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PALM OIL AS ENERGY SOURCE AND ITS EFFECT ON CHOLESTEROL CONTENT IN CHICKEN

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ABSTRACT

A research was done to study the effect of palm oil in high fiber diet on the performance of laying hens as well as broilers and its relation to the synthesis of cholesterol which could trigger the development of atherosclerosis. One hundred twenty laying hens and 120 pullets and 120 broilers were each divided into five treatment groups. The treatment diets were Basal diet, Basal diet + 10% Palm Oil, Basal diet + 10% Palm Oil + 0.1% Cholesterin, Basal diet + 10% Coconut Oil, Basal diet + 10% Coconut Oil + 0.1% Cholesterin. The experiment were started at the age of four weeks old for broilers, 20 weeks for pullets, and 40 weeks of age for laying hens and conducted for 20 weeks period of experiment. Two week adaptation period were given before data collections. Total lipid, total cholesterol, Low Density Lipoprotein (LDL) and High Density Lipoprotein (HDL) were analyzed from the plasma before and after the treatment diets were given. The results of the experiment indicated that palm oil gave better results as compared to that of coconut oil. Palm oil increased the egg production and feed efficiency for layers and increased average body weight in all experimental animals. Palm oil decreased the cholesterol content in the egg yolk, and somewhat tend to increase the average egg weight in layers. There was a tendency that serum LDL was not significantly influenced by palm oil but increased the serum HDL in the group given 10% palm oil. Palm oil also tend to somewhat decreased the serum cholesterol in the pullets.

Keywords : Poultry, laying hens, broilers, palm oil, cholesterol.

Palm oil that consisted of 0.109 fraction of Polyunsaturated Fatty Acid (PUFA), 0.390 fraction of Monounsaturated Fatty Acid (MUFA) and 0.500 fraction of SFA (Cottrell, 1991) given as part of the diet ingredient for *Macaca fascicularis* was demonstrated to have potential effect on lowering the serum cholesterol level, decreased Low Density Lipoprotein (LDL) level, and decrease the serum triglyceride (Piliang, 1993; Djojosoebagio *et al.*, 1994).

A specific protein in LDL (consists of 11% triglyceride, 46% cholesterol, 22% phospholipid, 21% protein) is recognized by receptor on the surface of liver cells and the cells of other tissues and when cholesterol is needed by these cells, LDL is taken up and its components utilized. High Density Lipoprotein (HDL) consists of 50% protein, 20% phospholipids, 22% cholesterol and 8% triglyceride, is an important scavenger of surplus cholesterol, transporting it from cell membranes to the liver, where it is degraded or converted into bile cells.

PUFA had been demonstrated to decrease the total cholesterol as well as to lower the LDL which could be found in the plasma (Goodnight *et al.* 1982). The research was demonstrated by using mice as the experimental animal model. This experiment showed that diet rich of PUFA could decrease the plasma cholesterol (Hosmark *et al.*, 1982).

Different experiment that also used mice as animal model demonstrated that the plasma cholesterol could increase when the PUFA was added in the diet (Shepherd *et al.*, 1978; Rifkind, 1983). Other researchers reported that a diet rich in PUFA given to the mice did not affect the cholesterol level in the plasma (Hosmark *et al.*, 1982; Dun *et al.*, 1975), while the HDL cholesterol in the plasma could increased if the diet was rich in PUFA (Hosmark *et al.*, 1982).

The LDL in the serum is a source of cholesterol and fatty acids in the cells. The LDL has its receptors in the certain body cells and it is therefore can enter easily in the body. In the cells, LDL dissociates to form fatty acids. Among the fatty acids formed as arachidonic acids which is the pre-cursor of the prostaglandin. The prostaglandin will act in the aggregation process of the thombocyte plaque which eventually involves in the development of atherosclerosis (Djojosoebagio, 1990).

It is well known that a diet rich in fat could develop atherosclerosis on some experimental animals (Vles *et al.*, 1964; Kritchevsky, 1969; Malmros, 1969; Wissler and Vesselinvitch, 1975; Weber, 1978; Howard, 1975).

The pathogenesis of atherosclerosis and the affect of diet for the development of atherosclerosis could be demonstrated in some animals as experimental models (Getz *et al.*, 1969). The approach of the atherosclerosis development through feed could be studied by using Rhesus Monkey as the experimental animal (Taylor *et al.*, 1962). Besides monkey, some other animals such as rabbits, mice, dogs and pigs gave satisfactory results for the atherosclerosis studies (Wissler, 1968; Tan *et al.*,1987; Ming-Peng *et al.*, 1987).

This research was conducted to study the effect of palm oil as high energy source on the performance of pullets, laying hens and broilers and its relation to the synthesis of cholesterol in the serum.

MATERIALS AND METHODS

One hundred twenty pullets, 120 laying hens and 120 broilers were each divided into five treatment groups, three replicates consisted of eight chickens in each replicate. The treatment diets were: Basal diet (Table 1),

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Basal diet + 10% Palm oil, Basal diet +10%Palm oil +0.1% cholesterin, Basal diet + 10% Coconut oil, Basal diet + 10% Coconut oil + 0.1% cholesterin. The experiment were started at the age of four weeks (for broilers), 20 weeks (for pullets), and 40 weeks (for layers) and conducted for a 20 week-period of experiment. The blood was withdrawn at the end of the experiment, taken from the wing's vein, analyzed biochemically for the total lipid content, cholesterol level, LDL and HDL status in the serum, using the spectrophotometric method. Eggs were collected everyday. Sample of eggs from each groups were collected at the end of 7-day egg collection, composited and analyzed for the egg yolk cholesterol content. The experiment were designed using a completely randomized design. The F-test and the New Duncan test were used in order to determine the significant difference among the treatment diets within the experiment.

Table 1 . *Basal diet used in the experiment.*

	Ingdredient	% in the diet
1.	Ricebran	64.5
2.	Yellow Corn	25.0
3.	Fish meal	5.0
4.	Soybean meal	5.0
5.	Premix A	0.5

RESULTS AND DISCUSSION

There were tendencies that palm oil in pullets diet and in layers diet lowered the feed consumption. Other treatment diets gave lower feed consumption than that of the hens fed palm oil diet (Table 2). Palm oil in the diet did not significantly influence the pullets' egg production, while the egg production from hens fed palm oil diet tended to be higher than of hens fed the basal diet (Table 3). The egg weight from pullets as well as from laying hens was not significantly influenced by the addition of palm oil in the diet (Table 4). Consequently, the feed conversion, manifested as kilogram eggs per kilogram feed from pullets as well as from layers, increased as the palm oil was added in the diet (Table 5).

Table 2. The average feed consumption of pullets' and layers fed with different treatment diets.

	Treatment diets	Feed consumption (gram/hen/day) Pullet	Layer
		Mean ± S.E *)	
1.	Basal diet (Control)	113.02 ± 8.97	109.64 ± 5.46
2.	Basal diet + 10% Palm oil	102.28 ± 6.73	101.29 ± 7.10
3.	Basal diet + 10% Coconut oil	101.93 ± 5.74	96.98 ± 4.08
4.	Basal diet + 10% Palm oil + 0.1% Cholesterin	100.01 ± 5.67	97.55 ± 3.94
5.	Basal diet + 10% Coconut oil + 0.1% Cholesterin	98.26 ± 3.03	100.51 ± 6.60

*) The stastistical analysis shows no significant difference among the treatment diets

The addition of palm oil did not significantly influence the serum lipid in pullets and in layers, although it may seem that there was a tendency that the serum lipid slightly decreased as 10% palm oil was added in the pullets diet (Table 6). This might be due to the relatively higher amount of unsaturated fatty acids in palm oil as compared to saturated fatty acids (Eckey, 1985).

Table 3. Egg production of pullets and layers fed with different treatment diets.

	Treatment diets	Egg production (%) Pullet	Layer
		Mean ± S.E *)	
1.	Basal diet (Control)	78.15 ± 9.36	72.76 ± 8.47
2.	Basal diet + 10% Palm oil	77.85 ± 6.45	73.73 ± 3.04
3.	Basal Diet + 10% Coconut oil	74.28 ± 6.44	69.45 ± 6.00
4.	Basal Diet + 10% Palm oil + 0.1% Cholesterin	65.74 ± 9.91	75.35 ± 6.07
5.	Basal Diet + 10% Coconut oil + 0.1% Cholesterin	68.83 ± 12.66	65.81 ± 9.61

*) The statistical analysis shows no significant difference among the treatment diets.

Table 4. The average egg weight of pullets and layers fed with different treatment diets.

	Treatment diets	Egg production (%) Pullet	Layer
		Mean ± S.E *)	
1.	Basal diet (Control)	61.78 ± 2.34	60.61 ± 0.86
2.	Basal diet + 10% Palm oil	59.73 ± 1.77	60.64 ± 0.51
3.	Basal diet + 10% Coconut oil	60.23 ± 1.59	61.78 ± 1.27
4.	Basal diet + 10% Palm oil + 0.1% Cholesterin	60.65 ± 2.57	62.77 ± 069
5.	Basal diet + 10% Coconut oil + 0.1% Cholesterin	63.60 ± 1.33	60.11 ± 0.77

*) The statistical analysis shows no significant difference among the treatment diets.

Table 5. Feed conversion of pullets and layers fed with different treatment diets.

	Treatment diets	Egg production (%) Pullet	Layer
		Mean ± S.E *)	
1.	Basal diet (Control)	0.427 ± 0.05	0.410 ± 0.04
2.	Basal diet + 10% Palm oil	0.455 ± 0.03	0.442 ± 0.03
3.	Basal diet + 10% Coconut oil	0.439 ± 0.04	0.484 ± 0.05
4.	Basal diet + 10% Palm oil + 0.1% Cholesterin	0.399 ± 0.06	0.492 ± 0.05
5.	Basal diet + 10% Coconut oil + 0.1% Cholesterin	0.444 ± 0.08	0.396 ± 0.06

*) The statistical analysis shows no significant difference among the treatment diets.

Table 6 . Total lipid content in pullets' and layers' serum fed with different diets.

	Treatment diets	Egg production (%) Pullet	Layer
		Mean ± S.E *)	
1.	Basal diet (Control)	2087.76 ± 370.00	1570.41 ± 528.67
2.	Basal diet + 10% Palm oil	1832.65 ± 244.17	1915.31 ± 482.41
3.	Basal diet + 10% Coconut oil	1484.70 ± 293.37	1779.59 ± 284.65
4.	Basal diet + 10% Palm oil + 0.1% Cholesterin	1903.06 ± 89.07	2004.34 ± 463.37
5.	Basal diet + 10% Coconut oil + 0.1% Cholesterin	1618.37 ± 37.00	1762..25 ± 186.76

*) The statistical analysis shows no significant difference among the treatment diets.

Table 7. Total cholestreol content in pullets' and layers' serum fed with different treatment diet.

	Total cholesterol (mg/dl)		
	Treatment diets	Pullet	Layer
		Mean ± S.E *)	
1.	Basal diet (Control)	101.68 ± 24.99	82.32 ±3.74
2.	Basal diet + 10% Palm oil	94.25 ± 7.00	93.19 ±1.40
3.	Basal diet + 10% Coconut oil	83.95 ± 0.30	87.10 ± 0.07
4.	Basal diet + 10% Palm oil + 0.1% Cholesterin	128.38 ± 14.05	136.91 ±8.21
5.	Basal diet + 10% Coconut oil + 0.1% Cholesterin	114.73 ± 3.54	111.53 ± 6.13

*) The statistical analysis shows no significant difference among the treatment diets.

Table 8. The average egg yolk cholesterol content of pullets and layers fed with different treatment diets.

	Egg yolk cholesterol (mg/dl)		
	Treatment diets	Layers	Pullets
1.	Basal diet (Control)	547.55	446.10
2.	Basal diet + 10% Palm oil	525.42	494.78
3.	Basal diet + 10% Coconut oil	559.16	494.28
4.	Basal diet + 10% Palm oil + 0.1% Cholesterin	547.96	512.24
5.	Basal diet + 10% Coconut oil + 0.1% Cholesterin	613.19	534.61

*) The statistical analysis shows no significant difference among the treatment diets.

The PUFA influenced the level of serum cholsterol as reflected in the cholesterol level in pullets' serum, although the effect of palm oil to the serum cholesterol was not significant (Table 7).

The average cholesterol content in the layers' egg yolk decreased as 10% of palm oil was added in the diet. As for the cholesterol in the pullets' egg yolk did not seem to be influenced by the palm oil in the diet (Table 8). This might be due to the fact that the pullets at the age of 20 weeks were considered as layer beginners, therefore their egg productions were relatively less than that of the layers and, as a result, relatively more cholesterol was secreted in the pullets' egg yolk.

The LDL and the HDL were not influenced by the addition of palm oil in the diet, nevertheless there was a tendency that the HDL level in pullets' serum increased somewhat as palm oil was added in the diet (Table 9 and Table 10). This result reflected the lowering level of the serum cholesterol in the pullets as it was discussed previously.

The result from the broilers' experiment showed that the LDL content in the serum decreased, followed by the decreasing level of the serum cholesterol as well as fat cholesterol content for the group given palm oil in the diet. It was not clear as to how the HDL level in the serum seemed to decrease, although the difference between the palm oil group and the control group was not significant (Table 11).

It was well understood that an attempt to demonstrate the effect of a therosclerotic diet, in this case the addition of 0.1% crystalline cholesterol in palm oil diet and in coconut diet, could not prove any symptoms of developing

Table 9. The average LDL in pullets' and layers' serum fed with different treatment diets.

	Treatment diets	Pullet	Layer
		Serum LDL (mg/dl) Mean ± S.E *)	
1.	Basal diet (Control)	50.52 ± 24.99	31.41 ± 12.64
2.	Basal diet + 10% Palm oil	54.01 ± 12.88	44.89 ± 1.88
3.	Basal diet + 10% Coconut oil	44.39 ± 10.20	49.53 ± 17.62
4.	Basal diet + 10% Palm oil + 0.1% Cholesterin	82.42 ± 12.72	65.59 ± 20.52
5.	Basal diet + 10% Coconut oil + 0.1% Cholesterin	67.41 ± 17.46	48.69 ± 16.82

*) The statistical analysis shows no significant difference among the treatment diets.

Table 10. The average of HDL in pullets' and layers' serum fed with different treatment diets.

	Treatment diets	Pullet	Layer
		Serum LDL (mg/dl) Mean ± S.E *)	
1.	Basal diet (Control)	12.28 ± 1.54	19.25 ± 5.00
2.	Basal diet + 10% Palm oil	12.70 ± 1.54	18.62 ± 3.72
3.	Basal diet + 10% Coconut oil	10.94 ± 1.74	14.72 ± 2.90
4.	Basal diet + 10% Palm oil + 0.1% Cholesterin	13.39 ± 1.62	19.81 ± 2.90
5.	Basal diet + 10% Coconut oil + 0.1% Cholesterin	10.88 ± 1.54	20.23 ± 3.67

*) The statistical analysis shows no significant difference among the treatment diets.

Table 11. The serum levels of LDL, HDL, and cholesterol as well as broilers fed different treatment diets.

	Treatment diets	Serum LDL (mg/dl)	Serum HDL (mg/dl)	Serum Cholesterol (mg/dl)	Fat Cholesterol (mg/dl)
1.	Basal diet (Control)	28.83	73.93	114.73	173.66
2.	Basal diet + 10% Palm oil	21.78	63.61	107.48	133.44
3.	Basal diet + 10% Coconut oil	24.71	44.50	90.42	125.88
4.	Basal diet + 10% Palm oil + 0.1% Cholesterin	73.09	92.43	196.19	169.99
5.	Basal diet + 10% Coconut oil + 0.1% Cholesterin	50.92	44.50	162.07	160.73

atherosclerosis in poultry. Nevertheless, in this limited period of experiment using pullets, laying hens and broilers as the experimental animals, had proved that the inclusion of palm oil in poultry ration tend to decrease the egg yolk cholesterol in the pullets, increased the HDL level in the pullets' blood serum, decreased the serum lipid in the pullets, somewhat increased the feed efficiency.

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