Effects of Various Levels of Detoxified and Deallergenized Castor Meal Ration on Growth Performance and Carcass Characteristics of Fattening Swine

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Abstract

Eighty 3-way-cross swine of which half were females and half were castrated males were used to study the effects of the use of detoxified and deallergenized castor meal (DDCM) at 4 levels of 0, 8, 12 and 16%. Two feeding experiments were conducted. Experiment I involved the starter period from 4 to 10 weeks old while experiment II was on the growing-finishing period (34-90 kg. body weight). Each experiment consisted of 40 animals, 20 castrated males and 20 females. It was found that the growth rate, feed intake and feed conversion ratio (FCR) of the swine fed with 0, 8 and 12% DDCM were not statistically different from each other and all were statistically better than the 16% DDCM group ($P<0.05$). The carcass characteristics among the 4 groups were not statistically different. It is therefore concluded that up to 12% of DDCM can be safely used without any adverse effects.

1. Introduction

Detoxified and deallergenized castor meal (DDCM) is a by-product of a recently introduced extraction process of the castor bean in Thailand. It can be safely used as animal feed due to the process whereby heat, together with some base solubles, is used and renders their harmlessness [1]. Kasidit [2] reported that DDCM could be used in fattening swine at up to 8% of the ration. The results indicated that a better growth rate was obtained in comparison to the normal castor meal ration.

The present experiment is designed to study the growth performance and carcass characteristics of swine finished on different levels of DDCM ration.

2. Objectives

2.1 To study and compare the growth performance of swine fattened with rations containing 8, 12 and 16% DDCM.

2.2 To study the carcass characteristics of pork carcass finished on 8, 12 and 16% DDCM rations.

3. Materials and Methods

The study used 3-way-cross swine (Landrace, Large White and Duroc) and was divided into 2 experiments as follows:

Experiment I – The experiment involved 6 weeks of the starting period from the 4^{th} to the 10^{th} week. The randomized complete block design was employed. Forty piglets of equal sex were randomly divided into 4 groups. In each pen one castrated male and one female piglet were confined together. The piglets in each pen were randomly fed with the following rations:

Ration 1 – control ration without castor meal
Ration 2 – with 8% DDCM
Ration 3 – with 12% DDCM
Ration 4 – with 16% DDCM

The feed formulation is given in Table 1. The feeds were fed *ad hoc* with drinking water provided all the time.

Experiment II – the experiment was conducted on the growth-finishing period from 34 kg. To 90 kg. body weight. The experimental design and the animal arrangements followed the first experiment. The feed formulation is given in Table 2. After reaching 90 kg. body weight (which terminated the growth performance data collection), the animals were further fed until reaching 100 kg. before slaughtering. All carcasses were chilled at 3°C for 24 hours before cutting according to the Thai commercial method [3].

4. Results and Discussion

The growth performances of swine fed with DDCM at 8, 12 and 16% during the starting period and growth-finishing period are shown in Table 3 and 4. At the starting period, as the level of the DDCM increased the average daily gain decreased 360, 349 341 and 301 gm/day for 0, 8, 12 and 16% DDCM, respectively. The feed conversion ratio also was poorer at 2.47, 2.53, 2.54 and 2.94 for 0, 8, 12 and 16% DDCM, respectively. The feed consumption showed a decreasing trend but not statistically different, at 884, 876, 849 and 872 gm/day for 0, 8, 12 and 16% DDCM, respectively. The growth rate and the FCR of the control group as compared to 8 and 12% groups were similar statistically while the 16% showed a poorer result. This therefore, suggested that up to 12% of DDCM could be used safely at the starter period of fattening swine.

During the growth-finishing period, the results were similar to the starter period that is as the level of the DDCM increased, the growth performance seemed to decrease especially at the 16% level. The average daily gain (ADG) was 669, 647, 661 and 618 gm/day for the control, 8%, 12% and 16% DDCM level, respectively. The control ration which used fish meal as a protein source was not statistically from the 8% and 12% DDCM but all were statistically higher that the 16% DDCM group. The FCR results were 3.71, 3.72, 3.89 and 4.00 for the control, 8% 12% and 16% group, respectively. However, the control ration was not statistically different from the 8% DDCM group. While both the 12% and 16% DDCM group were not statistically different both were poorer than the control and the 8% DDCM group.

These results clearly suggested that the daily growth rate and the FCR of the swine became poorer as the level of the DDCM increased above 12%. This behavior seemed to follow the same pattern as using other vegetable protein source, i.e. rubber seed meal, sun flower seed meal and palm kernel meal. This is due to the fact that these vegetable protein sources are higher in fiber content especially the outer layer of the seed itself. Castor bean meal has a high fiber content, up to 30%, while rice bran, in comparison, has only 12% fiber content. The fiber content in ration 4 which contained 16% DDCM was therefore more than double of that in the control ration which had rice bran as its vegetable protein source. This decreased the metabolizable energy content automatically and in turn decreased the digestibility of the available protein [4], [5]. In addition, this situation also decreased the metabolizable energy to some extent. As Just [6] reported, as the fiber content of the feed increased by 1%, the metabolizable energy would be decreased by 3.5%. It therefore could be concluded that there is a limit to the use of DDCM and that its highest level should be 12%. An amount above this recommended level may impair the growth performance of the animals.

Table 5 shows the carcass characteristics of the pork finished on the control, 8%, 12% and 16% DDCM rations. There was no statistical difference in any of the traits reported. The dressing percentages were 78.4, 77.5, 78.0 and 77.9 for the control, 8%, 12% and 16% DDCM rations, respectively. The carcass length ranged from 77.2 cm. in the control group to 80.8 cm. for the 12% DDCM group. The average 3 points backfat thickness was 1.2 cm. in every group while the loin eye area ranged from 36.0 $cm.^2$ in the 8% DDCM to 38.0 $cm.^2$ for the 12% DDCM group. Table 6 shows the carcass yield from these animals. The lean percentages were 37.7, 36.0, 37.2 and 36.6% for the control, 8%, 12% and 16% DDCM ration groups, respectively. Individual portion lean percentages were also measured but no statistical difference occurred as well as the percent of tender loin muscle. The ham lean percentages ranged from 14.5% in 8% DDCM

Table 1 Feed composition of starting swine (4-10 wks old).

Ingredient	DDCM (%)			
	0%	8%	12%	16%
Corn	54.40	65.41	64.46	63.52
Rice bran	15.00	---	---	---
Soy bean meal	20.60	16.40	13.30	10.20
Fish meal	5.00	5.00	5.00	5.00
DDCM	---	8.00	12.00	16.00
Dicalc. phosphate	1.30	1.70	1.70	1.70
Oyster shell	0.60	0.30	0.30	0.30
Vitamin premix[1]	0.30	0.30	0.30	0.30
Mineral premix[2]	0.50	0.50	0.50	0.50
Lard	2.00	2.00	2.00	2.00
Salt	0.30	0.30	0.30	0.30
Lysine	---	0.09	0.14	0.18
Total	100.00	100.00	100.00	100.00
Calculated nutrients				
Protein (%)	18.02	18.05	18.02	18.02
ME Kcal/kg	3232	3087	2987	2884
Calcium (%)	0.90	0.90	0.90	0.90
Phosphorus (%)	0.57	0.58	0.58	0.58
Lysine (%)	0.98	0.98	0.98	0.98
Meth.+cyst.	0.64	0.64	0.63	0.63

[1] Feed 1 kg supplemented with Vitamin A 30,000 IU, Vitamin D 5,000 IU, Vitamin E 20 IU, Vitamin K 5 mg., Vitamin B_1 5 mg., Vitamin B_2 12.5 mg., Vitamin B_{12} 37.5 mg., Nicotinic acid. 25 mg., Folic acid 2.5 mg., and Biotin 25µg.

[2] Feed 1 kg supplemented with Iron 80 mg., Copper 150 mg., Zinc 100 mg., Manganese 40 mg., Iodine 0.2 mg. And Selenium 0.3 mg.

Table 2 Feed composition of growth-finishing swine (4-10 wks old).

Ingredient	DDCM (%)			
	0%	8%	12%	16%
Corn	65.05	75.21	73.96	72.92
Rice bran	15.00	---	---	---
Soy bean meal	14.40	10.30	7.30	4.30
Fish meal	3.00	3.00	3.00	3.00
DDCM	---	8.00	12.00	16.00
Dicalc. phosphate	0.95	1.20	1.50	1.50
Oyster shell	0.70	0.30	0.20	0.20
Salt	0.30	0.30	0.30	0.30
Vitamin premix[1]	0.30	0.30	0.30	0.30
Mineral premix[2]	0.30	0.30	0.30	0.30
Lard	---	1.00	1.00	1.00
Lysine	---	0.09	0.14	0.18
Total	100.00	100.00	100.00	100.00
Calculated nutrients				
Protein (%)	15.02	15.02	15.02	15.02
ME Kcal/kg	3219	3121	3015	2916
Calcium (%)	0.72	0.72	0.72	0.72
Phosphorus (%)	0.43	0.42	0.47	0.47
Lysine (%)	0.76	0.76	0.76	0.76
Meth.+cyst.	0.56	0.56	0.55	0.55

[1] and [2] same as in Table 1.

Table 3 Growth performance of starting swine 4-10 wks old fed DDCM at 8, 12 and 16% level.

Trait[1]	DDCM (%)			
	0%	8%	12%	16%
Starting wt, kg.	6.05	5.89	6.03	6.02
Finishing wt, kg.	21.20	20.66	20.34	18.14
ADG, gm/d[2]	360[a]	349[a]	341[a]	302[b]
Feed consumed, gm/d	884	876	849	872
FCR[2]	2.47[a]	2.53[a]	2.54[a]	2.94[b]

[1] Average from 10 piglets

[2] Means with different superscript a, b indicated a statistical difference at $P<0.05$ level.

Table 4 Growth performance of growth-finishing swine (34-90 kg.) fed DDCM at 8, 12 and 16% level.

Trait[1]	DDCM (%)			
	0%	8%	12%	16%
Starting wt, kg.	33.12	34.04	34.32	34.01
Finishing wt, kg.	91.11	92.21	93.84	89.63
ADG, gm/da	669[a]	647[a]	661[a]	618[b]
Feed consumed, kg/d	2.48	2.41	2.57	2.47
FCR[2]	3.71[a]	3.72[a]	3.89[b,c]	4.00[c]

[1] Average from 10 animals

[2] Means with different superscript a, b, c indicated a statistical difference at P<0.05 level.

Table 5 Carcass characteristics of pork finished on DDCM rations[1].

Measurement	Level of DDCM			
	0%	8%	12%	16%
Animal number	10	10	10	10
Slaughter wt., kg.	97.2	99.2	101.7	98.2
Chilled carc. Wt., kg	74.2	75.1	77.2	74.3
Percent shrinkage	2.5	2.3	2.5	2.4
Dressing percentage	78.4	77.5	78.0	77.5
Carcass length, cm.	77.2	79.3	80.8	79.0
Backfat thickness, cm	1.2	1.2	1.2	1.2
Loin eye area, cm^2	37.3	36.0	38.0	37.9

[1] Means with non statistical difference.

Table 6 Yield of pork carcass finished on DDCM rations cut according to the Thai commercial method.

Measurement	Level of DDCM			
	0%	8%	12%	16%
Animal number	10	10	10	10
Percent lean	37.7	36.0	37.2	36.6
Percent lean of ham	15.5	14.5	15.3	14.7
Percent lean of shoulder	11.9	11.8	11.6	12.6
Percent loin muscle	8.6	7.9	8.5	8.2
Percent tender loin muscle	1.6	1.4	1.6	1.5
Percent fat	15.0	15.9	15.2	15.9
Percent belly	15.6	15.4	15.7	15.8
Liver weight, kg[1]	1.74[a]	2.00[a,b]	2.11[b]	2.18[b]

[1] Means with different superscript a, b, c indicated a statistical difference at P<0.01 level.

to 15% in the control group. The percent of fat ranged from 15.0% in the control group to 15.9% for the 16% DDCM group. For liver weight, it was 1.74, 2.00, 2.11 and 2.18 kg. for the control, 8%, 12% and 16% DDCM ration groups, respectively. These results showed that as the level of the DDCM increased the liver weight was statistically increased. The reason is probably due to the fact that there was some toxic substance in DDCM and consequently the liver had to prevent itself from such toxicity by increasing its cell size. Further study for mone details on this, however, may be carried out in the near future.

It can be concluded that DDCM could be safely used up to 12% without any ill effects on the growth performance of fattening swine. However, a higher level than this can also be used but may have to be supplemented with energy and protein sources.

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6. References

[1] Fuller, G., Walker, H.G., Jr., Mottola, A.C., Kuzmicky, D.D., and Kohler, G.O. (1971), Potential for Detoxified Castor Meal, J.A.O.C.S., Vol.48, p.616.

[2] Kasidit Uechiewcharnkit, Kanthapanich, C., Ponglamchiak, S., and Vithayasak, T. (1990), The Use of Detoxified and Deallergenized Castor Meal as Pig Feeds, 29th Kasetsart Univ. Ann. Conf.

[3] Chainarong Kanthapanit (1986), Principles of Meat Science. Thai Wattana Panich Co. Ltd., Bangkok.

[4] Kass, M.L., Van Soest, P.J., and Pond, W.G. (1980), Utilization of Detary Fiber from Alfalfa by Growing Swine, II. Volatile Fatty Acid Concentrations in and Disappearance from Gastrointestinal tract., J. Ani. Sci., Vol.50, p.192.

[5] Frank G.R., Ahern, R.X., and Jensen, A.H. (1983), A Study of the Relationship between Performance and Dietary Component Digestibility by Swine Fed Different Levels of Dietary Fiber, J. Ani. Sci., Vol.57, p.645.

[6] Just, A. (1982), The Influence of Ground Barley Straw on the Net Energy Value of Diets for Growth in Pigs, Livestock Prod. Sci., Vol.9, p.717.