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Effects of Different Dietary Fats on Mammary Carcinogenesis[1]

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ABSTRACT

Mammary tumor induction was examined in female Fischer rats fed a low-corn oil, a high-corn oil, a high-lard, a high-beef tallow, or a high-coconut oil diet since weaning. The diets were prepared by adding the experimental fat to a basal diet containing sufficient essential fatty acids for growth. These diets differed only in the concentration or type of dietary fat. The rats were given a single i.v. dose (50 mg/kg body weight) of *N*-nitrosomethylurea at 50 days of age. Mammary tumor incidences 28 weeks after *N*-nitrosomethylurea treatment in rats on low-corn oil, high-corn oil, high-lard, high-beef tallow, and high-coconut oil diets were 33, 85, 65, 50, and 43%, respectively. The data show that an increase in fat intake enhances mammary carcinogenesis, but the magnitude of the increase depends on the type of fat. Further analyses showed that the total oleic and linoleic acid intake in the five groups of rats correlated positively ($r = 0.95$) with mammary tumor incidence, whereas the composition of the mammary tissue neutral lipids and phospholipids did not. Our data suggest that the total oleate and linoleate intake in the high-fat diet is the major factor influencing the incidence of tumors by *N*-nitrosomethylurea.

INTRODUCTION

It has been reported that dietary fats containing a high content of polyunsaturated fatty acids are more effective in the promotion of mammary tumor induction by a chemical carcinogen than are dietary fats containing a high content of saturated fatty acids (1, 4, 9). However, dietary fats such as coconut oil and beef tallow are deficient in essential fatty acids. Long-term feeding with these fats may lead to retarded somatic growth and development (5, 6), including mammary gland (12, 13) and tumors. Thus, the low mammary tumor incidence observed in these experiments using diets deficient in essential fatty acids could not be interpreted as due solely to the saturated fatty acid in the diet. On the other hand, rapeseed oil, which contains a high level of polyunsaturated fatty acids, does not enhance mammary carcinogenesis when it is fed to rats in large amounts (20%) (1). This appears to contradict the notion that polyunsaturated fatty acids play a crucial role in the enhancement of mammary carcinogenesis.

Hopkins and Carroll (7) reported in a recent study that the mammary tumor incidence in rats fed a high-fat diet of different types was similar if these diets contained 3% linoleate. This finding led these authors to conclude that concentration, rather than type, of dietary fat was the important factor in the increased incidence of tumors. However, King *et al.* (11) observed that rats fed a diet containing 18% stripped, hydrogenated coconut oil plus 2% linoleic acid had a lower mammary tumor yield than did those rats fed a diet containing 20% stripped corn oil. Rogers and Wetsel (15) reported that rats on a diet containing 30% beef tallow supplemented with 2% vegetable oil had a lower mammary tumor yield than did rats on a diet containing 15% vegetable oil. These observations seem to disagree with the conclusions from Hopkins and Carroll's experiments. However, it must be pointed out that, in Hopkins and Carroll's experiments, 3% linoleic acid was used, whereas the linoleic acid concentration was only 2% or less in the other 2 studies. It is conceivable that the difference in tumor yield in these experiments is due to the difference in the concentration of linoleic acid in the diets.

The present investigation was designed to determine whether different types of dietary fat exert different effects on carcinogenesis of the mammary gland by NMU.[3] Experiments were carried out by adding the test fat to the basal diet containing adequate amounts of essential fatty acids. In addition, the fatty acid composition of the mammary tissues of these rats on different diets was analyzed to determine whether a relationship exists between dietary fat and mammary tumor induction by NMU.

MATERIALS AND METHODS

Weanling female Fischer rats were purchased from Harlan/Sprague-Dawley, Madison, Wis. They were divided into 5 groups of 30 rats each and were fed a low-corn oil diet (Group 1), a high-corn oil diet (Group 2), a high-lard diet (Group 3), a high-beef tallow diet (Group 4), and a high-coconut oil diet (Group 5) beginning at the age of 21 to 25 days. The formulae of the high- and low-corn oil diets (Table 1) were based on that suggested by Newberne *et al.* (14) and prepared as described in our previous publication (2). It should be noted that a low-corn oil diet was also the low-fat diet (5% fat) and was fed to the rats in Group 1, which served as controls for this study. The food ingredients were purchased from ICN, Cleveland, Ohio. The rats were given a single dose of NMU (50 mg/kg body weight i.v.) at 50 days of age. Thereafter, the rats were examined weekly for palpable tumors. Mammary tumors detected were recorded and their size measured by vernier calipers weekly. Body weight was recorded biweekly. Twenty-eight weeks after NMU treatment, the rats were killed. At autopsy, mammary tumors were dissected out, fixed, sectioned, and examined for histological type. Only adenocarcinomas were tabulated.

Fatty Acid Analysis. The extraction method used was as described by Folch *et al.* (3). Briefly, 0.5 g of inguinal mammary gland (containing mammary tissues and fat pad) and mammary tumor from each rat in each dietary group were minced and homogenized in 10 ml chloroform:methanol (2:1, v/v, plus butylated hydroxytoluene at 10 μg/ml) in a glass:glass homogenizer. The homogenate was filtered through a fat-freed glass filter, followed by 2 rinses with a mixture of chloroform: methanol. The filtrate was mixed with one-fifth its volume of air-freed water. The filtrate was centrifuged at 1000 rpm for 5 min. The aqueous layer was removed without disturbing the interface, and the lower phase was washed twice with water:methanol:chloroform (47:48:3, v/

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[3] The abbreviation used is: NMU, *N*-nitrosomethylurea.

Table 1
Diet formulae

Diet	Casein (g)	Dex-trose (g)	Cellu-lose (g)	AIN[a] vitamin mix (g)	AIN mineral mix (g)	Methio-nine (g)	Choline bitar-trate (g)	Fat (g): Basal corn oil	Additional: Corn oil	Additional: Lard	Additional: Beef tal-low	Additional: Coconut oil
1. Low-corn oil	20.0	64.5	5.0	1.0	4.0	0.3	0.2	1.0	4.0			
2. High-corn oil	20.0	19.6	5.0	1.0	4.0	0.3	0.2	0.75[b]	24.25			
3. High-lard	20.0	19.6	5.0	1.0	4.0	0.3	0.2	0.75		24.25		
4. High-beef tallow	20.0	19.6	5.0	1.0	4.0	0.3	0.2	0.75			24.25	
5. High-coconut oil	20.0	19.6	5.0	1.0	4.0	0.3	0.2	0.75				24.25

[a] AIN, American Institute of Nutrition.
[b] Equivalent to 1% by weight of the high-fat diet and provides 1.75% of total calories.

Table 2
Mammary tumor incidence

Group	Diet	No. of rats at risk	Body wt (g) at 50 days	Body wt (g) at 125 days	Body wt (g) at 200 days	Mammary tumor incidence (%)	No. of tumors/rat	Latent period (wk)[a]
1	Low-corn oil	23	120 ± 2[b]	166 ± 3	185 ± 3	33	0.6	11
2	High-corn oil	26	125 ± 2	169 ± 2	187 ± 3	85[c]	1.5	8
3	High-lard	27	118 ± 2	176 ± 2	197 ± 4	63	1.0	9
4	High-beef tallow	30	117 ± 2	169 ± 2	190 ± 2	50	0.8	10
5	High-coconut oil	23	120 ± 2	173 ± 2	194 ± 3	43	0.6	13

[a] Time between NMU treatment and detection of first palpable mammary tumor.
[b] Mean ± S.E.
[c] Significantly different from Groups 1 and 5 by Student-Neuman-Keuls analysis, $S \cdot Q_{0.05} > D_{crit} = 0.38$.

v). The interface and the lower phase were rendered homogenous by adding methanol and were dried over a stream of nitrogen. The lipid obtained was layered onto a glass column containing 1 g silicic acid (Bio-Sil A, 100 to 200 mesh; Bio-Rad Laboratories, Richmond, Calif.) to separate the neutral and phospholipids by eluting initially with 10 ml chloroform to remove the neutral lipids and then with 8 ml methanol to remove the phospholipids. The efficacy of separation was checked by thin-layer chromatography. The quantity of each lipid fraction was determined gravimetrically.

Samples of tissue lipid fractions and dietary fats were transesterified by adding 0.5 ml of 0.5 N HCl in anhydrous methanol, flushed with nitrogen, and heated for 30 to 60 min at 75°. The fatty acid methyl esters obtained were analyzed by gas-liquid chromatography (Varian aerograph model 2100) and identified by comparing retention times to those of standards (dodecanoic methyl ester, tetradecanoic methyl ester, hexadecanoic methyl ester, arachidonic methyl ester, docosatetraenoic methyl ester, and docosahexaenoic methyl ester) obtained from Nu-Chek (Elysian, Minn.).

RESULTS

Mammary tumor incidence in 5 groups of rats receiving different types and concentrations of dietary fat is summarized in Table 2. The tumor incidence in rats fed a low-corn oil diet was 33% (Group 1), a high-corn oil diet was 85% (Group 2), a high-lard diet was 63% (Group 3), a high-beef tallow diet was 50% (Group 4), and a high-coconut oil diet was 43% (Group 5). The differences were significant between Groups 1 and 2 and between Groups 2 and 5. The first palpable mammary tumor detected in the 5 dietary groups of rats was in the order of high-corn oil > high-lard > high-beef tallow > low-corn oil > high-coconut oil. There were no differences in body weight or the rate of weight increase among the 5 groups of rats throughout the period of experimentation. The histology of the nontumorous mammary tissue in the 5 groups of rats on different dietary formulae showed no differences under light microscopic examination.

Adult female Fischer rats consumed an average of 43.2 kcal/day (2). Of this amount, 25.3 and 5.1 cal were derived from fat in the high- and low-fat diets, respectively. The calories from oleate and linoleate in the 5 diets used in this study are

Table 3
Caloric intake from oleate and linoleate per day by rats on the different diets

	kcal/day/rat[a]: High-corn oil	High-lard	High-beef tallow	High-coconut oil	Low-corn oil
18:1 oleate	6.0[a]	11.8	11.7	2.9	1.2
18:2 linoleate	16.0	3.7	1.6	1.2	3.2
Total	22.0	15.5	13.3	4.2	4.4

[a] Calculation based on an average of 43.2 kcal/day/rat.

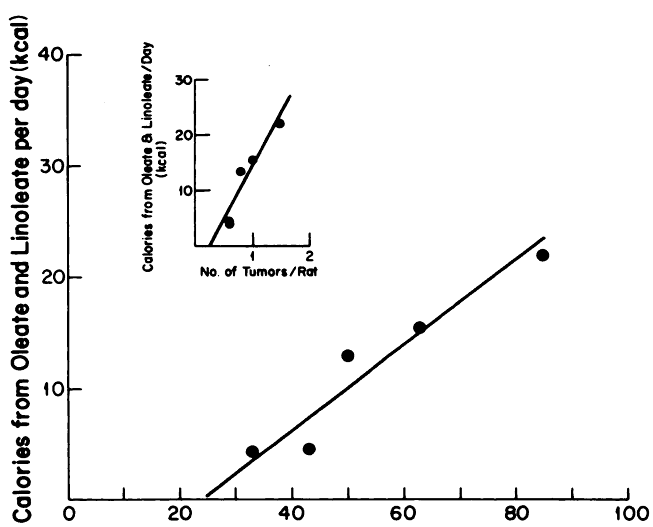

Chart 1. Calculated total oleate and linoleate intake plotted against mammary tumor incidence and number of tumors per rat (*inset*) in the 5 groups of rats. Total intake of oleate and linoleate is from Table 3; mammary tumor incidence and number of tumors are from Table 2.

presented in Table 3. The daily intake of linoleate shows a correlation ($r = 0.85$) with the mammary tumor incidence in these 5 groups of rats on different types of diet, whereas the intake of oleate does not ($r = 0.4$); however, when the total calories derived from daily oleate and linoleate intake are considered, an even better correlation ($r = 0.95$) emerges. Chart 1 depicts the correlation between the daily intake of oleate and linoleate and mammary tumor incidence in the 5 groups of rats. A similar correlation was observed when total oleate and linoleate intake was plotted against the number of tumors per rat (Chart 1, *inset*).

The results of the tissue lipid analyses are presented in Tables 4 to 7, and the fatty acid distribution in the dietary fats is presented in Table 8. Total neutral lipids and phospholipids in the mammary glands among the 5 groups of rats were not significantly different (Tables 4 and 6). Total neutral lipids and phospholipids in the mammary tumors in the 5 groups of rats were also similar (Tables 5 and 7). The data show that the mammary glands contained a higher amount of neutral lipids than did the mammary tumors, whereas the latter contained a higher amount of phospholipids than did the former.

The neutral lipids in the mammary glands and mammary tumor tissues of rats fed a high-corn oil diet contained higher linoleic acid (18:2) but less palmitic (16:0), palmitoleic (16:1), and oleic acid (18:1) as compared to those of rats fed low-corn oil diets (Tables 4 and 5). The neutral lipid profile of the mammary glands from rats on high-corn oil, high-lard, high-beef tallow, and high-coconut oil diets varied but reflected essentially the fatty acid composition of the specific dietary fats plus 1% corn oil in the diet (Table 4). This was also true in the mammary tumor tissues (Table 5). The phospholipid composition of the mammary tumor tissues from rats fed the high-corn oil diet also had a higher content of linoleic acid and a lower content of oleic acid (Table 7) than did that in rats on a low-corn oil diet. The phospholipid fatty acid composition of the mammary glands (Table 6) among the 4 groups of rats on different types of high-fat diets exhibited differences only in the content of 18:1 and 18:2 fatty acids. Rats on a high-corn oil diet had a higher content of linoleic acid and a lower level of oleic acid as compared to those of other groups of rats. The oleic and linoleic acid contents in the phospholipids of mammary tumors also followed the same pattern (Table 7) as those in mammary gland.

DISCUSSION

The 5 experimental diets used in the present study all contained a basal amount of corn oil (1% by weight) which provided 1.75% of total calories to the rats. Since 63.1% of the corn oil is linoleic acid, this basal amount of corn oil (1%) will therefore be sufficient to meet the requirements for essential fatty acids in the growing rats (6). A 4% by weight portion of corn oil or 32% by weight of corn oil, lard, beef tallow, or coconut oil was added to the basal diet to constitute the low-corn oil, high-corn

Table 4

Distribution of neutral lipid fatty acids in mammary fat pads

	Total % of neutral lipids in mammary glands				
Fatty acid[a] (mg/0.5 g, wet wt)	Group 1: low-corn oil	Group 2: high-corn oil	Group 3: high-lard	Group 4: high-beef tallow	Group 5: high-coconut oil
12:0			5.4 ± 0.9[b]		18.0 ± 3.2
14:0	1.2 ± 0.2	0.7 ± 0.1	4.8 ± 0.5	1.9 ± 0.3	11.6 ± 1.0
16:0	23.8 ± 2.0	12.7 ± 0.1	21.8 ± 0.7	19.6 ± 0.5	18.3 ± 0.8
16:1	5.9 ± 0.1	0.9 ± 0.1	3.4 ± 0.2	3.8 ± 0.3	4.6 ± 0.3
18:0	1.2 ± 0.1	2.4 ± 0.1	4.8 ± 0.2	7.0 ± 0.2	2.7 ± 0.2
18:1	35.5 ± 1.0	27.5 ± 0.4	46.7 ± 1.1	61.4 ± 1.0	35.3 ± 3.1
18:2	32.3 ± 1.0	55.2 ± 0.6	11.5 ± 0.8	6.1 ± 0.2	9.6 ± 0.5
18:3	Trace[c]	Trace	Trace	Trace	Trace
20:4	Trace	0.5 ± 0.1	Trace	Trace	Trace
Total neutral lipids	332.4 ± 28.3	328.3 ± 46.9	369.8 ± 15.4	388.5 ± 18.4	373.0 ± 32.8

[a] Fatty acids or methyl esters abbreviated as number of carbons in the chain:number of double bonds.
[b] Mean ± S.E. of 4 samples.
[c] <0.2%.

Table 5

Distribution of fatty acids in the neutral lipids of mammary tumors

	Total % of neutral lipids in mammary tumors				
Fatty acid[a] (mg/0.5 g, wet wt)	Group 1: low-corn oil	Group 2: high-corn oil	Group 3: high-lard	Group 4: high-beef tallow	Group 5: high-coconut oil
12:0			5.4 ± 1.0		18.2 ± 3.8
14:0	2.0 ± 0.1[b]	2.3 ± 0.4	4.9 ± 0.7	3.7 ± 1.1	13.1 ± 1.1
16:0	24.9 ± 1.0	15.5 ± 0.8	23.7 ± 2.1	18.8 ± 0.9	18.6 ± 0.6
16:1	5.8 ± 0.3	1.9 ± 0.4	4.3 ± 0.2	3.4 ± 0.3	5.0 ± 0.8
18:0	1.8 ± 0.1	2.8 ± 0.2	6.3 ± 1.1	7.5 ± 0.8	2.7 ± 0.4
18:1	37.5 ± 0.5	27.0 ± 0.4	44.2 ± 1.7	59.1 ± 1.8	32.7 ± 3.0
18:2	27.3 ± 0.6	49.6 ± 1.3	10.7 ± 0.7	5.8 ± 0.4	8.7 ± 0.8
18:3	Trace[c]	Trace	Trace	Trace	Trace
20:4	Trace	1.3 ± 0.2	1.2 ± 0.2	1.3 ± 0.3	0.8 ± 0.3
Total neutral lipids	23.5 ± 2.2	23.8 ± 5.9	28.8 ± 11.0	29.5 ± 13.5	25.0 ± 6.4

[a] Fatty acids or methyl esters are abbreviated as number of carbons in the chain:number of double bonds.
[b] Mean ± S.E. of 4 samples.
[c] <0.2%.

Table 6

Distribution of fatty acids in the phospholipids of mammary fat pads

Fatty acid[a] (mg/0.5 g, wet wt)	Total % of phospholipids in mammary glands				
	Group 1: low-corn oil	Group 2: high-corn oil	Group 3: high-lard	Group 4: high-beef tallow	Group 5: high-coconut oil
12:0					1.9 ± 0.8[b]
14:0	0.4 ± 0.3	Trace[c]	1.2 ± 0.2	1.0 ± 0.1	3.2 ± 0.8
16:0	17.2 ± 1.0	15.0 ± 0.9	16.0 ± 0.6	15.3 ± 0.9	18.3 ± 0.1
16:1	1.6 ± 0.02	0.8 ± 0.1	1.4 ± 0.3	1.5 ± 0.3	2.3 ± 0.2
18:0	16.7 ± 0.9	20.3 ± 0.9	20.2 ± 2.4	17.9 ± 3.0	17.0 ± 2.2
18:1	19.1 ± 1.0	15.8 ± 0.5	26.9 ± 4.0	37.1 ± 5.9	25.2 ± 3.4
18:2	17.2 ± 2.3	16.6 ± 3.3	10.3 ± 0.8	6.9 ± 0.9	9.5 ± 0.6
18:3	0.2 ± 0.1	0.3 ± 0.1	0.3 ± 0.1	0.4 ± 0.1	0.3 ± 0.1
20:1	Trace	Trace	Trace	Trace	Trace
20:2	Trace	Trace	Trace	Trace	Trace
20:3	Trace	Trace	Trace	Trace	Trace
20:4	20.1 ± 2.5	22.5 ± 1.8	18.4 ± 2.3	16.1 ± 3.5	18.8 ± 2.4
22:4	4.1 ± 0.04	4.6 ± 0.5	3.0 ± 0.4	2.0 ± 0.8	2.0 ± 0.4
22:5	2.2 ± 0.02	1.9 ± 0.5	1.6 ± 0.3	1.8 ± 0.3	2.0 ± 0.5
22:6	1.0 ± 0.04	0.6 ± 0.3	1.1 ± 0.6	0.5 ± 0.1	0.3 ± 0.1
Total phospholipids	3.0 ± 0.2	4.0 ± 0.6	5.5 ± 2.1	5.0 ± 1.1	3.0 ± 1.2

[a] Fatty acids or methyl esters are abbreviated as number of carbons in the chain:number of double bonds.
[b] Mean ± S.E. of 4 samples.
[c] <0.2%.

Table 7

Distribution of fatty acids in the phospholipids of mammary tumors

Fatty acids[a] (mg/0.5 g, wet wt)	Total % of phospholipids in mammary tumors				
	Group 1: low-corn oil	Group 2: high-corn oil	Group 3: high-lard	Group 4: high-beef tallow	Group 5: high-coconut oil
12:0			Trace[b]		0.6 ± 0.1
14:0	0.4 ± 0.04[c]	Trace	0.8 ± 0.1	0.5 ± 0.1	1.7 ± 0.4
16:0	19.3 ± 0.1	17.6 ± 0.9	18.8 ± 1.8	17.5 ± 1.1	18.0 ± 2.0
16:1	0.7 ± 0.04	1.7 ± 0.3	1.9 ± 0.3	1.7 ± 0.3	1.8 ± 0.2
18:0	18.4 ± 0.2	18.4 ± 1.1	19.4 ± 0.9	18.9 ± 0.6	17.7 ± 0.6
18:1	19.7 ± 0.3	15.6 ± 1.1	19.3 ± 1.1	21.3 ± 1.5	19.3 ± 1.1
18:2	6.5 ± 0.1	11.5 ± 3.4	3.9 ± 0.4	3.4 ± 0.2	3.6 ± 0.1
18:3	0.2 ± 0.1	0.3 ± 0.1	0.3 ± 0.1	0.2 ± 0.1	2.0 ± 0.1
20:1	Trace	Trace	Trace	Trace	Trace
20:2	Trace	Trace	Trace	Trace	Trace
20:3	Trace	Trace	Trace	Trace	Trace
20:4	25.6 ± 0.1	24.8 ± 2.3	26.7 ± 2.2	28.4 ± 1.9	29.0 ± 1.9
22:4	4.3 ± 0.05	5.0 ± 0.3	4.3 ± 0.2	3.8 ± 0.5	3.7 ± 0.2
22:5	3.1 ± 0.03	2.1 ± 0.4	2.5 ± 0.5	2.0 ± 0.3	2.0 ± 0.2
22:6	1.0 ± 0.01	1.3 ± 0.3	1.3 ± 0.1	1.2 ± 0.2	1.4 ± 0.1
Total phospholipids	6.0 ± 0.9	5.8 ± 0.5	9.2 ± 2.0	6.2 ± 0.8	8.2 ± 1.7

[a] Fatty acids or methyl esters are abbreviated as number of carbons in the chain:number of double bonds.
[b] <0.2%.
[c] Mean ± S.E. of 4 samples.

Table 8

Fatty acid profile of the dietary fats

Fatty acid[a]	% of fatty acid distribution in the dietary fats			
	Corn oil	Lard	Beef tallow	Coconut oil
10:0				0.8[b]
12:0		0.2		41.9
14:0		2.5	2.4	25.8
16:0	11.0	22.0	25.9	14.6
16:1		3.0	4.7	
18:0	1.6	12.4	15.9	3.1
18:1	23.5	47.0	46.7	11.1
18:2	63.1	12.9	4.4	2.7
18:3	0.8	Trace[c]		

[a] Fatty acids or methyl esters are abbreviated as number of carbons in the chain:number of double bonds.
[b] Mean of 3 samples.
[c] <0.2%.

oil, high-lard, high-beef tallow, and high-coconut oil diets, respectively. These diets differed only in the concentration (low-corn oil *versus* high-corn oil) or type of fat (the 4 high-fat diets). Rats on these diets have a similar caloric intake and consume the same amount of each food ingredient except fat and dextrose (2, 14). Thus, the experiments compared an increased fat and a decreased dextrose intake (Group 2) to a decreased fat and an increased dextrose intake (Group 1) and the effects of different types of fat in the diet on mammary carcinogenesis in the 4 groups of rats on the high-fat diets.

When the concentration of corn oil in the diet was increased from 5 to 33%, mammary tumor incidence rose from 33 to 85%. When the dietary fat increase was in lard, beef tallow, or coconut oil, the mammary tumor incidences were 63, 50, and 43%, respectively. The data clearly show that the magnitude of increase in mammary tumor incidence was dependent on the type of dietary fat these rats consumed. Corn oil was more efficient in enhancing mammary carcinogenesis than were lard, beef tallow, or coconut oil. The increase in tumor incidence above the control (low-corn oil) was significant in rats fed a high-corn oil diet but was not significant in rats on high-lard, high-beef tallow, or high-coconut oil diets. The present data, therefore, do not support the notion that it is the concentration, rather than the type, of fat in the diet that is critical in enhancing mammary carcinogenesis (7). King *et al.* (11) and Rogers and Wetsel (15) also reported that diets containing high coconut oil and beef tallow, supplemented with 2% linoleic acid and vegetable oil, respectively, were not as efficient as diets containing high levels of corn oil or vegetable oil in enhancing mammary carcinogenesis.

Fatty acid analyses showed that an increase in corn oil intake (Group 1 *versus* Group 2) raised the linoleic acid content in both the neutral lipids and phospholipids of the mammary tissues. This was accompanied by a lower palmitic and oleic acid content. Rats on a high-corn oil diet also had a higher content of linoleic acid and a lower content of oleic acid in the mammary tissues as compared to rats on high-beef tallow and high-coconut oil diets. When the linoleic acid content in the neutral lipids and phospholipids of the mammary tissues in the 5 groups of rats was compared, no relationship between the tissue linoleic acid contents and mammary tumor incidence was observed. Hopkins *et al.* (8) recently reported that rats fed a high-fat diet developed a higher incidence of tumors and also had a higher phospholipid unsaturation index in the mammary tissue. In the present experiments, we failed to find a positive correlation between the phospholipid unsaturation indices in mammary tissues and mammary tumor incidence among the 5 groups of rats. Our data, however, disclosed a good correlation between total oleate and linoleate intake and mammary tumor incidence in these rats. It appears that the total intake of oleate and linoleate plays an important role in mammary carcinogenesis in rats on a high-fat diet. In this connection, it may be suggested that the lack of tumor-enhancing effect of rapeseed oil (1), which is high in polyunsaturated fatty acids, may indeed be due to a lower content of oleate and linoleate. Kidwell *et al.* (10, 16) demonstrated that oleate and linoleate stimulated both normal and neoplastic mammary epithelial cell growth *in vitro*. The growth-stimulating effects of oleate and linoleate may explain their relationship to mammary carcinogenesis.

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