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Effects of Dietary Fats and Oils On the Growth and Serum Cholesterol Content of Rats and Chicks

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攝取 脂肪의 種類가 흰쥐와 병아리의 成長 및 血淸 Cholesterol 含量에 미치는 影響

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=국문초록=

몇가지 植物性油脂와 動物性油脂의 營養價를 比較評價하기 위하여 7종의 動, 植物油 10%를 90% 基礎飼料에 혼합한 試驗食餌를 쥐 32마리, 병아리 32마리에 4주간 攝取시켜 成長率, 食餌攝取量 및 食餌效率, 營養素利用率, 窒素蓄積率, 血淸콜레스테롤 含量, 肝脂肪含量, 각 지방의 脂肪酸 造成을 調査硏究해본 結果 아래와 같이 結論을 얻었다.

1. 成長率은 각 처리구간에 統計的인 留意差는 認定되지 않았으나 쥐 實驗에서는 콩기름군, 채종유군, 옥수수기름군, 동물성지방군의 增滯量이 다른 시험군보다 좋았고 옥수수군과 동물성지방군이 병아리 實驗에서는 더 좋았다. 한편 지방 10%를 첨가한 군의 成長率이 대조군보다 일반적으로 우수하였으나 병아리의 경우에 있어서 魚油군의 增滯率은 좋지 않았다.

2. 食餌攝取量에 있어서는 쥐나 병아리에 있어서 共히 옥수수 기름군이 가장 많았으며 魚油군의 攝取量이 두 實驗動物 다 가장낮았다. 이결과로 미루어 보면 魚油에는 식이의 嗜好性을 低下시키는 因子가 들어 있든지 어떤 有毒性分이 含有되어 있을지 모른다.

食餌效率面에서는 쥐 실험에서는 콩기름군, 병아리에 있어서는 옥수수 기름군이 가장 좋았으며 두 실험동물 다같이 대조군의 食餌效率이 가장 낮았으나 統計的인 留意性은 認定되지 않았다.

3. 營養素 利用率中 지방이용율은 대체로 일반식이 내의 肪脂肪보다는 脂肪質 添加食餌內의 肪脂肪이 吸收率이나 利用率이 더 우수함을 보여주었고, 筋素蓄積率은 쥐에 있어서는 魚油군이 73.5%, 병아리에 있어서는 채종유군이 52.1%로 가장 높았으며 또한 쥐에서는 참기름군이 66.0%, 병아리에서는 대조구가 33.4로 가장 낮았으나 각 구별 統計的인 차이는 없었다.

4. 쥐 實驗에서만 실시된 肝脂肪 含量測定은 채종유군의 그것이 다른 군보다 높았으며 옥수수기름, 콩기름, 참기름, 들기름, 동물유, 어유의 순서였으나 統計的인 留意性은 認定되지 않았고 一般的으로 식물성 유지급여군의 肝脂肪含量이 다른 군보다 높았다.

5. 血淸콜레스테롤 含量은 쥐에 있어서는 채종유군이 가장 높았으며 참기름군이 比較的 높은 數値를 나타냈고, 병아리실험에서는 동물유군이 어유, 콩기름, 참기름, 들기름, 옥수수기름, 채종유, 대

조군보다 높았으나 統計的인 留意差는 없었다.

6. 脂肪酸造成은 동물성유지는 대체로 palmitic acid, myristic acid 함량이 많았으며 식물성유는 Linoleic acid와 oleic acid가 많았고 옥수수기름이 필수지방산인 Linoleic acid 함량이 54.7%로 가장 많았으며 특히 들기름이 2중 결합 3개인 Linolenic acid가 58.4%로 다른 식물성기름보다 월등히 높았다.

한편 식물성 기름에는 Arachidonic acid가 소량있으나 動物油나 魚油에서는 分析되지 못했다.

1. INTRODUCTION

It was recognized that there is a close relationship between an abnormal lipid metabolism and various diseases, especially atherosclerosis.

As the amount of dietary fat consumption of human has been increased, a considerable amount of research has been conducted to prevent the diseases caused by overconsumption of dietary fats.

Suzuki et al. (1966) reported that growth rate of the albino rats fed 20% fat diet with soybean oil was the best, next with butter, and lesser with whale oil. Group received soybean oil had lower serum cholesterol content in comparison with the group fed butter. Yu (1968) experimented the effects of source and level of dietary fat on growth and metabolism of rats fed low protein diet. His data indicated that the group fed 5% fats grew best among various level of fat supplement, the growth order of which were in sequence of perilla oil group, tallow group, sesame oil group, soybean oil group and lard group. Groups fed sesame oil, lard and tallow showed higher serum cholesterol content than groups fed soybean oil and perilla oil.

Ahrens et al. (1954) and Beveridge et al. (1956) indicated that an abnormal lipid metabolism may be induced by a large intake of saturated fat, whereas no such effects occured when unsaturated fat was consumed as far as human subject was concerned. Price et al. (1957) also observed similar results with chicken.

Cruickshank (1934) observed that eggs from chicken fed animal fat diet gave significantly higher iodine number than those from chicken supplied with corn. oil. He also found that group of corn oil consumed less amount of feed than groups of animal fat, which showed that corn oil had higher caloric value compared with animal fat. Body composition of animal could mainly be affected by lipid in the diet, although adipose tissue was synthesized from nonlipid diet.

With the importance of essential fatty acids, these acids must be supplied by dietary lipid. Therefore fatty acid composition of dietary fat has to be given more attention.

Plasma cholesterol also appears to be important in the pathogenesis of atherosclerotic vascular disease. Because of these conditions, nutritive value of fats and oils must be experimentally examined. On the other hand, dietary fats and oils must be revalued in connection with the amount of intake of energy, amino acids, minerals and vitamins.

The study presented here was carried out to investigate the effects of feeding different dietary fats and oils on the growth response, nutrient utilizability, nitrogen retention, liver fat content, and serum cholesterol content of broiler chicks of Shaver strain and albino rats of Sparque-Dawley strain. An attempt was also made to compare the fatty acid composition of various fats and oils.

Ⅱ. METHOD AND MATERIALS

1. Periods of Experimentation

This experiment was started on December 26, 1974 and terminated on March 20, 1975. A total of 12 weeks of experimental period consisted of feeding trials (4 weeks), metabolism trials (1 week) and chemical analyses (7 weeks).

2. Experimental Design

A total of 32 broiler chicks of Shaver strain aged 18 days and the same number of albino rats aged 30~40 days of Sparque-Dawley strain was used in this experiment. Duplicate group of 2 chicks or rats were assigned to each of the 8 treatments arranged by 2×4 factorial design as is seen in Table 1.

Table 1. Experimental design

Item / Treatment	No. of replicate	No. of rat or chick per replicate	Total
Control	2	2	4
Rapeseed oil	2	2	4
Corn oil	2	2	4
Soybean oil	2	2	4
Sesame oil	2	2	4
Perilla oil	2	2	4
Animal fat	2	2	4
Fish oil	2	2	4

3. Experimental Diets

Animal in experimental groups were fed a basal diet supplemented with fats or oils at a level of 10%. Animal fat (tallow 90%+lard

Table 2. Formula and chemical composition of experimental diets

Item / Treatment	Control	Rapeseed oil	Corn oil	Soybean oil	Sesame oil	Perilla oil	Animal fat	Fish oil
	%	%	%	%	%	%	%	%
Ingredients:								
Corn, yellow	64.3	57.9	57.9	57.9	57.9	57.9	57.9	57.9
Fish meal	12.0	10.8	10.8	10.8	10.8	10.8	10.8	10.8
Feather meal	2.5	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Soybean meal	18.5	16.6	16.6	16.6	16.6	16.6	16.6	16.6
Oyster shell	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Bone meal	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Vitamin-mineral mix*	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Fats or oils	0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Chemical composition:								
Moisture	12.80	11.81	11.59	11.50	11.79	11.01	12.08	11.81
Crude protein	23.08	21.43	21.43	21.49	21.02	21.44	21.24	21.07
Crude fat	4.04	13.24	13.24	13.91	13.68	14.03	13.10	13.18
Crude fiber	3.34	2.98	2.91	3.08	3.19	3.28	2.97	2.85
Crude ash	7.61	6.32	6.72	6.39	6.44	6.33	6.11	6.08
NFE**	49.13	44.22	44.11	43.63	43.88	43.91	44.50	45.01

* Mixture of coccidiostat, arsenical compound, and vitamin and mineral complex equivalent to 1.5 times of minimum requirement that described in NRC Nutrient Requirement for Poutry.

** Nitrogen free extract.

10%) imported from USA and fish oil (Mackeral) produced by Korea Deepsea Fisheries were provided by Korea-Cargill Feed Manufacturing Co. Rapeseed oil and soybean oil were obtained from Dong Bang Oil Refinery Co. and Corn oil was processed by Chun Ill Feed Manufacturing Co.

Perilla oil and seasame oil were obtained from the seeds that were purchased at the local market in Seoul.

Formula and chemical composition of experimental diets are shown in Table 2.

Diet and water were supplied on the basis of ad libitum. Weight and diet intake of chicks and rats by replicate were measured once a day at 10 o'clock in the morning.

4. Chemical Analyses

(1) Proximate Analysis

The methods used for the proximate analysis of feeds, excreta, and liver fat samples were followed by the methods described in A.O.A.C. (1975). Nitrogen was analyzed by the method of Kjeldahl.

(2) Determination of Serum Cholesterol

Determination of serum cholesterol was conducted by the method of Zak et al. (1954).

(3) Fatty Acid Analysis

Fatty acid composition of various fats and oils were determined by Varian Gaschormatography fatty acid analyzer of the Korea Institute of Science and Technology (KIST).

Ⅲ. RESULTS AND DISCUSSION

1. Growing Performence

All groups received fat or oils gained more body weight than control group except the chicks fed fish oil and rapeseed oil although no statistical significance was found among treatments as shown in Table3 (rats) and 4 (chicks).

It was found that the total body weight gain achived by the rats received soybean

Table 3. Performance of albino rats fed experimental diets during 4 weeks

Item \ Treatment	Control	Rapeseed oil	Corn oil	Soybean oil	Sesame oil	Perilla oil	Animal fat	Fish oil
Initial Body Weight (g)	135.0	135.5	126.8	136.0	133.5	126.0	124.0	128.5
Final Body Weight (g)	208.0	234.0	223.3	240.8	227.0	209.5	221.5	220.0
Body Weight Gain (g)	73.0	98.8	96.5	104.8	93.5	83.5	97.5	91.5
Feed Intake (g)	522.8	502.0	538.5	504.5	516.5	455.0	499.5	494.0
Feed Efficiency	7.16	5.08	5.58	4.81	5.52	5.45	5.12	5.40

Table 4. Per ormance of broiler chicks fed experimefntal diets during 4 weeks

Item \ Treatment	Control	Rapeseed oil	Corn oil	Soybean oil	Sesame oil	Perilla oil	Animal fat	Fish oil
Initial Body (Weight (g)	198.8	215.5	202.5	221.3	205.0	213.8	210.0	203.8
Final Body Weight (g)	1045.0	1051.3	1383.8	1135.0	1141.3	1197.5	1230.0	835.0
Body Weight Gain (g)	846.2	835.8	1181.3	913.7	936.3	983.7	1020.0	631.2
Feed Intake (g)	2018.8	1932.0	2481.0	2052.5	2108.5	2135.3	2176.8	1555.5
Feed Efficiency	2.39	2.31	2.10	2.25	2.25	2.17	2.13	2.46

oil, rapeseed oil, animal fat or corn oil was considerably greater than that obtained by the rats fed perilla oil, sesame oil or fish oil.

Present observation were supported by Yu (1968) and Suzuki et al. (1966) who also found similar results with rats. In the body weight gain of chickens, corn oil and animal fat received group gained more than other vegetable oils fed groups. It is noted that this finding confirms observation made by Seel et al. (1961) and Jacobson (1974).

Feed intake data indicated that corn oil group of both rats and chicks consumed considerably more feed than other groups. Whereas fish oil group consumed the least amount of feed among the experimental animals. This would mean that fish oil might contain a certain toxic component which would exert adverse effect on body weight gain and feed intake of animals or fish oil might have oxidation problem.

Feed efficiency of soybean oil group of rats and corn oil group of chicks was significantly better than other experimental group. However, feed efficiency of control group in rat experiment was the worst among other treatments indicating that addition of fat or oils in the diet always improve the feed efficiency of diet. It is noted that feed efficiency of fish oil fed chicks was the worst among treatments as is shown in Table 4.

2. Nutrient Utilizability and Nitrogen Retention

Nutrient utilizability and nitrogen retention are summarized in Table 5 (rats) and 6 (chicks).

The data on the utilizability of nutrients showed that utilizability of crude fat in the diet contained 10% of fat or oils was better than that in control diet. Present data on fat utilizability revealed that the utilizability of fat in vegetable oils was superior to that in animal fat. This is in good agreement with observation made by Afifi (1972). He showed that the melting points of the fats seemed to have no influence on their digestibilities with the exception of beef fat, however, the digest-

Table 5. Nutrient utilizability and nitrogen retention of rats (%)

Item \ Treatment	Control	Rapeseed oil	Corn oil	Soybean oil	Sesame oil	Perilla oil	Animal fat	Fish oil
Dry matter	91.6	91.1	92.9	91.5	91.8	88.0	90.0	92.1
Crude fat	93.3	94.5	97.6	97.7	97.3	97.0	94.8	96.5
Crude fiber	80.9	75.1	78.8	76.0	77.8	64.9	68.1	76.8
NFE	95.8	95.6	95.8	95.0	95.4	92.7	93.7	95.4
Nitrogen retention	71.7	68.9	73.1	68.2	66.0	68.0	69.8	73.5

Table 6. Nutrient utilizability and nitrogen retention of chicks (%)

Item \ Treatment	Control	Rapeseed oil	Corn oil	Soybean oil	Sesame	Perilla oil	Animal fat	Fish oil
Dry matter	65.8	71.7	72.3	73.5	71.5	70.9	71.0	64.5
Crude fat	83.8	85.1	93.1	86.1	92.7	93.5	82.3	86.7
Total carbohydrate	84.4	82.9	83.3	85.6	81.3	80.6	81.4	78.2
Nitrogen retention	33.4	52.1	49.5	51.4	49.6	49.0	51.8	37.2

Table 7. Fat content in rat liver (%)

Treatment	Control	Rapeseed oil	Corn oil	Soybean oil	Sesame oil	Perilla oil	Animal fat	Fish oil
Fat Content	8.05	13.45	11.41	10.95	10.45	9.74	9.53	9.00

Table 8. Serum cholesterol level (mg/dl)

Treatment / Animal	Control	Rapeseed oil	Corn oil	Soybean oil	Sesame oil	Perilla oil	Animal fat	Fish oil
Rat	101.5	127.5	79.5	91.3	105.8	82.5	80.8	93.3
Chicken	150.3	194.5	196.8	201.3	197.3	197.3	197.8	204.8

ibility of the fats improved as the iodine value increased. It was found that there was no significant difference in nitrogen retention of experimental diet, although nitrogen retention of control and fish oil diet fed chicks was slightly lower than others.

3. Liver Fat Content

Liver fat content of rats received different oils and fat are presented in Table 7.

As is seen in Table 7, liver fat content of rapeseed oil group was much higher than that of control group and other groups. It was also noticed that feeding more of polyunsaturated fatty acids resulted in higher content of liver fat.

Alifin-slater et al. (1965) reported that animals given laurate supplements highest hepatic total lipid accumulation. Present data did not support the data obtained by Mason et al. (1972) who observed depressions of hepatic fatty acid synthetase by feeding polyunsaturated fatty acids to mice or rat.

4. Cholesterol Content of Serum

Cholesterol content of serum affected by the feeding fat and oils are recorded in Table 8.

Present data revealed that serum cholesterol content of rapeseed oil group (127.5 mg/dl) of rat was higher than that of sesame oil group (105.74 mg/dl) and that of control group was higher than that of corn oil group, soybean group, perilla group, animal fat group and fish oil group. In chicken experiment the serum cholesterol content of animal fat group (227.0 mg/dl) was higher than other experimental groups, In general, chicks received fat or vegetable oils showed higher serum cholesterol level than unsupplemented control group. It is interesting to note that serum cholesterol content of chicken was higher than that of rats regardless of the kind of oils received. This would mean that there would be a species difference in the serum cholesterol content, even if they are fed the same kind and level of fats or oils.

Han et al. (1969) reported that no significant difference in the liver fat of chickens was discovered among the treatment but it was observed that liver fat was decreased as the serum cholesterol content increased. This finding was not confirmed by the present data with rats.

On the contrary, there was a correlation between serum cholesterol of chicks and unsaturated fatty acid supplementation, and it was observed that vegetable oil that contains more unsaturated ftty acids tended to lower the serum cholesterol.

Table 9. Fatty acid composition of various fat and oils

Fat or oils	Lauric acid C_{12}	Myristic acid C_{14}	Palmitic acid C_{16}	Palmitoleic acid $_{16:1}$	Stearic acid C_{18}	Oleic acid $C_{18:1}$	Linoleic acid $C_{18:2}$	Linolenic acid $C_{18:3}$	Arachidonic acid $C_{20:4}$
Rapeseed oil	—	—	2.7	0.3	1.1	15.7	14.1	8.3	0.9
Corn oil	—	—	11.8	0.1	2.1	30.2	54.7	0.9	0.3
Soybean oil	—	—	10.0	0.1	9.5	23.7	54.3	8.5	0.1
Sesame oil	—	—	7.4	0.1	4.6	40.1	47.5	0.5	0.1
Perilla oil	—	—	5.9	0.1	2.1	18.1	15.4	58.4	0.1
Animal fat	0.5	3.4	24.3	3.7	15.5	43.1	9.1	0.4	—
Fish oil	0.1	7.8	12.2	9.4	1.9	16.7	0.8	0.4	—

5. Fatty Acid Composition

Fatty acid composition of rapeseed oil, corn oil, soybean oil, sesame oil, animal oil, animal fat and fish oil is presented in Table 9.

Analytical data showed that the vegetable oils composed mainly of oleic and linoleic acid. However, it should be noted that the perilla oil contained a very large amount of linolenic acid (58.4%) comparing with that in other vegetable oils. This data could be supported by Mo (1975) who presented the similar results. It should also be mentioned that animal fat contained more stearic acid and palmitic acid, and fish oil contained more palmitic acid, palmitoleic acid and myristic acid than other oils.

Since linolenic acid has an equal importance to linoleic acid in growth promotion of young animal, perilla oil that contain a large amount of linolenic acid might also be a good source of polyunsaturated fatty acids as is described as follows.

Devel et al. (1955) pointed out that the position of linolenic acid is less certain. It does promote growth but is inefficent in curing the skin lessions of the deficiency when fed alone, when fed in combination with linoleic acid, it is fully as effective as linoleic acid.

Tables 9 showed that a little arachidonic acid was detected in vegetable oil whereas none was found in animal fat and fish oil.

On the contrary, Haines et al. (1962) and Hulanicka et al. (1964) presented that arachidonic acid found predominantly in animal tissue is about three times as active as linoleic acid (Deuel et al., 1951; Turpeinen, 1938) and is readily synthesized, in vivo, from linoleic acid.

Ⅳ. SUMMARY

A series of experiment was carried out to study the effect of commonly used dietary fat or oils on the growth, feed efficiency, nutrient utilizability, nitrogen retention and serum cholesterol of rats and chicks fed various fat or oils at the level of 10% during 12 weeks of experimentation.

Fat and oils used in this experiment were also analyzed for the composition of some fatty acids.

The main observations made are as follows:

1. All groups received fat or oils gained more body weight than unsupplemented control group except chicks fed fish oil and rapeseed oil although no statistical significance was found between treatments. It was found that body weight gain achi-

eved by the rats fed soybean oil, rapeseed oil, animal fat or corn oil was much greater than other group and that achieved by the chicks fed corn oil and animal fat was greater than other vegetable oil groups, although no statistical significance was found among treatments.

2. Feed intake data indicated that corn oil group of both rats and chicks consumed considerably more feed than other groups. Whereas feed intake of fish oil groups was the lowest among the experimental animals indicating that fish oil might contain unfavorable compound that depresses the palatability. In feed efficiency, soybean oil group of rats and corn oil group of chicks were significantly better than other expe rimental groups. In general, addition of fat or oils in the diet improved feed effeciency of diet.
3. Nutrient utilizability and nitrogen retention data showed that fat in the experimental diet containing 10% fat or oils was absorbed better than crude fat in control diet. It was also found that there was no significant difference in nitrogen retention among treatment.
4. Liver fat content of rapeseed oil group was much higher than that of control group and other group. It was also noticed that feeding more polyunsaturated fatty acids resulted in higher content of liver fat.
5. Present data indicated that serum cholesterol content of rapeseed oil and sesame oil group of rat was the higher than that of control group. Serum cholesterol content of animal fat group of chicks was higher than other group. It was interesting to note that serum cholesterol content of chicken was higher than that of rats regardless of the kind of oils received.
6. Analytical data revealed that fatty acid composition of vegetable oil was composed mainly of oleic acid and linoleic acid, whereas animal fat and fish oil were composed of saturated fatty acid such as myristic and palmitic acid.

It should be mentionted that the perilla oil contained a very large amount of linolenic acid (58.4%) comparing with that in order vegetable oils.

Little arachidonic acid was detected in vegetable oil, whereas none in animal fat and fish oil.

V. Literature Cited

Afifi, M.A.: *1972. Comparative studies on the digestibility of beef, buffalo, camel and mutton fats for chicks. Br. J. Nutr., 27:97.*

Ahrens, E.H., D.H. Blankenhorn and T.T. Tsaltas: *1954, Effect on human serum lipids of substituting plant for animal fat in diet. Proc. Soc. Exp. Bio. Med., 86:872.*

Alfic-Slater, R.B., R.S., Morris, H. Hansen and J.F. Proctor: *1965. Effect af non essential fatty acid on essential fatty acid deficiency. J. Nutr., 87:168.*

A.O.A.C.: *1975. Official Methods of Analysis Association of Official Analytical Chemists (12th Ed.) A.O.A.C., Washington, D.C.*

Beveridge, J.M.R., W.F. Connell and G.A. Mayer: *1956. Dietary factors effecting the level of plasma cholesterol in humans: The role of fat. J. Biochem. Physiol., 34:441.*

Cruickshank, E.M.: *1934. Studies in fat mebabolism in the fowl. Biochem. J., 28:965.*

Devel, H.J., Jr. C.R. Martin and R.B. Alfin-Slater: *1955. The effect of fat level of the diet on general nutrition XVI. A comparison of linoleate and linolenate in satisfying the essential fatty acid requirement for pregnancy and lactation. J. Nutr., 57:297.*

Deul, H.J., Jr. S.M. Greenbert, L.L. Anisfeld and D. Melnick: *1951. The effect of fat level of the diet on general nutrition. VIII. The essential fatty acid content of margarine, shortening, butters, and cottonseed oil as determined by a new biological assay method. J. Nutr., 45:535.*

Han, I.K., S.M. Mo and K.I. Kim: *1969. Effects of suplementing Russian comprey and kale on the growth rate, nutrient untiliability and serum cholesterol of chicks. The Korean J. Nutr., 2(2-3):71.*

Haines, T.H., S. Aronson, J.L. Gellerman and H. Schlenk: *1962. Occurrence of arachidonic and related acids in Protozoan Ochromonas danica. Nature, 194:1282.*

Hulanicka, H.,J. Erwin and K. Block: *1964). Lipid metabolism of Euglena Gracilis. J. Biol. Chem., 239:2778.*

Jacoboson, N.L., M. Richard, P.J. Berger and J.P. Klnge: *1974. Comparative effects of tallow, lard and soybean oil with and without supplemental cholesterol on growth, tissue cholesterol and other response of calves. J. Nutr., 104:573.*

Mason, J.V. and W.E. Donaldson: *1972. Fatty acid synthesizing systems in chick liver: Influences of biotin deficiency and dietary fat. J. Nutr., 102:667.*

Mo, S.M: *1975. Fatty acid composition of varying seed oil of Korean origin. The Korean J. Nutr., 8(2):19.*

Price, J.D., B.L. Ried and J.R. Couch: *1957. The effect of feeding high levels of soybean lecithin and various fats on the feed efficiency and egg production of white leghorn hens. Poultry Sci., 36:1150.*

Sell, J.L. and G.C. Hodgson: *1962. J. Nutr., 76: 113.*

Suzuki, H.,F. Ohta, Y. Kanke and S. Oshima: *1966. Effect of the dietary fat on the grow the rate. The Japaness J. Nutr., 24(1):9.*

Turpeinen, O.: *1938. Further studies on the unsaturated fat acids essential in nutrition. J. Nutr., 15:351.*

Yu, J.Y.: *1968. Effect of souce and level of dietary fat on growth and metabolism or rat blood on low protein diet The Korean. J. Nutr., 1(1):19.*

Zak., B., R.C. Dickmann., E.G. White, H. Burnett and P.J. Cherney: *1954. Rapid estimation of free and total cholesterol American J. Clinic Path., 24:1305.*