbm	54		10	0.1			
8mbm	55	24	10	5			
9mbm	51	28.2	12.8	3.43	7.13	2.94	
10mbm	51.1	26.8	11.5	3.5			
12mbm	48	34	8	3	12	5.5	
13mbm	54.6	25.14	9.9	9.11			1.75
14mbm	51		10.25	3.5			
15mbm	54.92	25.8	9.51	5.2			1.09
16mbm	45		10	6			

F&P-00 Results
Methods

Methods	2pm			4pm			5pm			6pm			7pm		
	Mean		Std Err	Mean		Std Err	Mean		Std Err	Mean		Std Err	Mean		Std Err
Rooster TMEn	3492	a	127	2123	a	113	2944	abc	109	2188	a	69	2972	a	101
Turkey TMEn	2971	b	412	2454	a	113	2604	c	109	2054	a	69	2813	a	113
Chick Digesta AMEn	2956	b	127	2333	a	113	3059	abc	98	2128	a	69	2789	a	101
Chick Excreta AMEn	2939	b	127	2476	a	113	3171	ab	98	2221	a	69	2836	a	101
Chick Excreta TMEn	2980	b	127	2515	a	113	3203	a	98	2258	a	69	2889	a	101
Turkey Digesta AMEn	2973	b	127	2197	a	126	2706	abc	109	1957	a	90	2614	a	101
Turkey Excreta AMEn	3191	ab	127	2167	a	113	3072	abc	98	2185	a	69	2658	a	101
Turkey Excreta TMEn	3214	ab	127	2201	a	113	3091	ab	98	2206	a	69	2677	a	101

	8pm			9pm			10pm			11pm			12pm		
	Mean		Std Err	Mean		Std Err	Mean		Std Err	Mean		Std Err	Mean		Std Err
Rooster TMEn	1980	a	121	2734	a	168	2944	a	93	2605	a	114	2536	a	167
Turkey TMEn	2348	a	109	2219	a	168	3163	a	84	2614	a	114	2726	a	167
Chick Digesta AMEn	2384	a	109	1971	a	168	2887	a	84	2381	a	114	2727	a	167
Chick Excreta AMEn	2434	a	109	2403	a	168	3105	a	84	2658	a	114	2469	a	167
Chick Excreta TMEn	2473	a	109	2444	a	168	3145	a	84	2700	a	114	2520	a	167
Turkey Digesta AMEn	2457	a	121	2264	a	168	2860	a	84	2433	a	114	2369	a	167
Turkey Excreta AMEn	2224	a	109	2499	a	168	2915	a	84	2382	a	114	2567	a	167
Turkey Excreta TMEn	2244	a	109	2527	a	168	2938	a	84	2408	a	114	2586	a	167

	14pm			15pm			16pm			17pm			18pm		
	Mean		Std Err	Mean		Std Err	Mean		Std Err	Mean		Std Err	Mean		Std Err
Rooster TMEn	3111	a	73	1772	c	106	2462	a	124	3331	a	82	3192	a	94
Turkey TMEn	3104	a	73	1869	bc	106	2662	a	110	3014	a	82	2791	b	109
Chick Digesta AMEn	3011	a	73	1778	bc	168	2655	a	110	3119	a	82	2838	b	84
Chick Excreta AMEn	3135	a	73	2113	ab	106	2764	a	110	3197	a	82	3099	a	84
Chick Excreta TMEn	3180	a	73	2156	ab	106	2811	a	110	3239	a	82	3141	a	84
Turkey Digesta AMEn	3147	a	82	2246	a	119	2768	a	110	3142	a	82	3045	ab	94
Turkey Excreta AMEn	3325	a	82	1895	bc	106	2786	a	110	3099	a	82	3212	a	84
Turkey Excreta TMEn	3245	a	82	1936	abc	106	2807	a	110	3122	a	82	3238	a	84

	2mbm			3mbm			5mbm			7mbm			8mbm		
	Mean		Std Err	Mean		Std Err	Mean		Std Err	Mean		Std Err	Mean		Std Err
Rooster TMEn	2240	bc	90	2469	a	74	3026	a	61	3329	a	131	2547	a	86
Turkey TMEn	2528	ab	81	2517	a	74	2600	bc	79	3103	ab	131	2585	a	86
Chick Digesta AMEn	2135	c	81	2436	a	74	2555	c	61	2705	b	131	2401	a	97
Chick Excreta AMEn	2508	ab	81	2577	a	74	2751	abc	61	3038	ab	131	2552	a	86
Chick Excreta TMEn	2475	abc	81	2614	a	74	2786	abc	61	3081	ab	131	2594	a	86
Turkey Digesta AMEn	2722	a	90	2454	a	74	2882	ab	69	2863	ab	131	2581	a	97
Turkey Excreta AMEn	2586	ab	90	2510	a	74	2975	a	61	2888	ab	131	2503	a	86
Turkey Excreta TMEn	2611	ab	90	2534	a	74	3004	a	61	3103	ab	131	2530	a	86

	9mbm			10mbm			12mbm			13mbm			14mbm		
	Mean		Std Err	Mean		Std Err	Mean		Std Err	Mean		Std Err	Mean		Std Err
Rooster TMEn	3356	a	97	2685	a	118	1703	b	78	2282	a	107	2267	a	109
Turkey TMEn	2669	b	97	2789	a	152	2192	a	78	2010	a	107	2355	a	97
Chick Digesta AMEn	2858	b	86	2737	a	118	1813	b	78	2385	a	107	1953	a	97
Chick Excreta AMEn	3003	ab	86	2820	a	118	2168	a	78	2013	a	107	2332	a	97
Chick Excreta TMEn	3040	ab	86	2861	a	118	2204	a	78	2052	a	107	2369	a	97
Turkey Digesta AMEn	2946	ab	137	2891	a	118	1872	ab	78	2330	a	107	2067	a	97
Turkey Excreta AMEn	2822	b	86	2791	a	118	1975	ab	78	2115	a	107	2325	a	97
Turkey Excreta TMEn	2851	b	86	2811	a	118	1999	ab	78	2137	a	107	2355	a	97

	15mbm			16mbm		
	Mean		Std Err	Mean		Std Err
Rooster TMEn	2858	ab	135	2106	a	122
Turkey TMEn	2583	ab	120	1854	a	136
Chick Digesta AMEn	2474	b	120	1945	a	122
Chick Excreta AMEn	3079	a	120	1588	a	122
Chick Excreta TMEn	3123	a	120	1623	a	122
Turkey Digesta AMEn	2785	ab	135	2019	a	122
Turkey Excreta AMEn	2932	ab	120	2017	a	136
Turkey Excreta TMEn	2974	ab	120	2045	a	136