REFERENCES

Thai

กรมประมง, กระทรวงเกษตรและสหกรณ์. 2536. การเลี้ยงกุ้งกุลาดำ. กรุงเทพมหานคร : โรงพิมพ์ชุมนุมสหกรณ์การเกษตรแห่งประเทศไทย จำกัด.

กรมเศรษฐกิจการพาณิชย์, กระทรวงพาณิชย์. 2539. การประมาณการปริมาณมูลค่ากุ้งแช่แข็งส่งออกไทย.

ชลอ ลิ้มสุวรรณ. 2534. คัมภีร์การเลี้ยงกุ้งกุลาดำ. กรุงเทพมหานคร : ฐานเศรษฐกิจ.

วินัย ดะห์ลัน. 2533. เลซิทิน : บทบาทใหม่ทางการแพทย์และโภชนาการ. สาส์นยา. 6(5) : 190-196

English

Anonymous. 1988. Shrimp hatcheries. Coastal Aquaculture. 1(1) : 4-6.

Bololanik, J. C. 1989. World supply and outlook for fish meal 1989/1990. 29TH Annual Conference of the International Association of Fish Meal Manufacturers. Nov. 21-24, pp. 23-48. Hong Kong.

Bourre, J. M., Dumont, O. S., Piciotti, M. J., Pascal, G. A. and Durand, G. A., 1992. Dietary α-linolenic acid deficiency in adult rats for 7 months does not alter brain docosahexaenoic acid content, in contrast to liver, heart and testes. Biochem. Biophy. Acta. 1124 : 119-122.

Boyd, C. E. and Tucker, C. S. 1992. Water quality and pond soil analysis for aquaculture. Alabama : Auburn University.

Briggs, M. R. P., Januncey, K. and Brown, J. H., 1988. The cholesterol and lecithin requirements of juvenile prawn (*Macrobrachium rosenbergii*) fed semipuriied diets. Aquaculture. 70: 121-129.

Camara, M. R., 1994. Dietary phosphatidylcholine requirements of *Penaeus japonicus* Bate and *Penaeus vannamei* Boone (crustacea, Decapoda, Penaeidae). PhD Thesis. Univ. of Ghent. Belgium. 173 pp.

Castell, J. D. and Corey, J. F., 1976. Dietary lipid requirements of adult lobsters, *Homarus americanus*. J. Nutr., 106 : 1159-1165.

Chen, H. Y., Jenn, J. S., 1991. Combined effects of dietary phosphatidylcholine and cholesterol on the growth, survival and body lipid composition of marine shrimp, *Penaeus penicillatus*. Aquaculture. 96 : 167-178.

Chen, H. Y., 1993. Requirements of marine shrimp, *Penaeus monodon*, juveniles for phosphatidylchoine and Cholesterol. Aquaculture. 109 : 165-176.

Cheng, J. H. and Liao, I. C. 1986. The effect of salinity on the osmotic and ionic concentration in the haemolymph of *Penaeus penicillatus*. The first Asian Fisheries Forum. Manila, Philippines.

Chu, F. E., Webb, K. L., Hepworth, D. A. and Casey, B. B. 1987. Metamorphosis of larvae of *Crassostrea virginica* fed microencapsulated diets. Aquaculture. 64 : 185-197.

Conklin, D. E., D' Abramo, L. R , Bordner, C. E., Baum, N. A., 1980. A successful purified diet for the culture of juvenile lobsters : the effect of lecithin. Aquaculture. 21 : 243-249.

Coutteau, P., Camara, M. R., Sorgeloos, P., 1996. The effect of different levels and sources of dietary phosphatidylcholine on the growth, survival, stress resistance and fatty acid composition of postlarval, *Penaeus vannamei*. Aquaculture. 147 : 261-273.

D' Abramo, L. R., Bordner, C. E., Conklin, D. E., Baum, N. A., 1981. Essentiality of dietary phosphatidylcholine for the survival of juvenile lobster. *Homarus*. J. Nutr. 111: 425-431.

D' Abramo, L. R., 1989. Lipid requirements of shrimp. In : Advances in Tropical Aquaculture. AGUACOP, IFREMER, pp. 243-259.

Dahlan, W. 1989. Intravenous infusion of triacylglycerol-phospholipid complexs in man: effects on fatty acid pattern of plasma and on erythrocyte membrane lipid composition. Ph. D. dissertation, Universite Libre De Bruxelles.

Dahlan, W. 1995. Utilization of fish meal-derived lecithins as emulsifier for preparing mixed soya oil-fish oil emulsion. Biopolymers and Bioproducts: Structure, Function and Applications, Proceedings of the 11th FAOBMB Symposium, Thailand, Nov. 15-18, 1994 pp. 595-601.

Dahlan, W., Chatnilbandhu, S., na-Nagara, B., and Carpentier, Y. A.1996. Fish meal lecithin as alternative precursor of docosahexaenoate and choline. Biomed. Environ. Sci. 9: 263-268.

Dahlan, W., Chadnilbhandhu, S., Piyatiratitivorakul, S., na-Nagara, B. 1997a. Boosting omega 3 fatty acid content of intact blood cells by brief interactive contact with liposomes of fish meal lecithin. Proceedings of Chulalongkorn University 80th Anniversary Reserach Conference. Bangkok: Chulalongkorn University, pp. 777-784.

Dahlan W., Iriyama, I., Chadnilbhand, S., Chanprasert, S., Carpentier, Y.A. 1997b. Fats emulsions with lecithins derived from fish meal and soya supply respective n-3 and n-6 polyunsaturated fatty acids to blood cells. The Japanese Journal of Surgical Metabolism and Nutrition 31: 122.

Dahlan, W., Chanprasert, S., Chantanakajornfung, A., Chadhamara, K., na-Nagara, B., Carpentier, Y.A. 1997c. Transfers of Polyunsaturated Fatty Acids from Fishmeal Lecithin-Based Fat Emulsion to Platelets vs Red Blood Cells. Abstract of the 3th Congress of PENSA. Bangkok: The Parenteral and Enteral Nutrition Society of Aisa. pp. 36.

Delvin, T. M. 1993. Biological membranes : structure and membrane transport. In : T. M. Delvin (ed), Textbook of Biochemistry with clinical Correlation. 3 rd ed., pp. 195-236. New York : Wiley-Liss, Inc.

FAO (1983a). 1987 Yearbook of Fishery Statistics - Catches and Landings, vol. 52 , Part 1. Food and Agriculture Organization of United Nations, Rome.

Fraser, A. J., Gamble, J. C., Sargent, J. R., 1988. Changes in lipid content, lipid class composition of developing eggs of cod (*Gadus morhua*). Mar. Biol. 99 : 307-313.

Geurden, I., Charlon, N., Marion, D., Bergot, P., 1995a. Dietary phospholipids and body deformities in carp *Cyprinus carpio* L. larvae In : Lavens, P., Jaspers, E., Roelants, I. (Eds), Larvi' 95- Fish and Shellfish Symposium, Gent, Belgium. Europ. Aquacult. Soc., Spec. Pub., 24 : 162-165.

Geurden, I., Radunz- Neto, J., Bergot, P., 1995c. Essentiality of dietary phospholipids for carp (*Cyprinus carpio*) larvae. Aquaculture. 131 : 303-314.

Hamilton, S., and Hamilton, R.J. 1992. Extraction of lipids and derivative formation. In: R.J. Hamilton, and S. Hamilton (eds) Lipid analysis: A Practical Approach, pp. 13-64. New York: IRL Press.

Harada, K., 1987. Relationships between structure and feeding attraction activity of certain L- amino acids and lecithin in aquatic animals. Nippon Suisan Gakkaishi 53, 2243-2247.

Holthuis, L.B. and Rosa, H. Jr. 1965. List of species of shrimps and prawns of economic value : Food and Agriculture Organization of the United Nations, Rome. 21 p.

Jeckel, W. H., de Moreno, J. E. A. and Moreno, V. J., 1989. Biochemical composition, lipid classes and fatty acids in the ovary of the shrimp *Pleoticus muelleri* Bate. Comp. Biochem. Physiol. 92B : 271-276.

Ji, W. J. and Xu, X. L., 1992. Comparative studies on ovarian fatty acid composition analysis during ovarian development of chinese prawn, *Penaeus chinensis*. Mar. Fish. Res. China. 13 : 7-12.

Jone, D. A., Kurmaly, K., and Arshard. 1987. Penaeid shrimp hatchery trials using microencapsulated diets. Aquaculture. 64 : 133-142.

Kanazawa, A., 1982. Penaeid nutrition. In : G. D. Pruder, C. J. Langdon and D. E. Conklin (Edition), Proceedings of the Second International Conference on Aquaculture Nutrition : Biochemical and Physiological Approacches to Shellfish Nutrition, Delaware. Special Publication No.2, World Mariculture Society, pp. 87-105.

Kanazawa, A. 1982. Penaeid nutrition. In : G. D. Pruder, C. J. Langdon and D. E. Conklin (eds), Proceeding of the Second International Conference on Aquaculture Nutrition : Biochemical and Physiological Approaches to Shellfish Nutrition. Louisiana State University Press, Baton Rouge, LA, pp. 87-105.

Kanazawa, A., 1985. Nutrition of penaeid prawns and shrimps. In : Proceeding of the International Conference on Culture of Penaeid Prawns/Shrimps, SEAFDEC Aquaculture : Department, Iloilo. city, Philippines, pp. 123-130.

Kanazawa, A., 1993. Essential phospholipids of fish and crustaceans. In : Kaushik, S. J., Luguet, P. (eds), Fish Nutrition in Practice, Biarrtiz (France), June 24-27. Edn. INRA. Paris 1993, Les Colloques No. 61, 519-530.

Kanazawa, A. 1997. Effect of docosahexaenoic acid and phospholipids on stress tolerance of fish. Aquaculture. 155 : 129-134.

Kanazawa, A., Miyazawa, T., Hirono, H., Hayashi, M. and Fujimoto, K., 1991. Possible essentiality of docosahexaenoic acid in Japanese monkey neonates : Occurrence in colostrum and low biosynthetic capacity in neonate brains. Lipid. 26 : 53-57.

Kanazawa, A., Teshima, S., Endo, M. and Kayama, M., 1978. Effect of eicosapentaenoic acid on growth and fatty acid composition of the prawn *Penaeus japonicus*. Mem. Fac. Fish. Kagoshima Univ. 27: 35-40.

Kanazawa, A., Teshima, S., Inamori, S., Iwashita, T., Nagao, A., 1981. Effects of phospholipids on growth, survival rate and incidence of malformation in the larval ayu. Mem. Fac. Fish., Kagoshima Univ. 30, 301-309.

Kanazawa, A. Tokiwa, S., Kayama, M. 1977. Essential fatty acids in the diet of the prawn- Effects of linileic acid and linolenic acids on growth. Bull. Jpn. Soc. Sci. Fish., 43(9): 1111-1114.

Kanazawa, A. Teshima, S. and Sasaki, M. 1979a. Requirement of prawn, *Penaeus japonicus* for essential fatty acids . Mem. Fac. Fish., Kagoshima University., 33 (1): 63-71.

Kanazawa, A., Teshima, S., Sakamoto, M., 1985. Effect of dietary lipids, fatty acids and phospholipids on growth and survival of prawn (*Penaeus japonicus*) larvae. Aquaculture. 50 : 39-49.

Kanazawa, A., Teshima, S., Tokiwa, S. and Ceccaldi, H. J., 1979a. Effects of dietary linoleic and linolenic acids on growth of prawn. Oceanologica Acta. 2(1) : 41-47.

Kanazawa, A., Teshima, S., Tokiwa, S., Endo, M., Abdel Razek, F.A., 1979. Effects of short-necked clam phospholipids on the growth of prawn. Bull. Jpn. Soc. Sci. Fish. 45 : 961-965.

Kanazawa, A., Teshima, S., Tokiwa, S., Kayama, M. and Hirata, M., 1979c. Essential fatty acid in the diet of prawn II. Effect of docosahexaenoic acid on growth. Bull. Jpn. Soc. Sci. Fish. 45 : 1151-1153.

King. M. F., Boyd, L. C., Sheldon, B. W., 1992. Effects of phospholipid on lipid oxidation of a salmon oil model system. J. Am. Oil. Chem. Soc. 69, 237-242.

Knowlton, R. E., 1974. Larval developmental process and controlling factors in decapod crustacea with emphasis on caridea. Thalassia Jugosl., 10 : 138-148.

Kontara, E. K. M., Coutteau, P., Sorgeloos, P., 1997. Effect of dietary phospholipid on requirement for and incorporation of n-3 highly unsaturated fatty acids in postlarval *Penaeus japonicus* Bate. Aquaculture. 158 : 305-320.

Kontara, E. K. M., Djunaidah, I. S., Coutteau, P., Sorgeloos, P., 1997. Evaluation of nutritional value of native soybean phosphatidylcholine in comparation to hydrogenated and lyso sn-2 phosphatidylcholine for postlarval *Penaeus japonicus* Bate. Arch. Anim. Nutr., in press.

Koven, W. M., Kolkovsski, S., Tandler, A., Kissil, G. W., Sklan, D., 1993. The effect of dietary lecithin and lipase, as a function of age, on n-9 fatty acid incorporation in the tissue lipids of *Sparus aurata* larvae. Fish Physiol. Biochem. 10, 357-364.

Laing, I. 1987. The use of artificial in rearing bivale spat. Aquaculture. 65 : 243-249.

Lavens, P., Sorgeloos, P., Dhert, P., and Devresse, B. 1992. Latest developments in larval food production. Aquaculture and Fisheries Management. (in press).

Lester, R., Cary, M. C., Little, I. M., Cooperstein, L. A. and Dowd, S. R., 1975. Crustacean intestinal detergent promotes sterol solubilization. Science., 189 : 1098-1100.

Lim, C., Ako, H.,Brown, C. L., and Hahn, K., 1997. Growth response and fatty acid composition of juvenile *Penaeus vannamei* fed different sources of dietary lipid. Aquaculture. 151 : 143-153.

McEvoy, L. S., Navarro, J. C., Amat, F., Sargent, J. R., 1995. Optimisation of a phospholipid-enhanced enrichment emulsion for Artemia. In : Larvens, P., Jaspers, E.,Roelants, I. (eds), Larvi' 95- Fish and Shellfish Symposium, Gent, Belgium. Europ. Aquacult. Soc., Spec. Publ., 24, 141-144.

Motoh, H. 1979. Larvae of Decapod Crustacea of the Philippines III. Larval development of the giant tiger prawn, *Penaeus monodon* reared in the laboratory. Bull. Jpn. Soc. Fish. 45 (10) : 1201-1216.

Motoh, H. 1981. Studies on the fisheriess biology of the giant tiger prawn, *Penaeus monodon* in the Philippines. Technical report, No. 7. Tibauan, Iloilo : SEAFDEC Aquaculture Department. 128 p.

Motoh, H. 1984. Biology and ecology of *Penaeus monodon* . Proceeding of the first international conference on the culture of penaeid prawn/shrimp. The Philippines.

Motoh, H. 1985. Biology and ecology of *Penaeus monodon* . Taki, Y., Primavera Ilt, Liobrera IA, eds. Proceeding of the first international conference on the culture of penaeid prawns/shrimp ; 1984 December 4-7; Illoilo City, Philippines. Illoilo : SEAFDEC Aquaculture Department ; 27-36.

Mourente, G. and Tocher, D. R., 1992. Effects of weaning onto a pellected diet on docosahexaenoic acid (22:6 n-3) levels in brain of developing turbot (*Scophthalmus maximus*). Aquaculture. 105 : 363-377.

Neuringer, M., Connor, W. E., Lin, D. S., Barstad, L., and Luck, S., 1986. Biochemical and functional effects of parental and postnatal omega-3 fatty acid deficiency on retina and brain in rhesus monkey. Proc. Natl. Acad. Sci. USA. 83 : 4021-4025.

Othmer, K. 1981. Concise encyclopedia of chemical Technology, 3 rd ed., pp. 250-267. New York : Wiley-liss, Inc.

Paibulkichakul, C. 1996. Optimal level of lecithin and cholesterol in diet for black tiger prawn *Penaeus monodon* larvae. M. S. disssertation Chulalongkorn University. Thailand.

Pardun, H. 1982. Progress in the recovery and processing of plant lecithin. In : J. N. Hawthorne, and D. Lekim (eds), Soya lecithin Dietelic Application : Proceeding of the Second International Collogium on Soya lecithin, April 3, pp. 37-53. England.

Racek, A. A. 1995. Littoral penaeidae from New South Wales and adjacent Queensland waters. Aust. J. Mar. Freshwaat. Res. 6(2) : 209-241. pp 1-9.

Rainuzzo, J. R., Reitan, K. I., Jorgensen, L., 1992. Comparative study on the fatty acids and lipid composition of four marine fish larvae. Comp. Biochem. Physiol. 103 B, 21-26.

Read, G. H. L., 1981. The response of *Penaeus indicus* (crustacea : penocidea) to purified and compound diets to varying fatty acid composition. Aquaculture. 24 : 245-256.

Rees, J. F., Cure, K., Pyiatiratitivorakul, S., Sorgeloos, P., Menasveta, P., 1994. Highly unsaturated fatty acid requirments of *Penaeus monodon* postlarvae : An experimental approach based on Artemia enrichment. Aquaculture. 122 : 193-207.

Schneider, M., 1992. Achieving purer lecithin. Drug and Cosmatic Ingredients. pp. 54-66, 101-103.

Shieh, M. S., 1969. The biosynthesis of phospholipids in the lobster. *Homarus americanus*. Comp. Biochem. Physiol. 30 : 179-184.

Simopoulos, A. P.1991. Omega-3 fatty acids in health and disease and in growth and development. Am. J. Clin. Nutr. 54: 438-463.

Sorgeloos, P. and Leger, P., 1992. Improved larviculture outputs of marine fish, shrimp and prawn. J. World Aquacult. Soc., 23(4) : 251-264.

Tacon, A. G. J., 1987. The nutrition and feeding of farmed fish and shrimp- a training manual 1. The essential nutrients. GCP/RLA/075/ITA. FAO, Rome, 117 pp.

Tacon, A. G. J. 1990. Standard methods for the nutrition and feeding of farmed fish and shrimp. Volume I : the essential nutrients. Washington : Argent Laboratories Press.

Tackaret, W., Camara, M. R., Sorgeloos, P., 1991. The effect of dietary phosphatidylcholine in postlarval penaeid shrimp. I. Diet preparation . In : Lavens, P., Sorgeloos, P., Jasspers, E., Ollivier, F. (eds). Larvi' 91- Fish and crustacean Larviculture Aymposium. Gent. Belgium. Europe. Aquacult. Soc., Spec. Pub., 15, 76-79.

Teshima, S. and Kanazawa, A., 1983. Variation in lipid composition during the ovarian maturation of the prawn. Nippon Suisan Gakkaishi. 49 : 957-962.

Teshima, S., Kanazawa, A., Kakuta, Y., 1986a. Effects of dietary phospholipids on growth and body composition of the juvenile prawn. Bull. Jpn. Soc. Sci. Fish. 52, 155-158.

Teshima, S., Kanazawa, A., KaKuta, Y., 1986b. Effects of dietary phospholipids on lipid transport in the juvenile prawn. Aquaculture. 52 : 159-163.

Teshima, S., Kanazawa, A., Kakuta, Y., 1986c. Growth, Survival and body composition of the prawn larvae receiving several dietary phospholipids. Mem. Fac. Fish., Kagashima Uni. 35, 17-27.

Teshima, S., Kanazawa, A., Kakata, Y., 1986c. Role of dietary phospholipids in the transport of ^{14}C tripalmitin in the prawn. Bull. Jpn. Soc. Sci. Fish. 52, 519-524.

Teshima, S., Kanazawa, A., Sasada, H. and Kawasaki, M., 1982. Requirements of larval prawn *Penaeus japonicus*, for cholesterol and soybean phospholipids. Mem. Fac. Fish. agoshima Univ., 31: 193-199.

Thorsteinson, A. J. and Nayar, J. K., 1963. Plant phosphoipids as feeding stimulants for grasshoppers. Can. J. Zool., 41 : 931-935.

Tocher, D. R., Fraser, A. J., Sargent, J. R., Gamble, J. C., 1985. Lipid class composition during embryonic and early larval development in Atlantic herring (*Clupea harengus*). Lipid. 20 : 84-89.

Tocher, D. R., Mourente, G. and Sargent, J. R., 1992. Metabolism of [1-^{14}C] docosahexaenoate (22:6 n-3), [1-^{14}C] eicosapentanoate (20:5 n-3) and [1-^{14}C] linolenate (18:3 n-3) in brain cells from juvenile turbot *Scophthalmus maximus*. Lipid. 27 : 494-499.

Wetzel, R. G. 1975. Limnology. Philadelphia : W. B. Saunders Co.

Wiseman, J., 1991. The relationship between the chemical characteristics and nutritive value of fats. The Bulletin, National Renderers Association Inc., London, pp. 8-11.

Xu, X. L., Ji, W. J., Castell, J. D., and O' Dor, R. K., 1994. Influence of dietary lipid sources on fecundityy, egg hatchability and fatty acid composition of chinese prawn (*Penaeus chinensis*) broodstock. Aquaculture. 119 : 359-370.

Xu, X. L., Ji, W. J., Castell, J. D., O' Dor, R. K., 1994. Essential fatty acid requirement of the Chinese prawn, *Penaeus chinensis*. Aquaculture. 127:29-40.

APPENDIX I

Table 21 Water quality of the rearing units at differents stages of larvae rearing*

Larvae stage	salinity (ppt)	Temperature (^{0} C)	pH	DO (ppm)	Ammonium (ppm)	Nitrate (ppm)
zoea	25, 30	28-28.5	7.8-8.0	5.1-5.4	0.5-1.0	0-10
mysis	25, 30	27-28	7.7-8.0	5.2-5.4	0.5-1.0	10-25
postlarva	25, 30	26-28	7.7-8.2	5.1-5.4	0.5-1.0	10-25

* All parameters tested at Marine Research Unit. Ammonium and nitrate were assessed by test kits.

Table 22 Water quality for shrimp living

Water quality	Approximate range	Source
Temperature (^{0} C)	25-30	Boyd and Tucker (1992)
	25-30	กรมประมง (2536)
Salinity (ppt)	23-25	Cheng and Laio (1986)
	15-25	กรมประมง (2534)
	15-30	Boyd and Tucker (1992)
pH	7-9	Boyd and Tucker (1992)
	7.5-8.5	ชลอ ลิ้มสุวรรณ (2534)
	7.5-8.5	กรมประมง (2534)
DO (ppm)	≥ 3.5-อิ่มตัว	Boyd and Tucker (1992)
	5-7.5	กรมประมง (2534)
Ammonium (ppm)	0.4-2.0	Boyd and Tucker (1992)
	0.4-2.0	กรมประมง (2534)
Nitrate (ppm)	non toxic	Wetzel (1975)

APPENDIX II

STATISTICAL ANALYSIS

Raw data of length of post larva 15

OBS	TREAT	REP	SALINITY	LENGTH
1	1	1	25	12.0
2	1	1	25	11.8
3	1	1	25	9.9
4	1	1	25	13.6
5	1	1	25	11.4
6	1	1	25	12.1
7	1	1	25	10.8
8	1	1	25	11.5
9	1	1	25	11.0
10	1	1	25	11.4
11	1	1	25	10.9
12	1	1	25	12.3
13	1	1	25	11.4
14	1	1	25	10.3
15	1	1	25	11.2
16	1	1	25	11.8
17	1	1	25	11.1
18	1	1	25	10.2
19	1	1	25	12.2
20	1	1	25	8.5
21	1	2	25	12.1
22	1	2	25	12.2
23	1	2	25	10.1
24	1	2	25	9.6
25	1	2	25	11.6
26	1	2	25	8.5
27	1	2	25	11.7
28	1	2	25	12.1
29	1	2	25	12.8
30	1	2	25	11.7
31	1	2	25	10.2
32	1	2	25	10.2
33	1	2	25	12.2
34	1	2	25	14.6
35	1	2	25	11.5
36	1	2	25	10.2
37	1	2	25	12.9
38	1	3	25	12.4
39	1	3	25	10.7
40	1	3	25	11.7
41	1	3	25	10.3
42	1	3	25	12.7
43	1	3	25	10.4
44	1	3	25	11.7
45	1	3	25	12.0
46	1	3	25	8.4
47	1	3	25	14.1
48	1	3	25	12.1
49	1	3	25	12.2
50	1	3	25	11.4
51	1	3	25	10.5
52	1	3	25	10.0

53	1	3	25	11.6
54	1	3	25	10.8
55	1	3	25	12.3
56	1	3	25	11.5
57	1	3	25	14.5
58	1	1	30	10.1
59	1	1	30	11.6
60	1	1	30	12.9
61	1	1	30	12.5
62	1	1	30	9.7
63	1	1	30	12.0
64	1	1	30	12.7
65	1	1	30	11.3
66	1	1	30	10.2
67	1	1	30	11.1
68	1	1	30	11.5
69	1	1	30	11.9
70	1	1	30	11.2
71	1	1	30	11.6
72	1	1	30	11.1
73	1	1	30	11.9
74	1	1	30	10.9
75	1	1	30	12.5
76	1	1	30	10.6
77	1	1	30	11.6
78	1	2	30	11.6
79	1	2	30	10.4
80	1	2	30	10.8
81	1	2	30	12.1
82	1	2	30	11.2
83	1	2	30	10.7
84	1	2	30	11.1
85	1	2	30	10.5
86	1	2	30	11.7
87	1	2	30	10.5
88	1	2	30	10.7
89	1	2	30	11.2
90	1	2	30	12.6
91	1	2	30	9.5
92	1	2	30	10.2
93	1	2	30	12.1
94	1	2	30	11.3
95	1	2	30	10.7
96	1	2	30	11.5
97	1	2	30	10.7
98	1	3	30	12.1
99	1	3	30	9.6
100	1	3	30	9.8
101	1	3	30	9.3
102	1	3	30	9.9
103	1	3	30	10.4
104	1	3	30	11.4
105	1	3	30	9.9
106	1	3	30	11.1
107	1	3	30	11.0
108	1	3	30	8.8
109	1	3	30	8.9
110	1	3	30	10.8
111	1	3	30	12.0
112	1	3	30	11.5
113	1	3	30	11.1
114	1	3	30	9.0
115	1	3	30	11.6
116	1	3	30	12.7
117	1	3	30	11.6
118	2	1	25	10.5
119	2	1	25	10.9
120	2	1	25	11.0
121	2	1	25	11.2
122	2	1	25	9.7
123	2	1	25	10.1
124	2	1	25	11.6
125	2	1	25	8.9
126	2	1	25	9.8
127	2	1	25	10.3
128	2	1	25	10.8

129	2	1	25	11.3
130	2	1	25	11.2
131	2	1	25	11.5
132	2	1	25	9.6
133	2	1	25	10.6
134	2	1	25	11.5
135	2	1	25	12.3
136	2	2	25	10.9
137	2	2	25	10.8
138	2	2	25	12.1
139	2	2	25	12.1
140	2	2	25	11.5
141	2	2	25	12.5
142	2	2	25	11.7
143	2	2	25	11.2
144	2	2	25	12.4
145	2	2	25	10.9
146	2	2	25	11.9
147	2	2	25	11.9
148	2	2	25	13.2
149	2	2	25	10.9
150	2	3	25	0.0
151	2	1	30	11.1
152	2	1	30	10.4
153	2	1	30	10.1
154	2	1	30	9.9
155	2	1	30	11.5
156	2	1	30	9.7
157	2	1	30	9.1
158	2	1	30	11.2
159	2	1	30	8.6
160	2	1	30	11.3
161	2	1	30	11.6
162	2	1	30	11.4
163	2	1	30	12.2
164	2	1	30	10.2
165	2	1	30	11.2
166	2	1	30	12.3
167	2	1	30	11.5
168	2	1	30	10.2
169	2	1	30	10.7
170	2	1	30	11.9
171	2	2	30	10.7
172	2	2	30	10.4
173	2	2	30	12.7
174	2	2	30	10.5
175	2	2	30	10.5
176	2	2	30	10.8
177	2	2	30	11.5
178	2	2	30	11.3
179	2	2	30	11.4
180	2	2	30	10.7
181	2	2	30	10.6
182	2	2	30	12.9
183	2	2	30	10.4
184	2	2	30	10.2
185	2	2	30	10.6
186	2	2	30	11.3
187	2	2	30	11.0
188	2	2	30	9.6
189	2	2	30	11.1
190	2	2	30	11.2
191	2	3	30	10.1
192	2	3	30	10.9
193	2	3	30	10.9
194	2	3	30	11.2
195	2	3	30	10.6
196	2	3	30	10.4
197	2	3	30	10.9
198	2	3	30	11.3
199	2	3	30	9.3
200	2	3	30	11.2
201	2	3	30	11.6
202	2	3	30	11.2
203	2	3	30	10.5
204	2	3	30	10.8

205	2	3	30	11.4
206	2	3	30	11.2
207	2	3	30	11.7
208	2	3	30	9.7
209	2	3	30	9.8
210	2	3	30	11.5
211	3	1	25	11.1
212	3	1	25	11.7
213	3	1	25	8.9
214	3	1	25	11.2
215	3	1	25	12.4
216	3	1	25	11.3
217	3	1	25	12.0
218	3	1	25	10.3
219	3	1	25	10.7
220	3	1	25	10.4
221	3	1	25	10.3
222	3	1	25	11.0
223	3	1	25	11.2
224	3	1	25	12.7
225	3	1	25	11.8
226	3	1	25	10.9
227	3	2	25	10.9
228	3	2	25	11.6
229	3	2	25	11.6
230	3	2	25	9.9
231	3	2	25	12.4
232	3	2	25	11.2
233	3	2	25	11.5
234	3	2	25	10.2
235	3	2	25	11.3
236	3	2	25	9.8
237	3	2	25	12.0
238	3	2	25	11.1
239	3	2	25	10.8
240	3	2	25	11.2
241	3	2	25	10.2
242	3	2	25	10.1
243	3	2	25	9.7
244	3	2	25	9.4
245	3	2	25	11.1
246	3	2	25	11.3
247	3	3	25	9.9
248	3	3	25	10.0
249	3	3	25	10.5
250	3	3	25	10.2
251	3	3	25	11.4
252	3	3	25	8.6
253	3	3	25	11.8
254	3	3	25	9.2
255	3	3	25	10.3
256	3	3	25	8.6
257	3	3	25	8.0
258	3	3	25	9.7
259	3	3	25	8.9
260	3	3	25	8.6
261	3	3	25	9.9
262	3	3	25	12.0
263	3	1	30	12.1
264	3	1	30	11.2
265	3	1	30	10.7
266	3	1	30	11.3
267	3	1	30	10.9
268	3	1	30	11.7
269	3	1	30	10.8
270	3	1	30	11.8
271	3	1	30	12.3
272	3	1	30	10.9
273	3	1	30	11.6
274	3	1	30	12.5
275	3	1	30	11.1
276	3	1	30	13.3
277	3	2	30	10.1
278	3	2	30	10.7
279	3	2	30	11.9
280	3	2	30	11.3

281	3	2	30	8.7
282	3	2	30	11.2
283	3	2	30	10.4
284	3	2	30	10.5
285	3	2	30	10.7
286	3	2	30	11.1
287	3	2	30	10.9
288	3	2	30	11.2
289	3	2	30	10.7
290	3	2	30	10.5
291	3	2	30	10.7
292	3	2	30	10.8
293	3	3	30	11.2
294	3	3	30	12.0
295	3	3	30	11.6
296	3	3	30	11.5
297	3	3	30	11.5
298	3	3	30	12.9
299	3	3	30	10.7
300	3	3	30	10.7
301	3	3	30	11.9
302	3	3	30	10.8
303	3	3	30	11.1
304	3	3	30	11.0
305	3	3	30	10.6
306	3	3	30	10.2
307	3	3	30	12.0
308	3	3	30	10.6
309	3	3	30	11.6
310	3	3	30	10.3
311	3	3	30	11.2
312	3	3	30	10.9
313	4	1	25	10.5
314	4	1	25	11.2
315	4	1	25	9.1
316	4	1	25	11.3
317	4	1	25	9.8
318	4	1	25	10.3
319	4	1	25	10.6
320	4	1	25	10.7
321	4	1	25	11.3
322	4	1	25	10.5
323	4	1	25	11.1
324	4	1	25	10.1
325	4	1	25	10.8
326	4	2	25	11.0
327	4	2	25	10.3
328	4	2	25	9.7
329	4	2	25	12.1
330	4	2	25	12.1
331	4	2	25	11.9
332	4	2	25	10.6
333	4	2	25	10.9
334	4	2	25	11.8
335	4	2	25	9.6
336	4	2	25	10.5
337	4	2	25	10.4
338	4	2	25	11.4
339	4	2	25	10.7
340	4	2	25	10.7
341	4	2	25	10.9
342	4	2	25	12.6
343	4	2	25	10.9
344	4	2	25	12.1
345	4	2	25	11.5
346	4	3	25	12.8
347	4	3	25	14.5
348	4	3	25	11.2
349	4	3	25	10.9
350	4	3	25	10.6
351	4	3	25	11.5
352	4	3	25	11.6
353	4	3	25	10.6
354	4	3	25	11.5
355	4	3	25	10.5
356	4	3	25	11.3

357	4	3	25	11.0
358	4	3	25	11.4
359	4	3	25	10.2
360	4	3	25	11.5
361	4	3	25	10.4
362	4	3	25	11.1
363	4	3	25	12.6
364	4	3	25	11.0
365	4	3	25	11.0
366	4	1	30	13.0
367	4	1	30	11.8
368	4	1	30	9.5
369	4	1	30	11.7
370	4	1	30	11.7
371	4	1	30	12.2
372	4	1	30	10.8
373	4	1	30	12.8
374	4	1	30	12.4
375	4	1	30	12.2
376	4	1	30	13.6
377	4	1	30	10.7
378	4	1	30	9.1
379	4	1	30	12.1
380	4	1	30	11.4
381	4	1	30	10.1
382	4	1	30	12.1
383	4	1	30	8.9
384	4	1	30	11.4
385	4	1	30	9.9
386	4	2	30	10.0
387	4	2	30	9.2
388	4	2	30	8.3
389	4	2	30	8.8
390	4	2	30	9.1
391	4	2	30	10.8
392	4	2	30	8.8
393	4	2	30	10.0
394	4	2	30	9.8
395	4	2	30	10.1
396	4	2	30	10.0
397	4	2	30	10.8
398	4	2	30	10.3
399	4	2	30	9.2
400	4	2	30	10.8
401	4	2	30	8.9
402	4	2	30	11.6
403	4	2	30	8.8
404	4	2	30	11.1
405	4	2	30	9.3
406	4	3	30	10.7
407	4	3	30	10.5
408	4	3	30	11.2
409	4	3	30	9.7
410	4	3	30	11.4
411	4	3	30	10.5
412	4	3	30	10.2
413	4	3	30	10.6
414	4	3	30	11.0
415	4	3	30	11.3
416	4	3	30	9.5
417	4	3	30	10.8
418	4	3	30	9.6
419	4	3	30	10.6
420	4	3	30	9.6

ANOVA of length of postlarva 15 fed different diet at salinity 25,30 ppt.

General Linear Models Procedure

Dependent Variable: LENGTH

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	31.02156985	4.43165284	3.33	0.0019
Error	412	548.98840634	1.33249613		
Corrected Total	419	580.00997619			

R-Square	C.V.	Root MSE	LENGTH Mean
0.053485	10.54167	1.154338	10.9502381

Dependent Variable: LENGTH

Source	DF	Type I SS	Mean Square	F Value	Pr > F
TREAT	3	12.70960729	4.23653576	3.18	0.0240
SALINITY	1	1.02904656	1.02904656	0.77	0.3800
TREAT*SALINITY	3	17.28291600	5.76097200	4.32	0.0051

Source	DF	Type III SS	Mean Square	F Value	Pr > F
TREAT	3	12.84422681	4.28140894	3.21	0.0229
SALINITY	1	0.61158581	0.61158581	0.46	0.4985
TREAT*SALINITY	3	17.28291600	5.76097200	4.32	0.0051

General Linear Models Procedure

Dependent Variable: LENGTH

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	12.70960729	4.23653576	3.11	0.0264
Error	416	567.30036890	1.36370281		
Corrected Total	419	580.00997619			

R-Square	C.V.	Root MSE	LENGTH Mean
0.021913	10.66440	1.167777	10.9502381

Source	DF	Type I SS	Mean Square	F Value	Pr > F
TREAT	3	12.70960729	4.23653576	3.11	0.0264

Source	DF	Type III SS	Mean Square	F Value	Pr > F
TREAT	3	12.70960729	4.23653576	3.11	0.0264

Duncan's Multiple Range Test for variable: LENGTH

Alpha= 0.05 df= 416 MSE= 1.363703

Number of Means	2	3	4
Critical Range	0.321	0.338	0.349

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	TREAT
A	11.226	117	1
B	10.889	102	3
B	10.844	93	2
B	10.801	108	4

General Linear Models Procedure

Dependent Variable: LENGTH

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	1.24484115	1.24484115	0.90	0.3436
Error	418	578.76513504	1.38460559		
Corrected Total	419	580.00997619			

R-Square	C.V.	Root MSE	LENGTH Mean
0.002146	10.74582	1.176693	10.9502381

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SALINITY	1	1.24484115	1.24484115	0.90	0.3436

Source	DF	Type III SS	Mean Square	F Value	Pr > F
SALINITY	1	1.24484115	1.24484115	0.90	0.3436

Duncan's Multiple Range Test for variable: LENGTH

Alpha= 0.05 df= 418 MSE= 1.384606

Number of Means	2
Critical Range	0.229

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	SALINITY
A	11.009	195	25
A	10.900	225	30

---------- SALINITY=25 ----------

General Linear Models Procedure
Dependent Variable: LENGTH

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	18.45369436	6.15123145	3.42	0.0184
Error	191	343.74148513	1.79969364		
Corrected Total	194	362.19517949			

R-Square	C.V.	Root MSE	LENGTH Mean
0.050950	12.18604	1.341527	11.0087179

Source	DF	Type I SS	Mean Square	F Value	Pr > F
TREAT	3	18.45369436	6.15123145	3.42	0.0184

Source	DF	Type III SS	Mean Square	F Value	Pr > F
TREAT	3	18.45369436	6.15123145	3.42	0.0184

Duncan's Multiple Range Test for variable: LENGTH
Alpha= 0.05 df= 191 MSE= 1.799694
Number of Means 2 3 4
Critical Range 0.552 0.581 0.599
Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	TREAT
A	11.419	57	1
B A	11.060	53	4
B	10.812	33	2
B	10.631	52	3

---------- SALINITY=30 ----------

General Linear Models Procedure
Dependent Variable: LENGTH

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	11.32303434	3.77434478	4.06	0.0078
Error	221	205.24692121	0.92871910		
Corrected Total	224	216.56995556			

R-Square	C.V.	Root MSE	LENGTH Mean
0.052283	8.841652	0.963701	10.8995556

Dependent Variable: LENGTH

Source	DF	Type I SS	Mean Square	F Value	Pr > F
TREAT	3	11.32303434	3.77434478	4.06	0.0078

Source	DF	Type III SS	Mean Square	F Value	Pr > F
TREAT	3	11.32303434	3.77434478	4.06	0.0078

Duncan's Multiple Range Test for variable: LENGTH
Alpha= 0.05 df= 221 MSE= 0.928719
Number of Means 2 3 4
Critical Range 0.362 0.381 0.393
Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	TREAT
A	11.158	50	3
A	11.042	60	1
B A	10.862	60	2
B	10.551	55	4

---------- TREAT=1 ----------

General Linear Models Procedure
Dependent Variable: LENGTH

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	4.16847166	4.16847166	3.18	0.0770
Error	115	150.53460526	1.30899657		
Corrected Total	116	154.70307692			

R-Square	C.V.	Root MSE	LENGTH Mean
0.026945	10.19197	1.144114	11.2256410

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SALINITY	1	4.16847166	4.16847166	3.18	0.0770

Source	DF	Type III SS	Mean Square	F Value	Pr > F
SALINITY	1	4.16847166	4.16847166	3.18	0.0770

Duncan's Multiple Range Test for variable: LENGTH
Alpha= 0.05 df= 115 MSE= 1.308997
Number of Means 2
Critical Range 0.420
Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	SALINITY
A	11.419	57	25
A	11.042	60	30

---------- TREAT=2 ----------

General Linear Models Procedure

Dependent Variable: LENGTH

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	0.05226246	0.05226246	0.03	0.8737
Error	91	187.23698485	2.05754928		
Corrected Total	92	187.28924731			

R-Square	C.V.	Root MSE	LENGTH Mean
0.000279	13.22763	1.434416	10.8440860

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SALINITY	1	0.05226246	0.05226246	0.03	0.8737

Source	DF	Type III SS	Mean Square	F Value	Pr > F
SALINITY	1	0.05226246	0.05226246	0.03	0.8737

Duncan's Multiple Range Test for variable: LENGTH

Alpha= 0.05 df= 91 MSE= 2.057549

Number of Means 2

Critical Range 0.618

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	SALINITY
A	10.862	60	30
A	10.812	33	25

---------- TREAT=3 ----------

General Linear Models Procedure

Dependent Variable: LENGTH

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	7.08556802	7.08556802	7.86	0.0061
Error	100	90.13256923	0.90132569		
Corrected Total	101	97.21813725			

R-Square	C.V.	Root MSE	LENGTH Mean
0.072883	8.718550	0.949382	10.8892157

Dependent Variable: LENGTH

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SALINITY	1	7.08556802	7.08556802	7.86	0.0061

Source	DF	Type III SS	Mean Square	F Value	Pr > F
SALINITY	1	7.08556802	7.08556802	7.86	0.0061

Duncan's Multiple Range Test for variable: LENGTH

Alpha= 0.05 df= 100 MSE= 0.901326

Number of Means 2

Critical Range 0.374

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	SALINITY
A	11.158	50	30
B	10.631	52	25

---------- TREAT=4 ----------

General Linear Models Procedure

Dependent Variable: LENGTH

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	7.00566041	7.00566041	6.13	0.0149
Error	106	121.08424700	1.14230422		
Corrected Total	107	128.08990741			

R-Square	C.V.	Root MSE	LENGTH Mean
0.054693	9.895321	1.068786	10.8009259

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SALINITY	1	7.00566041	7.00566041	6.13	0.0149

Source	DF	Type III SS	Mean Square	F Value	Pr > F
SALINITY	1	7.00566041	7.00566041	6.13	0.0149

Duncan's Multiple Range Test for variable: LENGTH

Alpha= 0.05 df= 106 MSE= 1.142304

Number of Means 2

Critical Range 0.409

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	SALINITY
A	11.060	53	25
B	10.551	55	30

Raw data of survival of zoea stage

OBS	STAGE	TREAT	REPL	SALINITY	SURVIVE	PSURVIVE
1	m1	1	1	25	.	.
2	m1	1	2	25	.	.
3	m1	1	3	25	136	45.3333
4	m1	1	1	30	161	53.6667
5	m1	1	2	30	219	73.0000
6	m1	1	3	30	256	85.3333
7	m1	2	1	25	19	6.3333
8	m1	2	2	25	166	55.3333
9	m1	2	3	25	44	14.6667
10	m1	2	1	30	119	39.6667
11	m1	2	2	30	146	48.6667
12	m1	2	3	30	177	59.0000
13	m1	3	1	25	15	5.0000
14	m1	3	2	25	165	55.0000
15	m1	3	3	25	36	12.0000
16	m1	3	1	30	192	64.0000
17	m1	3	2	30	221	73.6667
18	m1	3	3	30	178	59.3333
19	m1	4	1	25	81	27.0000
20	m1	4	2	25	87	29.0000
21	m1	4	3	25	157	52.3333
22	m1	4	1	30	208	69.3333
23	m1	4	2	30	90	30.0000
24	m1	4	3	30	116	38.6667

General Linear Models Procedure

Dependent Variable: PSURVIVE

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	6730.510101	747.834456	2.15	0.1088
Error	12	4181.777778	348.481481		
Corrected Total	21	10912.287879			

R-Square	C.V.	Root MSE	PSURVIVE Mean
0.616783	41.21999	18.66766	45.2878788

Source	DF	Type I SS	Mean Square	F Value	Pr > F
REPL	2	713.272006	356.636003	1.02	0.3887
TREAT	3	1954.751323	651.583774	1.87	0.1885
SALINITY	1	3300.192308	3300.192308	9.47	0.0096
TREAT*SALINITY	3	762.294465	254.098155	0.73	0.5541

Source	DF	Type III SS	Mean Square	F Value	Pr > F
REPL	2	713.555556	356.777778	1.02	0.3886
TREAT	3	841.774522	280.591507	0.81	0.5148
SALINITY	1	2985.587596	2985.587596	8.57	0.0127
TREAT*SALINITY	3	762.294465	254.098155	0.73	0.5541

Duncan's Multiple Range Test for variable: PSURVIVE

Alpha= 0.05 df= 12 MSE= 348.4815

Number of Means 2

Critical Range 17.38

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	SALINITY
A	57.861	12	30
B	30.200	10	25

General Linear Models Procedure

Duncan's Multiple Range Test for variable: PSURVIVE

Alpha= 0.05 df= 12 MSE= 348.4815

Number of Means 2 3 4

Critical Range 24.86 26.04 26.83

Means with the same letter are not significantly different.

Duncan Grouping		Mean	N	TREAT
	A	64.33	4	1
B	A	44.83	6	3
B	A	41.06	6	4
B		37.28	6	2

Raw data of survival of mysis stage

OBS	STAGE	TREAT	REPL	SALINITY	SURVIVE
1	p1	1	1	25	46
2	p1	1	2	25	50
3	p1	1	3	25	74
4	p1	1	1	30	42
5	p1	1	2	30	58
6	p1	1	3	30	58
7	p1	2	1	25	88
8	p1	2	2	25	47
9	p1	2	3	25	67
10	p1	2	1	30	80
11	p1	2	2	30	59
12	p1	2	3	30	56
13	p1	3	1	25	65
14	p1	3	2	25	55
15	p1	3	3	25	68
16	p1	3	1	30	81
17	p1	3	2	30	84
18	p1	3	3	30	60
19	p1	4	1	25	82
20	p1	4	2	25	73
21	p1	4	3	25	52
22	p1	4	1	30	63
23	p1	4	2	30	58
24	p1	4	3	30	53

General Linear Models Procedure

Dependent Variable: SURVIVE

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	1433.375000	159.263889	0.91	0.5454
Error	14	2459.583333	175.684524		
Corrected Total	23	3892.958333			

R-Square	C.V.	Root MSE	SURVIVE Mean
0.368197	20.94210	13.25460	63.2916667

Source	DF	Type I SS	Mean Square	F Value	Pr > F
REPL	2	311.0833333	155.5416667	0.89	0.4345
TREAT	3	680.4583333	226.8194444	1.29	0.3162
SALINITY	1	9.3750000	9.3750000	0.05	0.8207
TREAT*SALINITY	3	432.4583333	144.1527778	0.82	0.5039

Source	DF	Type III SS	Mean Square	F Value	Pr > F
REPL	2	311.0833333	155.5416667	0.89	0.4345
TREAT	3	680.4583333	226.8194444	1.29	0.3162
SALINITY	1	9.3750000	9.3750000	0.05	0.8207
TREAT*SALINITY	3	432.4583333	144.1527778	0.82	0.5039

Duncan's Multiple Range Test for variable: SURVIVE

Alpha= 0.05 df= 14 MSE= 175.6845

Number of Means 2

Critical Range 11.58

Duncan Grouping	Mean	N	SALINITY
A	63.917	12	25
A	62.667	12	30

Duncan's Multiple Range Test for variable: SURVIVE

Alpha= 0.05 df= 14 MSE= 175.6845

Number of Means 2 3 4

Critical Range 16.38 17.18 17.72

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	TREAT
A	68.833	6	3
A	66.167	6	2
A	63.500	6	4
A	54.667	6	1

Raw data of survival of postlarva stage

OBS	STAGE	TREAT	REPL	SALINITY	SURVIVE	PSURVIVE
1	P15	1	1	25	31	62
2	P15	1	2	25	17	34
3	P15	1	3	25	40	80
4	P15	1	1	30	23	46
5	P15	1	2	30	22	44
6	P15	1	3	30	45	90
7	P15	2	1	25	18	36
8	P15	2	2	25	14	28
9	P15	2	3	25	.	.
10	P15	2	1	30	24	48
11	P15	2	2	30	26	52
12	P15	2	3	30	33	66
13	P15	3	1	25	18	36
14	P15	3	2	25	25	50
15	P15	3	3	25	16	32
16	P15	3	1	30	14	28
17	P15	3	2	30	16	32
18	P15	3	3	30	36	72
19	P15	4	1	25	13	26
20	P15	4	2	25	24	48
21	P15	4	3	25	21	42
22	P15	4	1	30	23	46
23	P15	4	2	30	26	52
24	P15	4	3	30	15	30

General Linear Models Procedure

Dependent Variable: PSURVIVE

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	3203.004141	355.889349	1.38	0.2901
Error	13	3355.952381	258.150183		
Corrected Total	22	6558.956522			

R-Square	C.V.	Root MSE	PSURVIVE Mean
0.488341	34.21687	16.06705	46.9565217

Source	DF	Type I SS	Mean Square	F Value	Pr > F
REPL	2	1434.099379	717.049689	2.78	0.0990
TREAT	3	1327.560847	442.520282	1.71	0.2132
SALINITY	1	230.119826	230.119826	0.89	0.3623
TREAT*SALINITY	3	211.224090	70.408030	0.27	0.8440

Source	DF	Type III SS	Mean Square	F Value	Pr > F
REPL	2	1161.380952	580.690476	2.25	0.14
TREAT	3	1326.361345	442.120448	1.71	0.2135
SALINITY	1	276.269841	276.269841	1.07	0.3198
TREAT*SALINITY	3	211.224090	70.408030	0.27	0.8440

Duncan's Multiple Range Test for variable: PSURVIVE

Alpha= 0.05 df= 13 MSE= 258.1502

Number of Means 2

Critical Range 14.46

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	SALINITY
A	50.500	12	30
A	43.091	11	25

Duncan's Multiple Range Test for variable: PSURVIVE

Alpha= 0.05 df= 13 MSE= 258.1502

Number of Means	2	3	4
Critical Range	20.50	21.48	22.15

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	TREAT
A	59.333	6	1
A	46.000	5	2
A	41.667	6	3
A	40.667	6	4

APPENDIX III

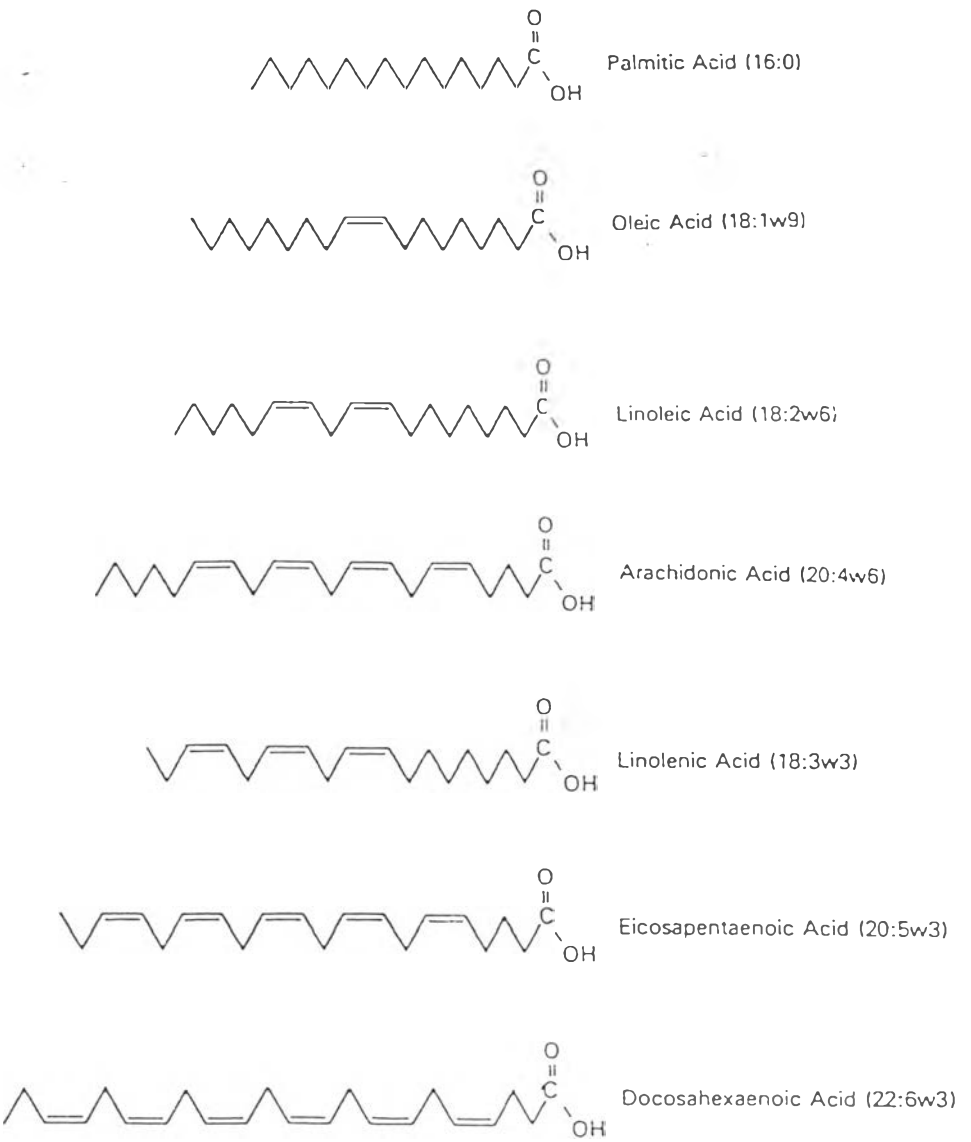

Figure 12 Structural formulas for omega6 (linoleic acid, 18:2 ω6) and omega3 (alpha-linoleic acid, 18:3 ω3) fatty acids. The first nimber (before the colon) give the nimber of carbon atoms in the molecule and the second give the number of double bonds. ω6 indicate position of the first double bond in a given fatty acid molecule.

Table 23 Fatty acid composition of food fats (g fatty acid per 100g total fatty acid).

	Caprylic $C_{8:0}$	Capric $C_{10:0}$	Lauric $C_{12:0}$	Myristic $C_{14:0}$	Pentadecylic $C_{15:0}$	Palmic $C_{16:0}$	Palmitoleic $C_{16:1}$	Hexadecadienoic $C_{16:2}$	Margaric $C_{17:0}$	Stearic $C_{18:0}$	Oleic $C_{18:1}$	Linoleic $C_{18:2}$	Linolenic $C_{18:3}$*	Steardonic $C_{18:4}$	Arachidic $C_{20:0}$	Eicosenoic $C_{20:1}$	Eicosadienoic $C_{20:2}$	Arachidonic $C_{20:4}$	Timnodonic $C_{20:5}$	Behenic $C_{22:0}$	Erucic[a] Cetoleic[a] $C_{22:1}$	Docosatetraenoic $C_{22:4}$	Docosapentaenoic $C_{22:5}$	Clupanodonic $C_{22:6}$	Lignoceric $C_{24:0}$	Selacholeic $C_{24:1}$	References
Plant lipids																											
Almond oil	0	0	0	trace	–	7.0	0.6	–	0.1	1.2	67.3	23.7	0.2	–	0	–	–	–	–	0	0	–	–	–	0	–	21
Cocoa butter	–	0	trace	0.1	–	27.6	0.4	–	trace	33.9	34.0	3.1	trace	–	0.9	–	0	–	–	0	0	–	–	–	–	–	21
Coconut oil	10.1	6.6	45.8	18.4	–	8.0	trace	–	–	2.4	6.0	1.7	0	–	0	–	–	–	–	0	0	–	–	–	–	–	21
Corn oil	0	0	0	trace	–	11.5	0.1	–	trace	2.0	28.3	56.3	1.0	–	0.6	–	–	–	–	0	0	–	–	–	–	–	21
Cottonseed oil	0	trace	0.1	0.6	–	22.6	0.5	–	trace	2.6	18.1	52.3	1.7	–	0.5	–	–	–	–	0.2	0.7	–	–	–	–	–	21
Grape-seed oil	–	0	trace	0.04	–	6.7	0.1	–	–	3.1	12.5	77.3	0.7	–	0	–	0	–	–	0	–	–	–	–	–	–	21
Linseed oil	–	0	trace	trace	–	6.0	0.1	–	trace	5.1	21.1	14.9	53.0	–	trace	–	–	–	–	trace	0	–	–	–	–	–	22
Margarine**	2.2–5.0	1.9–3.7	14.2–29.3	6.1–11.4	–	9.4–22.1	–	–	–	3.3–8.0	14.3–38.1	10.3–29.3	0–2.5	–	–	–	–	–	–	–	–	–	–	–	–	0.3	2.7	21
Mustard-seed oil	0	0	trace	0.05	–	2.9	0.2	–	–	1.0	19.4	9.7	21.4	–	0.7	–	0.4	–	–	0.4	44.4	–	–	–	–	–	24
Olive oil, European†	0	0	0	trace	–	11.8	0.9	–	trace	2.8	74.5	8.7	1.0	–	–	–	–	–	–	–	–	–	–	–	–	–	21
– –, Tunisian	–	0	0	0	–	16.8	1.9	–	trace	2.5	58.9	18.8	0.9	–	–	–	–	–	–	–	–	–	–	–	–	–	21
Palm-kernel oil	4.9	3.9	48.7	16.0	–	7.6	0	–	–	1.9	14.2	2.6	0	–	–	–	–	–	–	–	–	–	–	–	–	–	21
Palm oil	–	–	trace	1.5	–	45.1	trace	–	trace	4.8	36.8	10.2	0.5	–	0.5	–	0	–	–	trace	0.2	–	–	–	–	–	21
Peanut oil	–	0	trace	trace	–	10.6	0.1	–	0.1	3.5	49.5	28.8	1.3	–	1.8	–	–	–	–	3.1	0.1	–	–	–	1.6	–	21
Rapeseed oil	0	0	0	0.05	–	3.6	0.2	–	trace	1.4	15.5	13.9	19.0	–	0.8	7.5	0.5	–	–	0.5	45.5†	–	–	–	0.5	–	21
Safflower oil	0	0	trace	0.1	–	7.5	0.1	–	trace	2.6	12.7	75.5	0.8	–	0.7	–	–	–	–	0.2	0.1	–	–	–	–	–	21
Sesame oil	–	0	trace	trace	–	8.9	0.3	–	trace	6.0	40.7	41.7	1.7	–	0.8	–	–	–	–	0	0	–	–	–	–	–	21
Soybean oil	0	0	0	0.1	–	10.7	0.1	–	0.1	3.8	23.0	52.4	8.9	–	0.6	–	–	–	–	0.4	trace	–	–	–	–	–	21
Sunflower-seed oil	–	0	trace	0.1	–	6.6	0.1	–	trace	4.3	22.4	65.2	0.3	–	0.4	–	–	–	–	0.7	0	–	–	–	–	–	21
Walnut oil	–	0	0	0.02	–	7.0	0.1	–	trace	2.1	18.7	59.8	13.3	–	trace	–	–	–	–	0	0	–	–	–	0	–	21
Animal lipids																											
Cow's milk	1.0	2.5	2.9	10.1	–	24.7	3.3	–	–	9.5	22.5	4.0	2.8	–	trace	–	–	–	–	–	–	–	–	–	–	–	26
Eggs	–	–	–	0.6	–	25.5	4.5	–	–	9.9	45.4	13.0	1.7	–	–	–	–	–	–	–	–	–	–	–	–	–	23
Fish																											
Cod	–	–	–	1.8	–	0.5	33.4	2.4	0.9	4.0	11.8	1.2	0.8	1.2	–	1.6	–	3.2	12.4	–	0.7	–	0.6	21.9	–	–	23
Cod-liver oil	–	–	–	2.8	–	0.4	10.7	6.9	1.2	3.7	23.9	1.5	0.9	2.6	–	8.8	0.5	1.0	8.0	–	5.3	0.3	1.3	14.3	–	0.5	23
	–	–	–	3.7	0.1	0.2	12.8	11.8	0.9	3.2	25.7	1.0	0.4	1.6	trace	6.7	0.2	0.2	12.7	trace	3.8	0.2	1.5	6.9	trace	1.0	23
	–	–	–	5.9	1.6	0.6	14.0	12.4	0.7	1.4	27.8	1.0	trace	–	–	28.3	–	0.5	0.8	trace	trace	trace	0.7	0.5	–	trace	24
Eel	–	–	–	7.6	–	0.4	18.3	8.3	0.5	2.2	16.9	1.6	0.6	2.8	–	9.4	–	0.4	8.6	–	11.6	trace	1.3	7.6	–	0.9	23
Herring	–	–	–	4.9	–	0.5	28.2	5.3	1.0	3.9	19.3	1.1	1.3	3.4	–	3.1	–	3.9	7.1	–	2.8	–	1.2	10.8	–	0.8	25
Mackerel	–	–	–	15.1	–	trace	15.3	5.6	1.5	3.8	27.2	1.5	0.9	–	trace	8.0	–	0.5	3.4	trace	10.5	–	0.7	2.5	–	trace	24
Salmon	–	–	–	2.1	–	0.8	11.9	8.2	1.5	4.1	19.8	4.6	5.2	1.5	–	3.0	0.6	2.2	5.0	–	1.3	0.6	2.6	19.6	–	0.7	23
Trout	–	–	–	4.5	–	0.6	22.1	2.8	0.8	6.1	21.7	2.1	1.2	1.5	–	2.0	–	3.0	13.2	–	trace	–	1.5	17.3	–	–	27
Tunny	–	–	–	3.2	0.6	26.9	6.3	–	1.2	13.0	42.0	2.0	1.3	–	–	trace	–	1.0	trace	–	–	trace	–	–	–	–	6
Beef	–	–	–	1.3	trace	26.7	7.2	–	trace	7.1	39.8	13.5	0.7	–	–	0.6	–	0.7	–	–	–	–	–	1.0	–	–	6
Chicken	–	–	–	0.6	trace	22.8	4.4	–	trace	5.5	52.8	12.1	0.6	–	–	trace	–	trace	trace	–	–	–	trace	–	–	–	6
Duck	–	–	–	5.4	0.6	24.2	1.3	–	1.0	20.9	38.2	2.5	2.5	–	–	trace	–	0	trace	–	–	–	trace	–	–	–	6
Lamb	–	–	–	1.6	trace	27.1	3.4	–	trace	13.8	43.8	7.4	0.9	–	–	0.7	–	trace	trace	–	–	–	trace	–	–	–	6
Pork	–	–	–	1.0	trace	25.0	5.0	–	0.5	10.0	21.5	20.0	1.0	–	–	0.4	–	5.0	1.5	–	–	–	2.0	5.0	–	–	6
Turkey	–	–	–																								

* In plant lipids $C_{18:3} + C_{20:3}$. [a] Erucic acid in plant lipids, cetoleic acid in fish. ** Values based on 9 Swiss samples; for American brands, see Weihrauch et al. [6]
† Spain, France, Italy. † New strains contain less erucic acid.

Table 24 Content of ω3 Fatty acids and other Fat Component in Selected Fish.

Fish	Total fat	Total saturated	Total mono-unsaturated	Total poly-unsaturated	18:3	20:5	22:6	Cholesterol
	Fatty acids							
Anchovy, European	4.8	1.3	1.2	1.6	—	0.5	0.9	—
Bass, striped	2.3	0.5	0.7	0.8	Tr	0.2	0.6	80
Bluefish	6.5	1.4	2.9	1.6	—	0.4	0.8	59
Carp	5.6	1.1	2.3	1.4	0.3	0.2	0.1	67
Catfish, brown bullhead	2.7	0.6	1.0	0.8	0.1	0.2	0.2	75
Catfish, channel	4.3	1.0	1.6	1.0	Tr	0.1	0.2	58
Cod, Atlantic	0.7	0.1	0.1	0.3	Tr	0.1	0.2	43
Croaker, Atlantic	3.2	1.1	1.2	0.5	Tr	0.1	0.1	61
Flounder, unspecified	1.0	0.2	0.3	0.3	Tr	0.1	0.1	46
Grouper, red	0.8	0.2	0.1	0.2	—	Tr	0.2	—
Haddock	0.7	0.1	0.1	0.2	Tr	0.1	0.1	63
Halibut, Greenland	13.8	2.4	8.4	1.4	Tr	0.5	0.4	46
Halibut, Pacific	2.3	0.3	0.8	0.7	0.1	0.1	0.3	32
Herring, Pacific	13.9	3.3	6.9	2.4	0.1	1.0	0.7	77
Herring, Round	4.4	1.3	0.8	1.5	0.1	0.4	0.8	28
Mackerel, king	13.0	2.5	5.9	3.2	—	1.0	1.2	53
Mullet, striped	3.7	1.2	1.1	1.1	0.1	0.3	0.2	49
Ocean perch	1.6	0.3	0.6	0.5	Tr	0.1	0.1	42
Plaice, European	1.5	0.3	0.5	0.4	Tr	0.1	0.1	70
Pollock	1.0	0.1	0.1	0.5	—	0.1	0.4	71
Pompano, Florida	9.5	3.5	2.6	1.1	—	0.2	0.4	50
Salmon, Chinook	10.4	2.5	4.5	2.1	0.1	0.8	0.6	—
Salmon, pink	3.4	0.6	0.9	1.4	Tr	0.4	0.6	—
Snapper, red	1.2	0.2	0.2	0.4	Tr	Tr	0.2	—
Sole, European	1.2	0.3	0.4	0.2	Tr	Tr	0.1	50
Swordfish	2.1	0.6	0.8	0.2	—	0.1	0.1	39
Trout, rainbow	3.4	0.6	1.0	1.2	0.1	0.1	0.4	57
Tuna, albacore	4.9	1.2	1.2	1.8	0.2	0.3	1.0	54
Tuna, unspecified	2.5	0.9	0.6	0.5	—	0.1	0.4	—

[a] Values are given as g/100 g edible portion, raw except for cholesterol, which is given as mg. Dash (—) denotes lack of reliable data for nutrient known to be present. Tr, trace (less than 0.05 g/100 g of food).

Adapted from the U.S. Department of Agriculture Provisional Table on the Content of Omega-3 Fatty Acids and Other Fat Components in Seafoods, as presented by Simopoulos et al.

Table 25 Effects of ω3 Fatty acids on Factor Involved in the pathophysiology of Atherosclerosis and Inflammation.

Factor	Function	Effect of w3 fatty acid
Arachidonic acid	Eicosanoid precursor; aggregates platelets; stimulates white blood cells	↓
Thromboxane	Platelet aggregation; vasoconstriction; increase of intracellular Ca++	↓
Prostacyclin ($PGI_{2/3}$)	Prevent platelet aggregation; vasodilation; increase cAMP	↑
Leukotriene (LTB_4)	Neutrophil chemoattractant increase of intracellular Ca++	↓
Tissue plasminogen activator	Increase endogenous fibrinolysis	↑
Fibrinogen	Blood clotting factor	↓
Red cell deformability	Decreases tendency to thrombosis and improves oxygen delivery to tissues	↑
Platelet activating factor (PAF)	Activates platelets and white blood cells	↓
Platelet-derived growth factor (PDGF)	Chemoattractant and mitogen for smooth muscles and macrophages	↓
Oxygen-free radicals	Cellular damage; enhance LDL uptake via scavenger pathway; stimulate arachidonic acid metabolism	↓
Lipid hydroperoxides	Stimulate eicosanoid formation	↓
Interleukin 1 and tumor necrosis factor	Stimulate neutrophil O_2 free radical formation; stimulate lymphocyte proliferation; stimulate PAF; express intercellular adhesion molecule-1 on endothelial cells; inhibit plasminogen activator, thus, procoagulants	↓
Endothelial-derived relaxation factor (EDRF)	Reduces arterial vasoconstrictor response	↑
VLDL	Related to LDL and HDL level	↓
HDL	Decreases the risk for coronary heart disease	↑
Lp(a)	Lipoprotein (a) is a genetically determined protein that has atherogenic and thrombogenic properties	↓
Triglycerides and chylomicrons	Contribute to postprandial lipemia	↓

Adapted from Weber, P.C. and Leaf, A., *World Rev. Nutr. Diet*, 66, 218, 1991.

APPENDIX IV

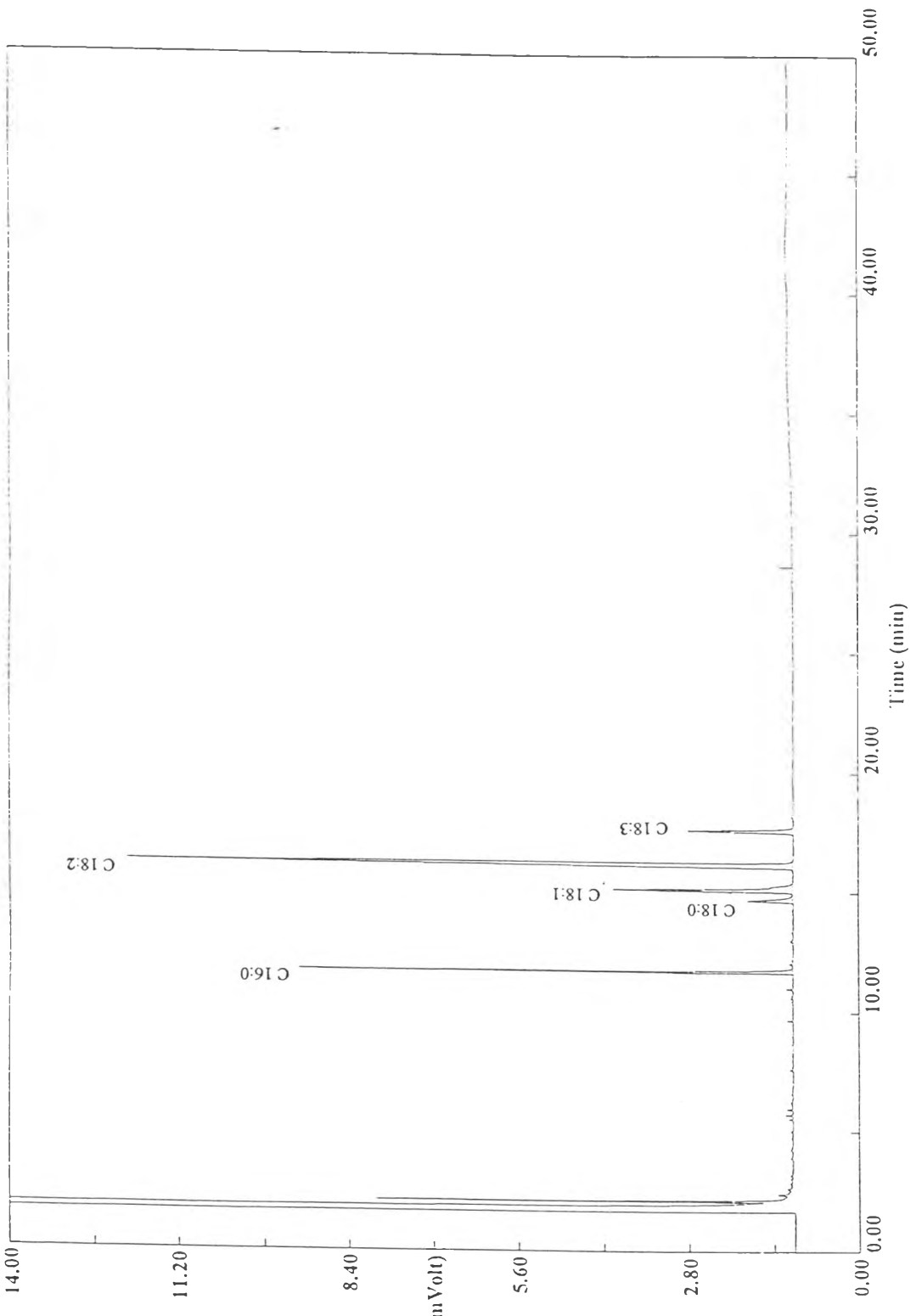

Figure 13 Gas-liquid chromatogram of fatty acid of total lecithin derived from soybean .

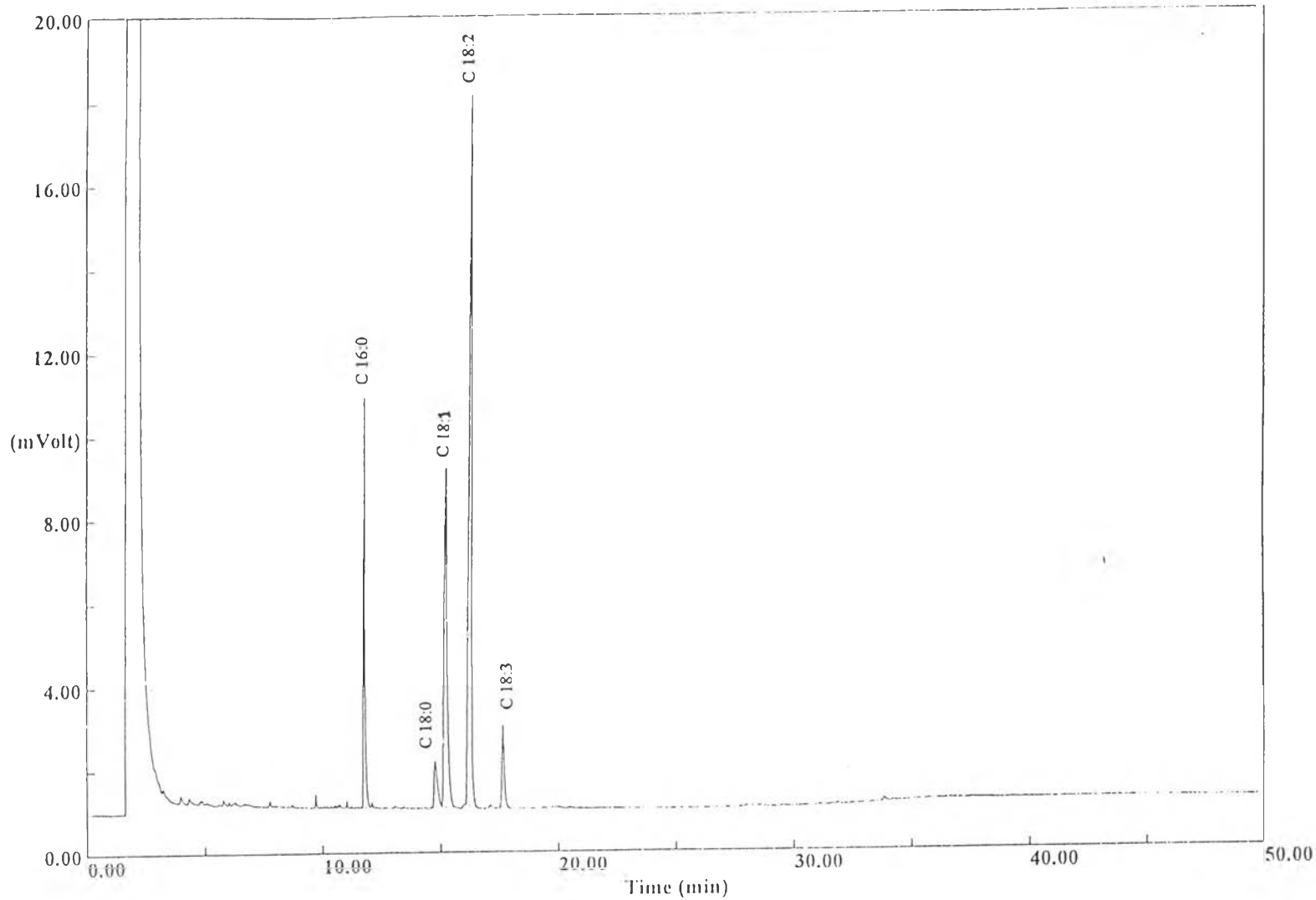

Figure 14 Gas-liquid chromatogram of fatty acid of triglycerides fraction of lecithin derived from soybean.

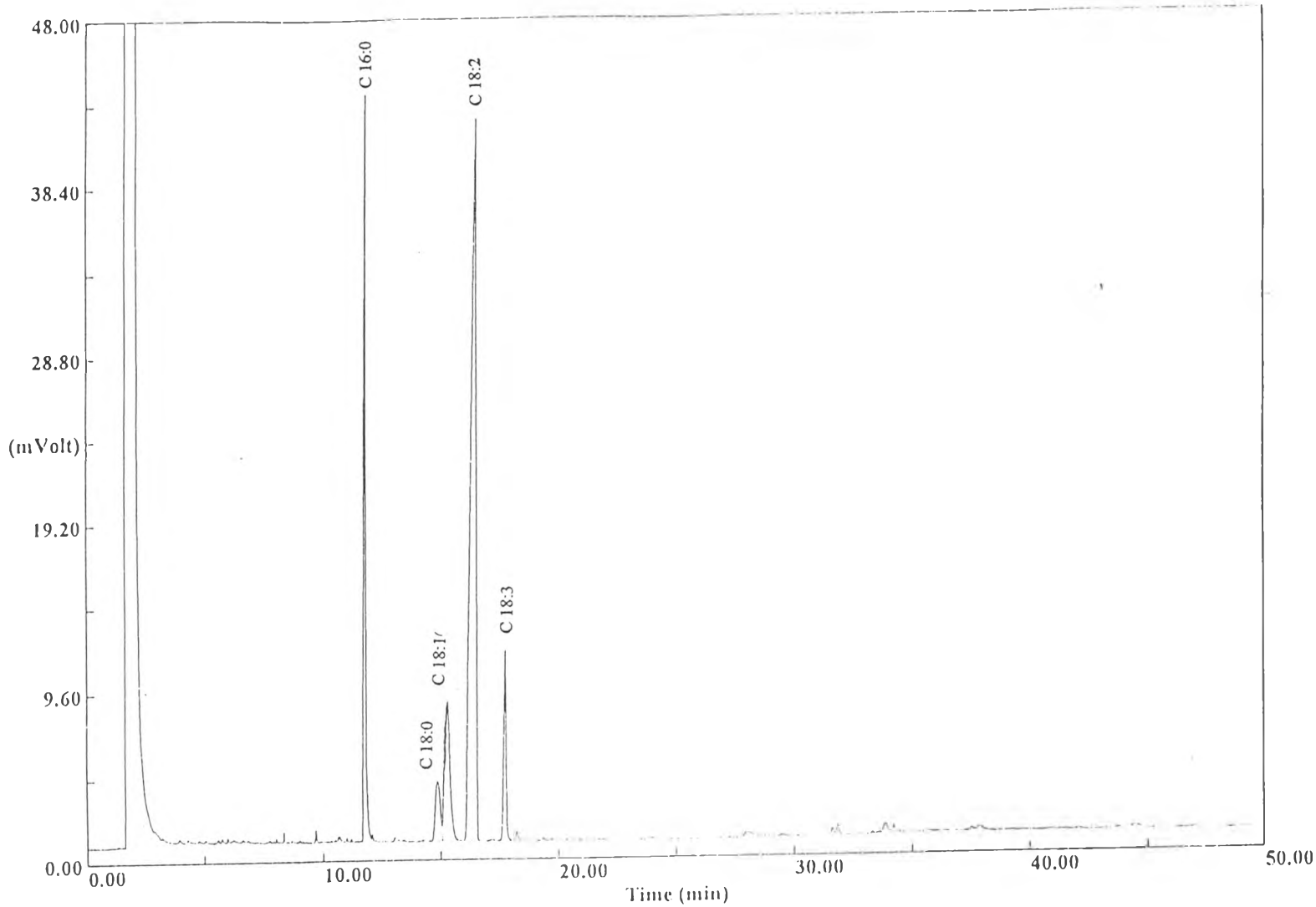

Figure 15 Gas-liquid chromatogram of fatty acid of phospholipid fraction of lecithin derived from soybean.

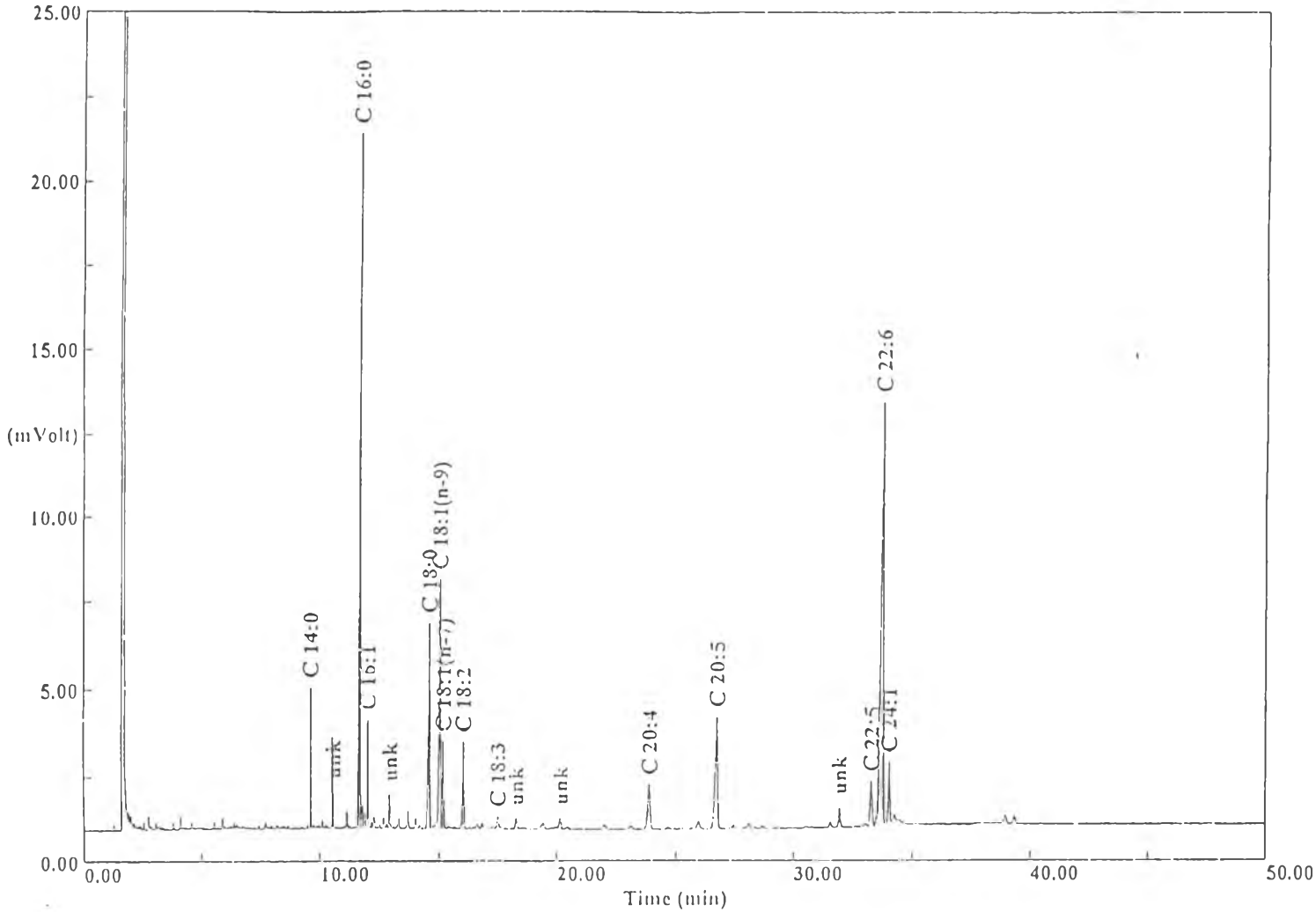

Figure 16 Gas-liquid chromatogram of fatty acid of total lecithin derived from Danish fish meal .

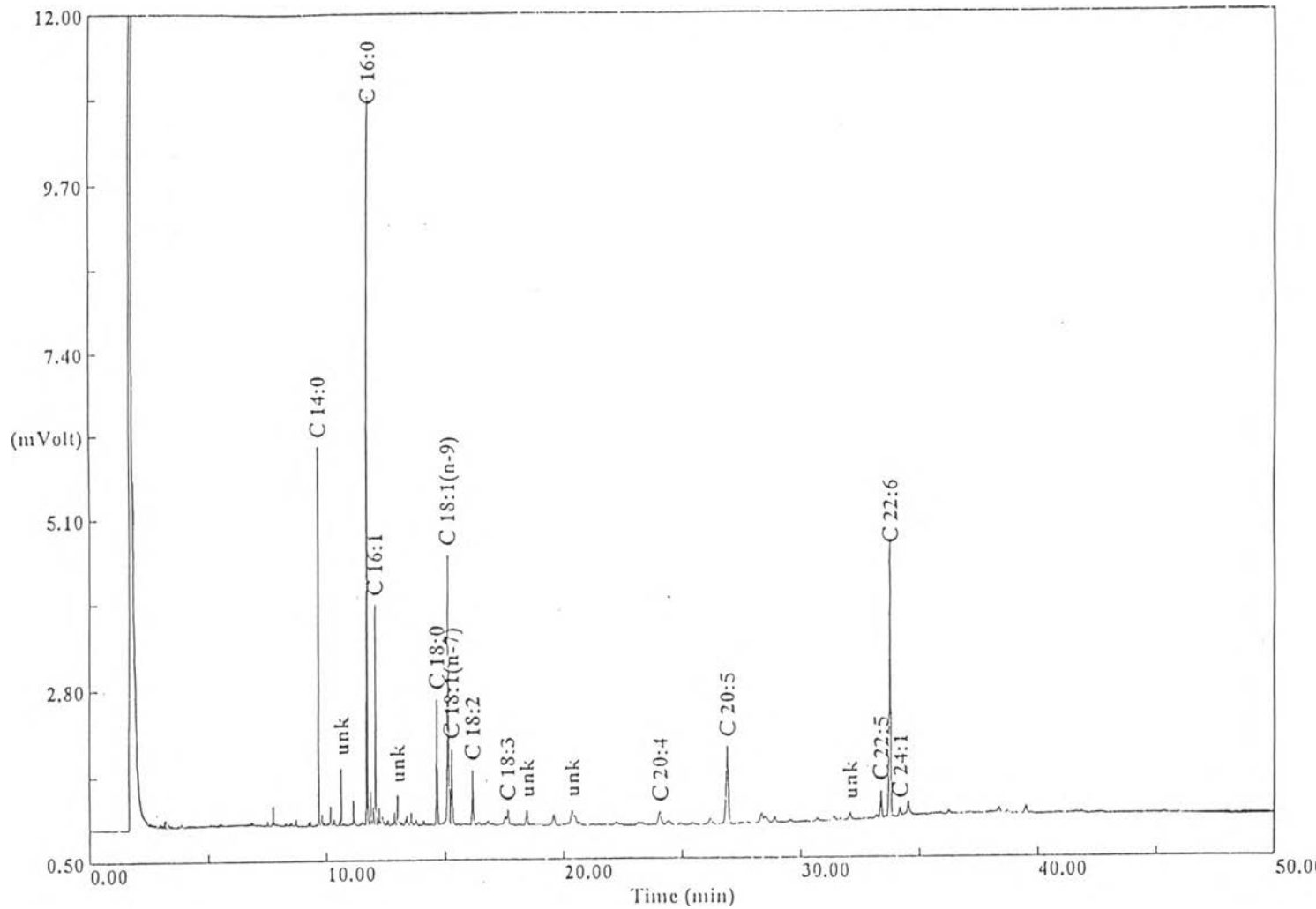

Figure 17 Gas-liquid chromatogram of fatty acid of triglyceride fraction of lecithin derived from Danish fish meal .

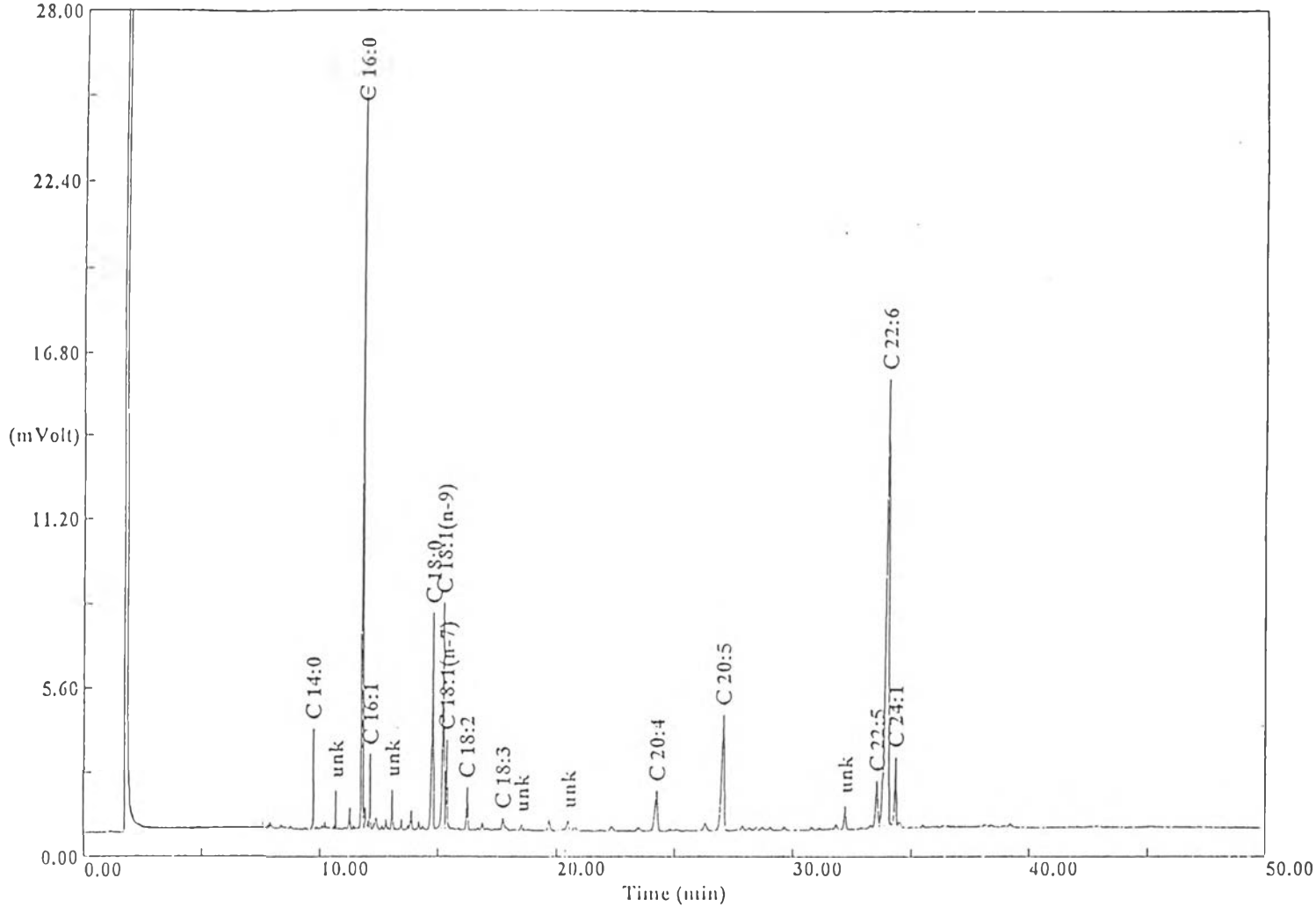

Figure 18 Gas-liquid chromatogram of fatty acid of phospholipid fraction of lecithin derived from Danish fish meal .

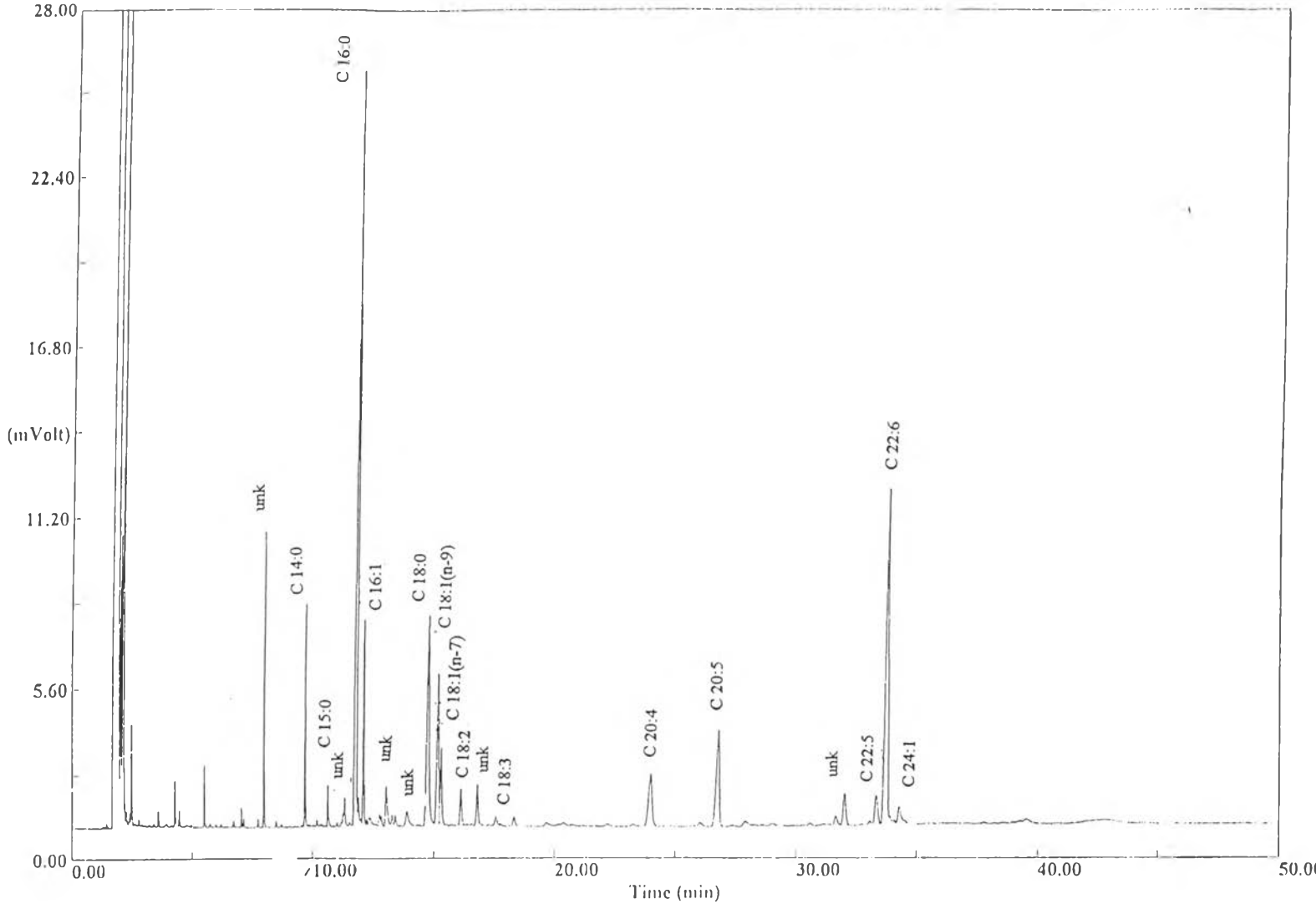

Figure 19 Gas-liquid chromatogram of fatty acid of total lecithin derived from local fish meal.

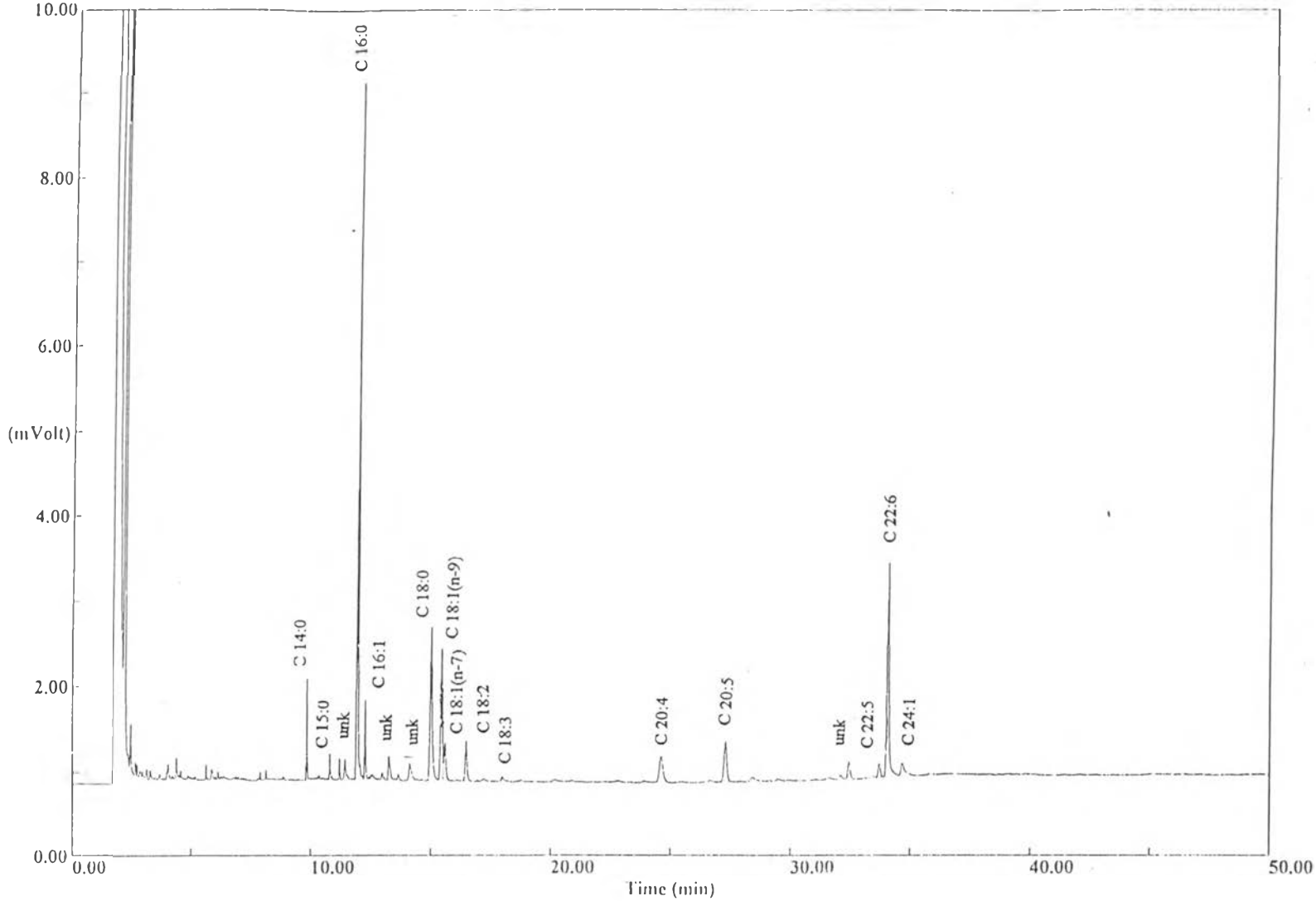

Figure 20 Gas-liquid chromatogram of fatty acid of triglyceride fraction of lecithin derived from local fish meal.

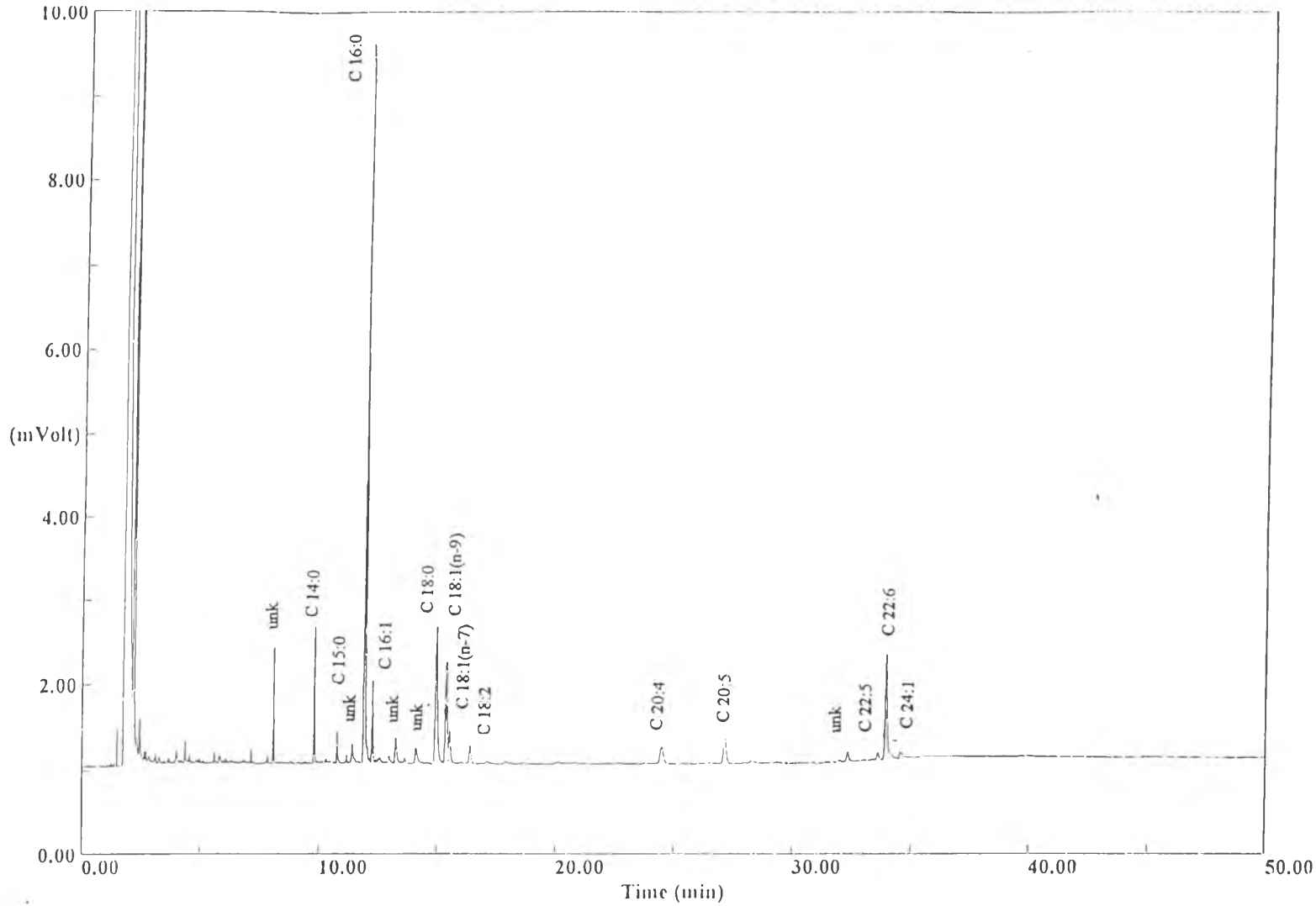

Figure 21 Gas-liquid chromatogram of fatty acid of phospholipid fraction of lecithin derived from local fish meal.

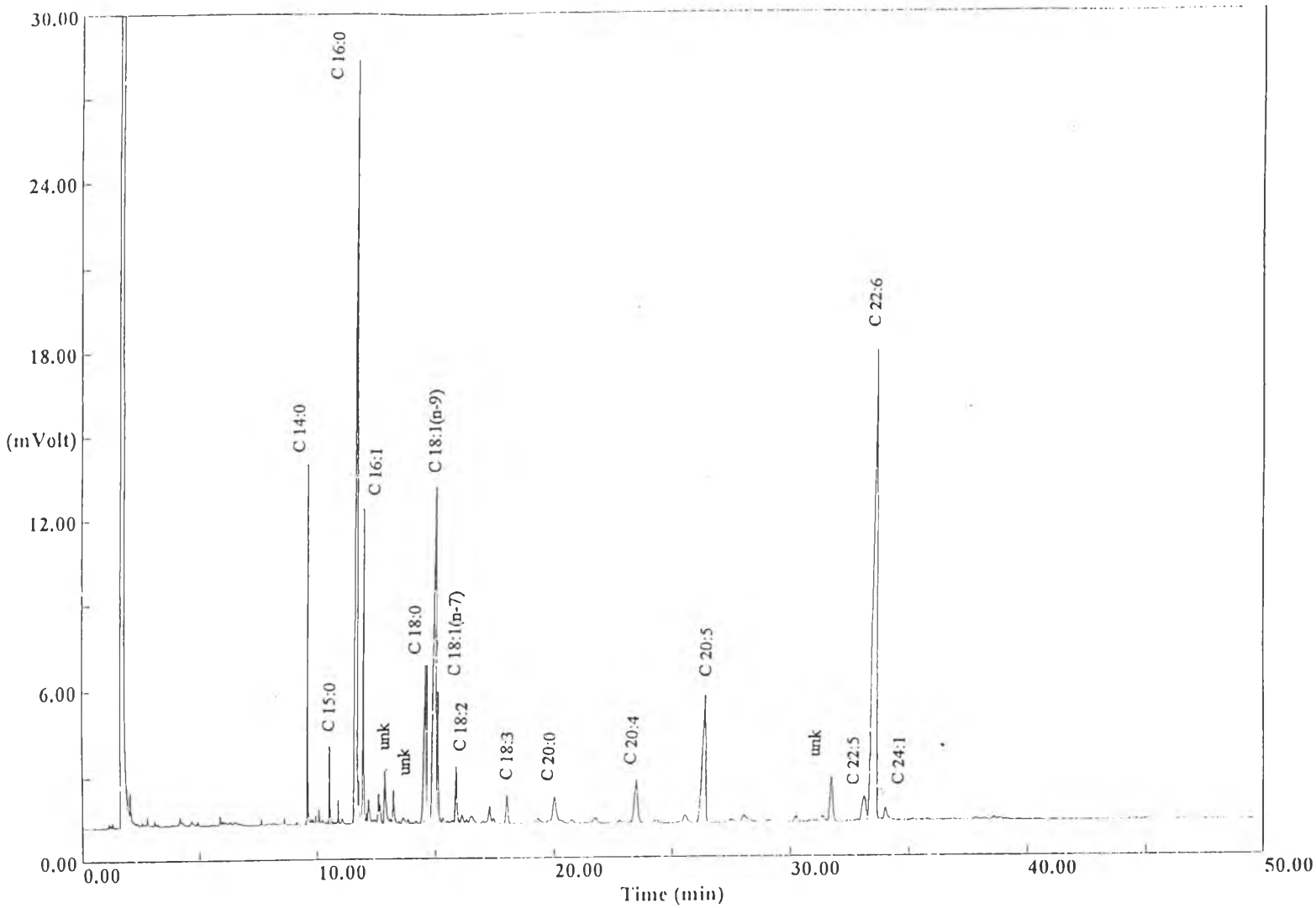

Figure 22 Gas-liquid chromatogram of fatty acid derived from fish oil.

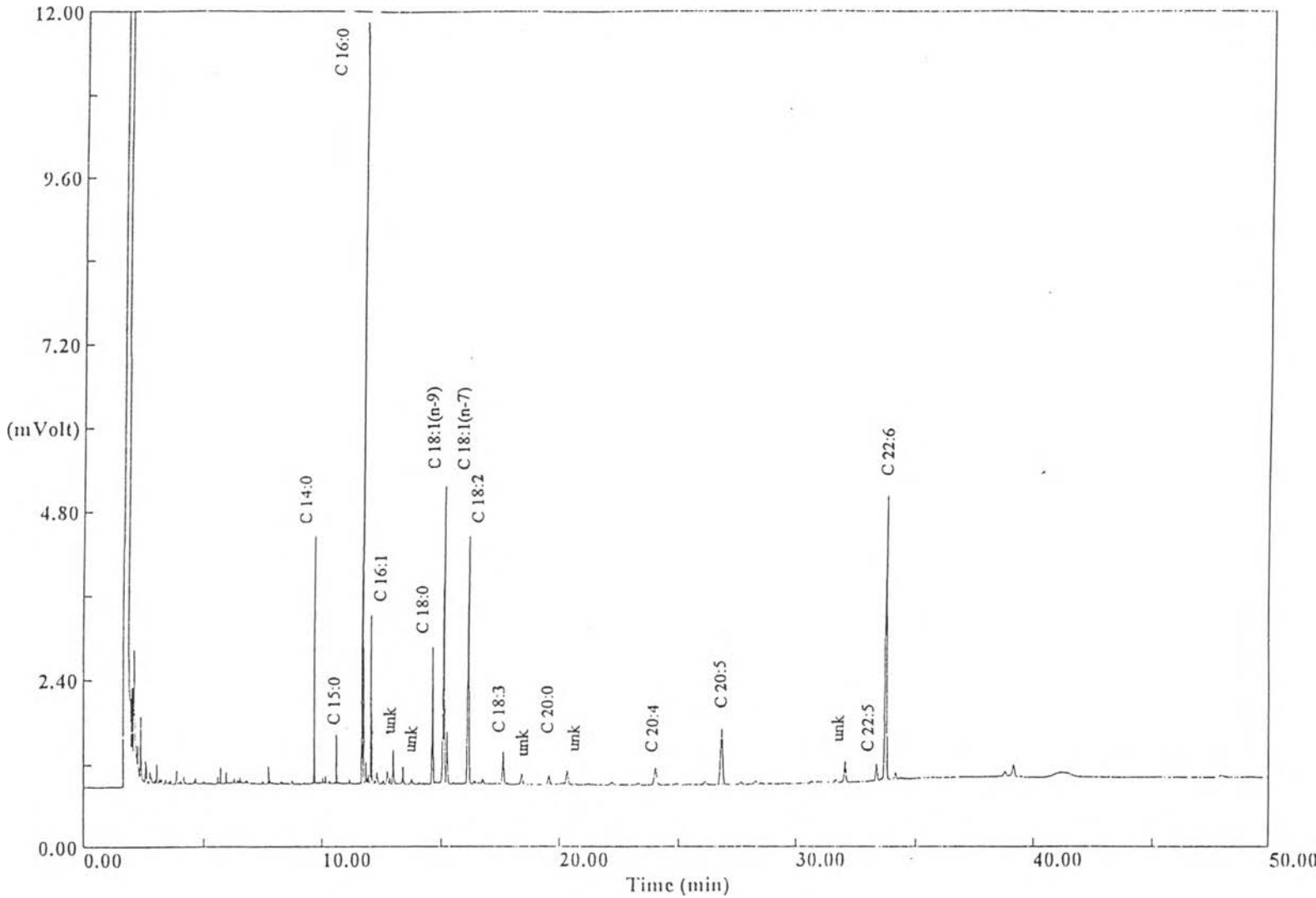

Figure 23 Gas-liquid chromatogram of fatty acid of Soybean lecithin - added diet (SAD) .

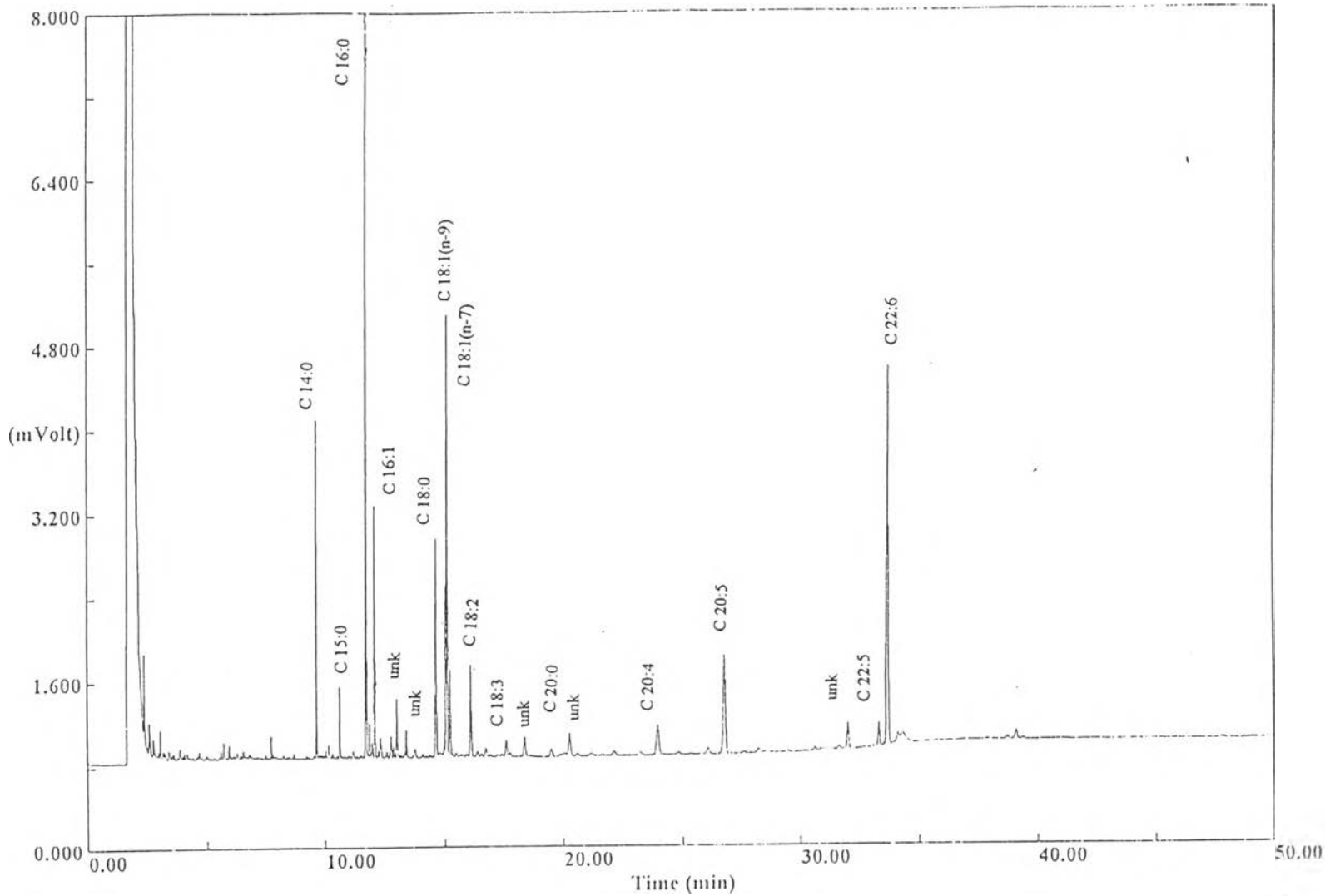

Figure 24 Gas-liquid chromatogram of fatty acid of Danish fish meal lecithin - added diet (DAD).

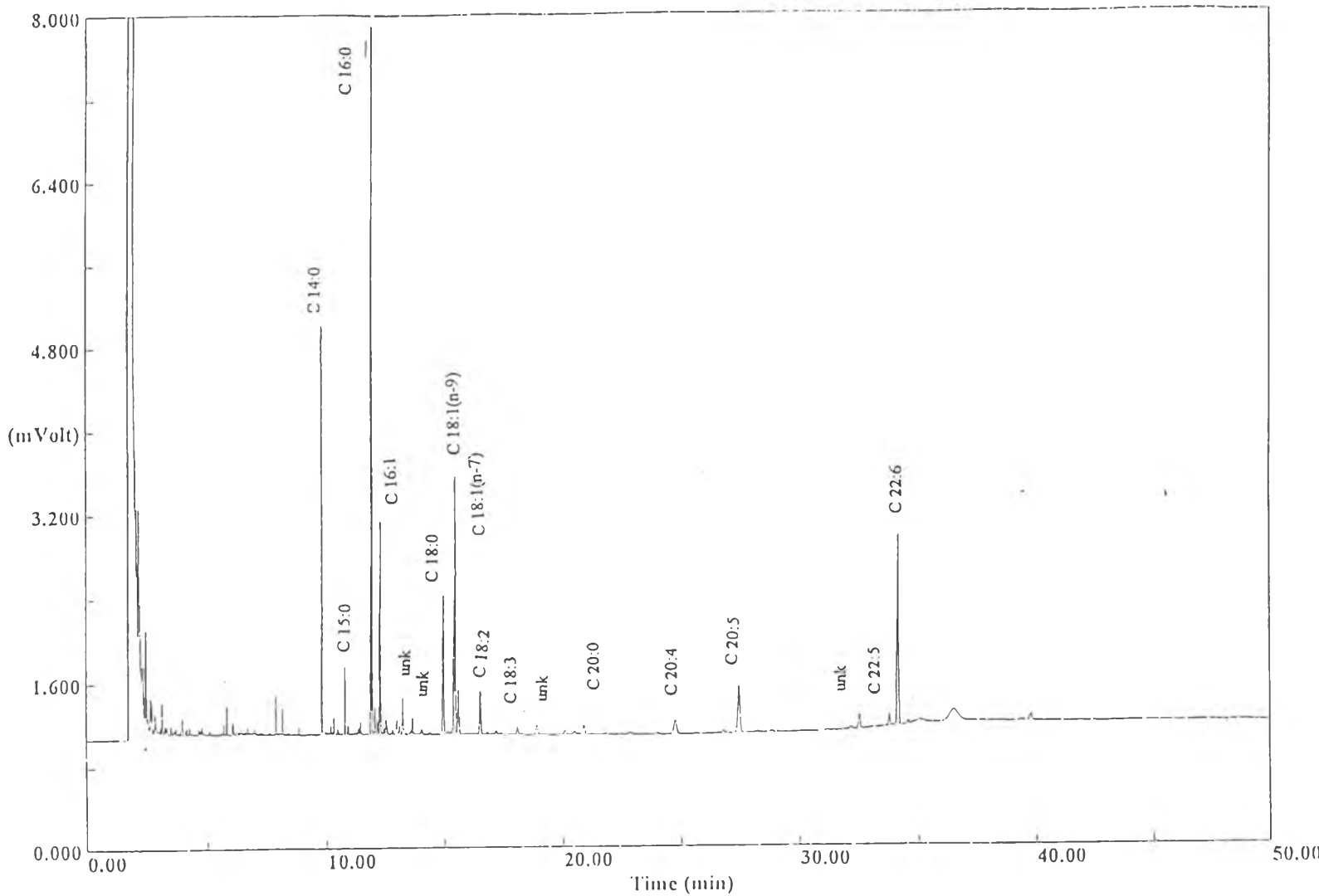

Figure 25 Gas-liquid chromatogram of fatty acid of local fish meal lecithin - added diet (LAD).

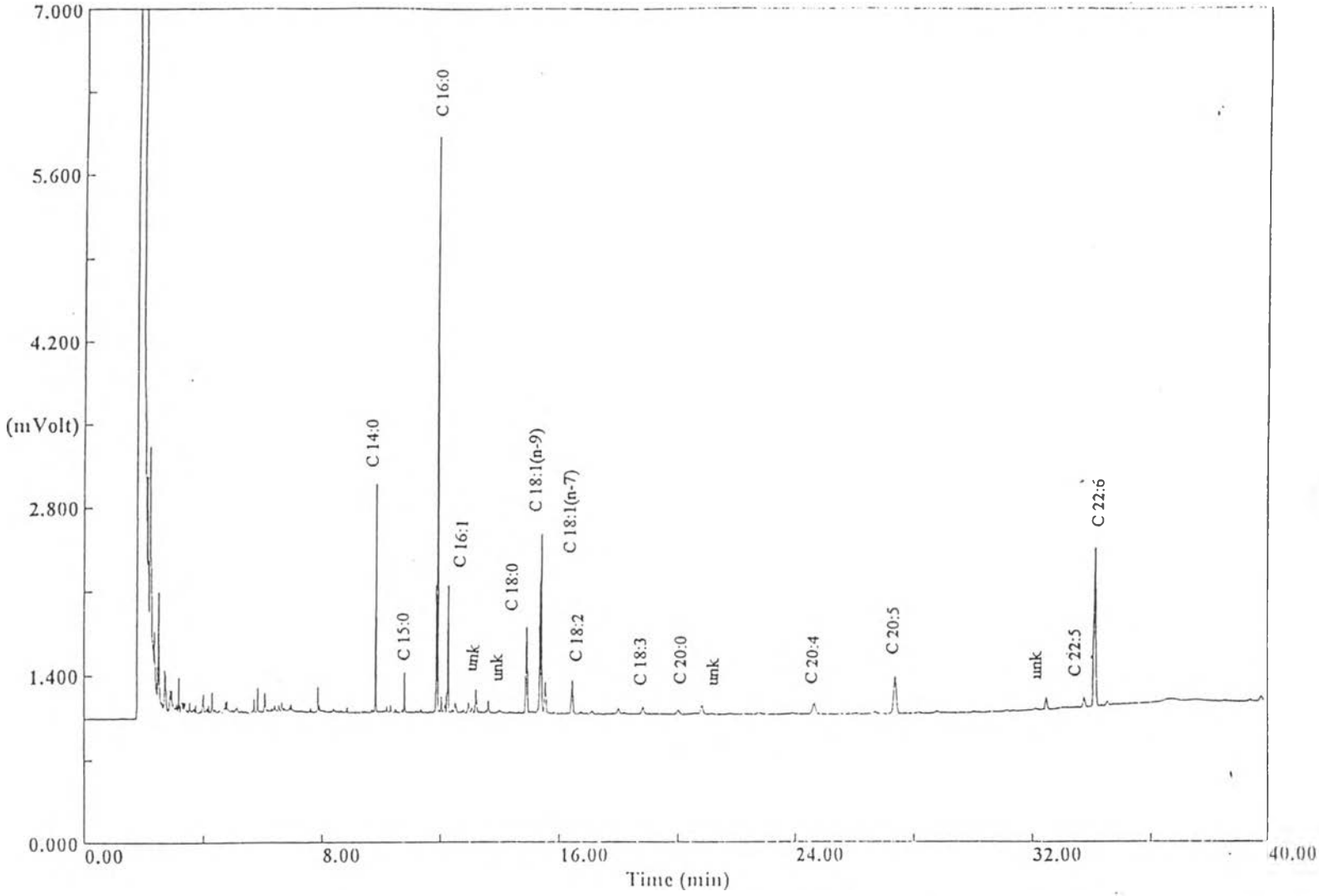

Figure 26 Gas-liquid chromatogram of fatty acid of Free - lecithin added diet (CD).

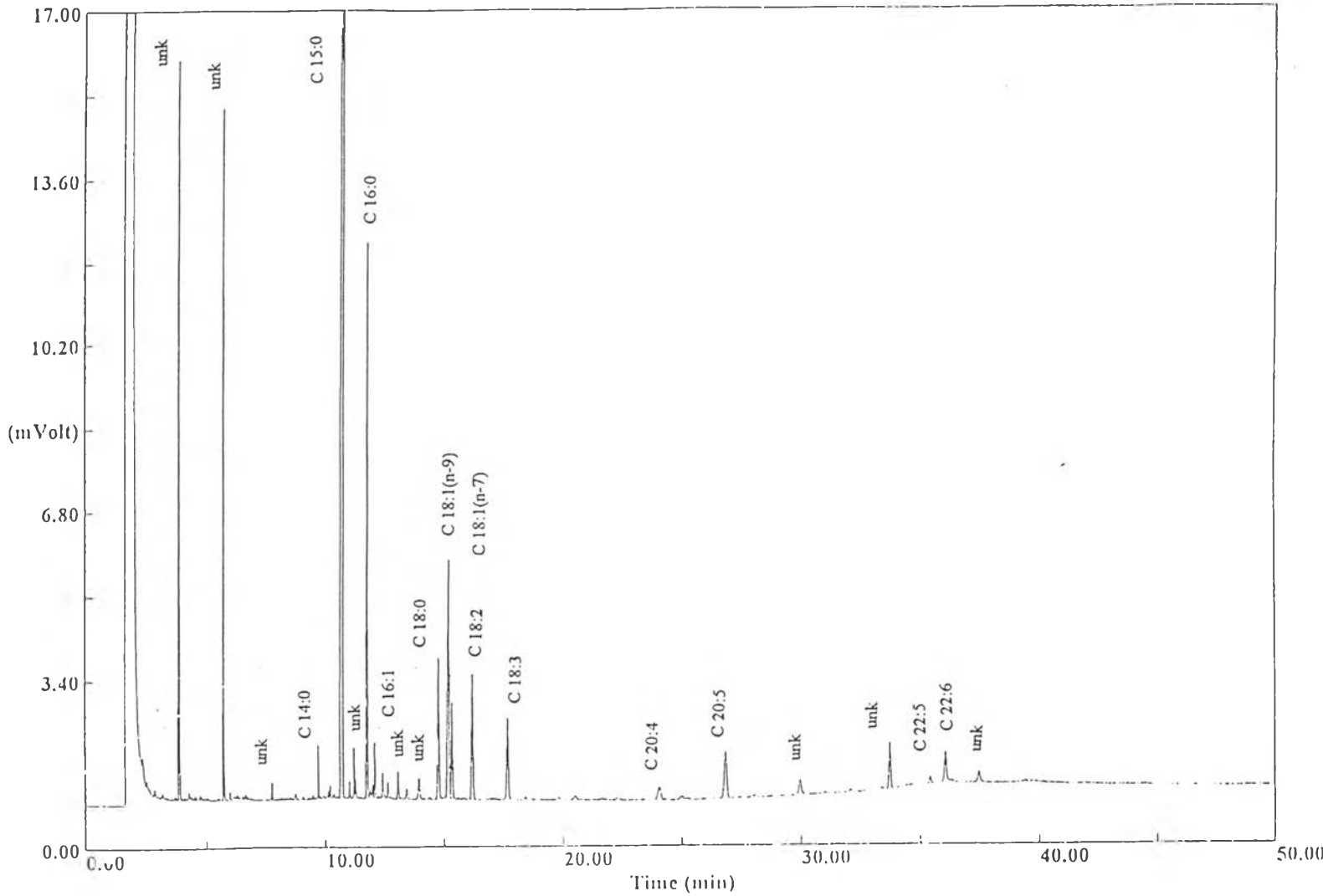

Figure 27 Gas-liquid chromatogram of fatty acid of sluimp fed SAD .

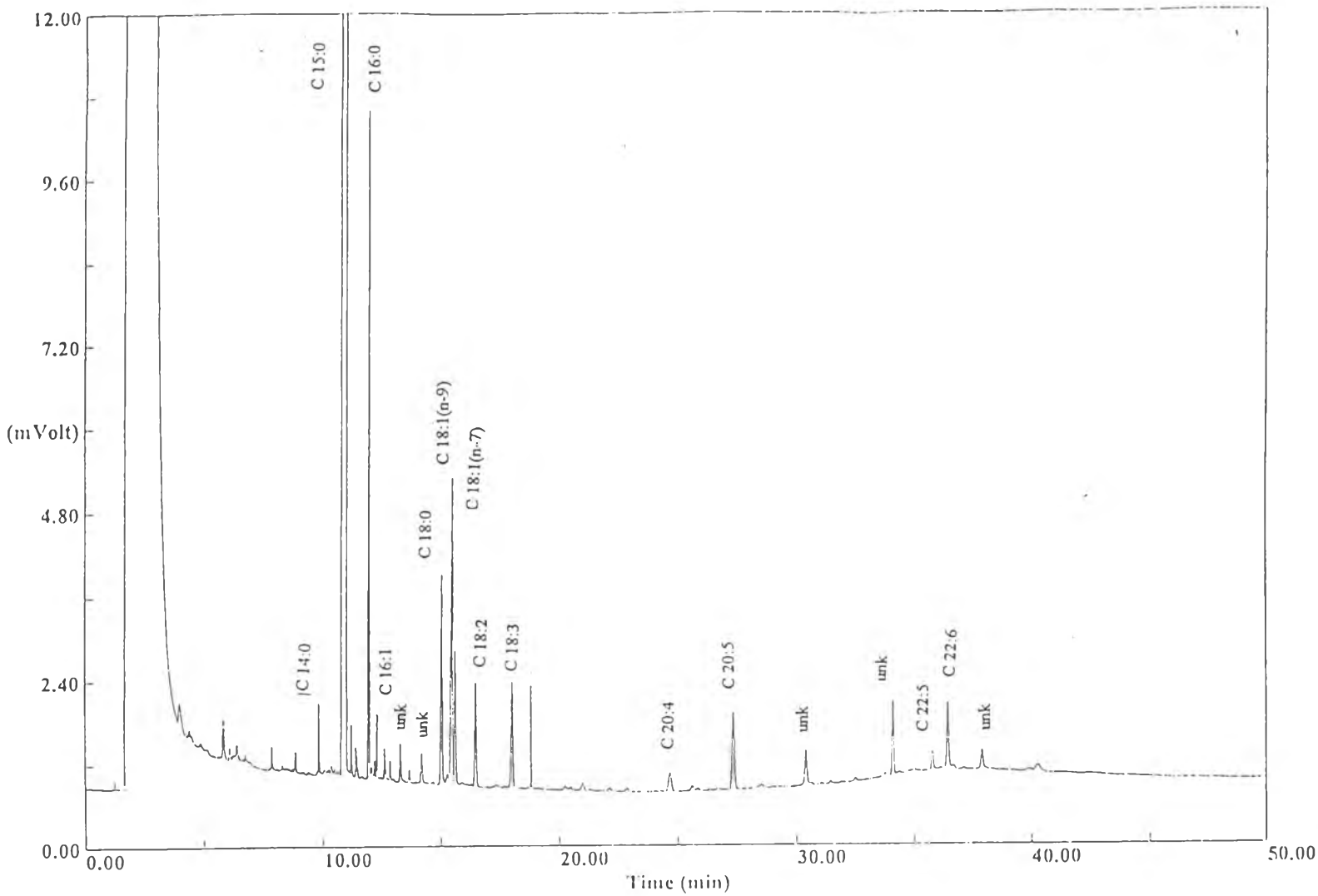

Figure 28 Gas-liquid chromatogram of fatty acid of shrimp fed DAD.

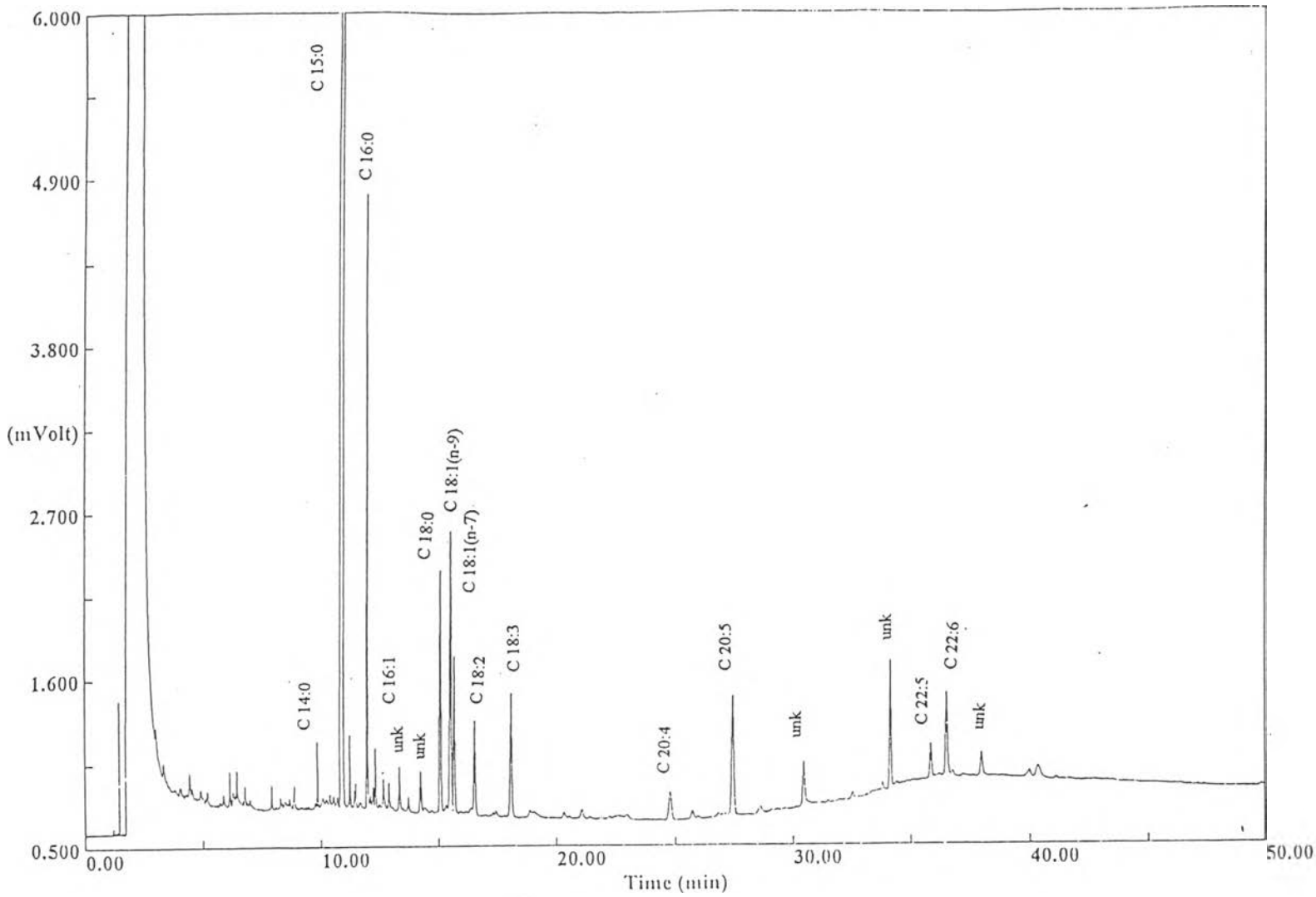

Figure 29 Gas-liquid chromatogram of fatty acid of shrimp fed LAD.

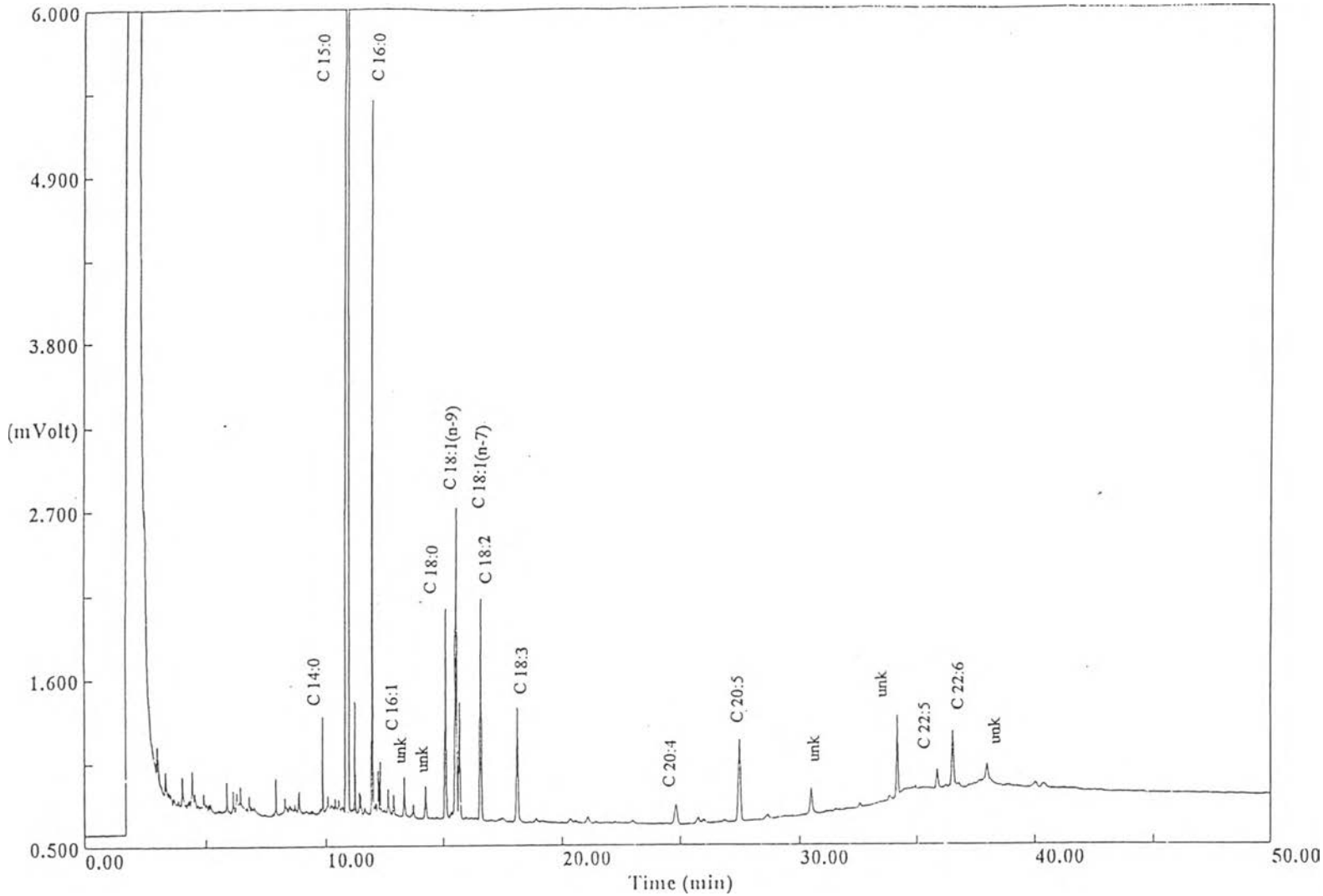

Figure 30 Gas-liquid chromatogram of fatty acid of shrimp fed CD.

BIOGRAPHY

Miss Pimporn Innopakun was born on Januray 22, 1973 in Saraburi Province, Thailand. She graduated with a Bachelor degree in Biology, Faculty of Science, Chulalongkorn University in 1995. She has studied for Master degree in Biotechnology Programme at Chulalongkorn University since 1995.