No isomerization of a mono-acetylenic compound, 3-nonyne, in the presence of sodamide in liquid ammonia has been observed by Vaughn and others (17). It is also known that the *balanced disubstituted monoacetylenes* undergo less rearrangement in the presence of sodamide in liquid ammonia (12) than the unsymmetrical compounds. This may explain the low yields of phenyl acetylene and 10-undecynoic acid obtained in this study.

From these results it may be concluded that the dehydrohalogenation reaction by sodamide can be effectively applied to α,β-dibromo compounds and not to other polybromo-derivatives. Such reaction runs smoothly without appreciable side reactions if the bromine atoms are located close to the middle of the C-chain of a comparatively large molecule.

Summary

The advantages of dehydrohalogenation by sodamide in liquid ammonia over the alcoholic potassium hydroxide method are noted. The sodamide reaction is found to be a mild and quite suitable reaction for the preparation of mono-acetylenic acids (especially those having long and balanced alkyl groups on either side of the triple bond) by dehydrobromination of the dibromides obtained from the corresponding olefinic compounds. Dehydrobromination of tetrabromostearic acid was unsuccessful. A large laboratory scale preparation of stearolic acid has been accomplished. Stearolic acid and 9,10-diketo-stearic were prepared from the crude olive oil acids. A procedure for detecting oleic acid and stearolic acid in mixtures has been outlined. The sodamide dehydrohalogenation method has been successfully applied to the preparation of 6-octadecynoic acid (for the first time from a natural source, petroselinic acid), phenyl acetylene and 10-undecynoic acid from their parent olefinic compounds. An explanation for the low yields of the last two substances has been offered.

Acknowledgment

The author wishes to thank C. L. Wilson of the Chemistry Department, Ohio State University, Columbus, for the infrared spectrum of stearolic acid and J. R. Chipault of the Hormel Institute for his kind help. He also takes this opportunity to thank S. A. Fusari of Park Davis and Company, Detroit, Mich., who supplied petroselinic acid and 8-stearolic acid; and W. F. Huber of Procter and Gamble, Cincinnati, O., who supplied 10-octadecenoic acid used for the preparation of 10-stearolic acid and 10,11-diketostearic acid. He is grateful to the authorities of the American Petroleum Institute project at Ohio State University for facilities in running the large-scale sodamide reactions and the freezing point curve.

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[Received December 1, 1952]

Supply and Consumption of Oils and Fats[1]

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THE best data (1) available on the production and the consumption of visible oils and fats have been compiled and are presented herewith in two sections. The first is on a world basis and the second is for the U.S.A. It should be emphasized that only visible oils and fats are considered and that the data for the world as a whole necessarily include some estimates. Furthermore no adjustment has been made for differences in the world carry-over from one year to the next, which means that production and consumption are treated as interchangeable terms. Even with these limitations however we accept the figures given as being reasonably accurate, probably within the range of ±10%. For the convenience of the reader the data are shown in terms of pounds per capita when this is practicable.

I. The pre-war world average annual production and consumption of visible fats was around 20-22 lb. per capita. During the war it fell to about 15 lb., but it has now risen to about 23 lb. Approximately 60% comes from vegetable seeds and 40% from animal sources. A high proportion, possible 85%, is considered to be of edible quailty as produced, not necessarily by U. S. standards but as judged by the standards of the areas involved. The more important of the individual oils and fats are shown in Table I.

It is estimated that 70-80% of the total production is consumed in the countries of origin and only 20-30% moves into the international markets. Western Europe is the main market for the fats that cross national boundaries, for most of the western European nations depend on imported fats to make up their deficits. Ireland, Spain, and Denmark are the only nations in this group that produce as much as they consume. Pre-war, the others produced on the average about 50% of their requirements, but Great Britain produced only 10%. At the present time these countries are probably doing somewhat better than

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[1] Presented before the Regional Meeting of the American Institute of Chemical Engineers, Cincinnati, O., April 24, 1953.

TABLE I

Estimated Visible World Fats (1952)

Kind	Weight (mil. lb.)	Percentage	Lbs. per capita
Butter	9,000	15.5	3.6
Lard	7,200	12.5	2.9
Peanut oil	5.500	9.5	2.2
Inedible tallow and grease	5.400	9.4	2.2
Soybean oil	4,600	8.0	1.9
Cottonseed oil	4,000	7.0	1.6
Rapeseed oil	3,500	6.1	1.4
Coconut oil	3,000	5.2	1.2
Linseed oil	2,600	4.5	1.1
Olive oil	2,000	3.5	0.8
Sunflower oil	2,000	3.5	0.8
Marine oils	1,725	3.0	0.7
Sesame oil	1,550	2.7	0.6
Palm oil	1,250	2.2	0.5
Others	4,175	7.4	1.7
Total	57,500	100.0	23.2

pre-war, but we have no reliable data. The principal exporting nations before the war were India, Malaya, the East Indies (now Indonesia), the Philippines, China, and Africa. During the war the supply from the far east was lost entirely and the U.S.A. changed from an importing to an exporting nation to make up as much of the deficit as possible. Since the war the Philippines have outdone their pre-war record and Africa has done well, but the other nations on the above list are either down in their exports or out entirely as in the case of China. India is down because it is more prosperous and can afford to consume more of the fats produced, and both Indonesia and Malaya are low because of a combination of war damage and disturbed political conditions.

While the world fat consumption now averages around 23 lb., the deviations from that average shown by different countries are quite wide. For example, the low point in U. S. consumption came in 1945 when it was 62.6 lb., but we used 76.7 lb. in 1941 and our long time average is between 68 and 69 lb. In England and other countries of western Europe the average is probably around 60 lb. per capita while in southeastern Asia, where a large part of the fat sold in the world's markets is produced, the average consumption is very low. In India they had about 14-15 lb. pre-war, but during the war this was reduced to about 11 lb. We have no figures for China but can be sure they are lower still. While the visible fats we have listed are only part of the total consumed, we have no information on how large a part they represent. Nevertheless the total amount of fats that these people get are not enough to satisfy them, and it is an interesting puzzle to figure out what will happen when and if the over-populated areas of Asia, which account for a large share of the world's population, ever get to the economic stage where they can satisfy—even partly—their perennial hunger for fats. A relatively small increase in their income would probably result in their consuming not only all the fat now exported but might turn these countries into imporers of fat—if it could be found. Partly compensating factors are the probability that higher incomes would result in improved equipment and better technology so that higher yields would result from the oil seeds crushed. Even with a high recovery however the amounts of oil and fat that might now be made available are much below the level that is desired and needed as food for the people.

The proportion of the visible fats available that is used as food varies widely, but we estimate the average to be around 85%. Pre-war it was about 96.5% in India and probably a higher percentage in China. At the other extreme is the U.S.A. with around 60-65% used as food and with 35-40% left over for such uses as soap, paint, etc.

II. Turning now to the U.S.A., we find that prewar we were an importing nation, producing around 85% of the fats consumed and bringing in about 15% of our requirements, mostly palm and coconut oils from the Orient. Actually the trade picture was somewhat more complicated than that indicates as some of our higher priced lard and cottonseed oil moved to Europe where they were preferred and were replaced in the United States by cheaper oils. Consequently the above refers to the net position. As a result of the shortages brought about by World War II our production of fats and oils was increased about 50% to satisfy the needs of ourselves and our allies. The increase derived mainly from soybean oil, but linseed oil, lard, and inedible tallow and grease also showed marked gains. That wartime increase in production has largely been held, but our population increase of almost 20% during the interval has reduced our exportable surplus accordingly. The production last year was just over 12.3 billion pounds with net exports of slightly more than 1.5 billion, and a net domestic disappearance of 10.2 billion pounds or 65.5 lb. per capita. Before breaking down our consumption however, we should look at the sources and identities of the oils and fats we produce. First, dividing the fats produced into edible and inedible grades, we find they run about 70% edible and 30% inedible. Then dividing them according to origins, we find that 56% came from animal sources and 44% from vegetable oil seeds. The more important of the different oils and fats and their percentages of the total production are shown in Table II.

TABLE II

Oils and Fats Produced (U. S. 1952)

	Weight (mil. lb.)	Percentage	Lbs. per capita
Lard and rendered pork fat	2,887	23.3	18.6
Soybean oil	2,478	20.1	16.0
Inedible tallow and grease	2,318	18.8	15.0
Cottonseed oil	1,708	13.8	11.0
Butter, actual weight	1.435	11.6	9.3
(fat content)	(1,150)	......	(7.4)
Linseed oil	545	4.4	3.5
All others	970	8.0	6.3
Total, actual weight	12,341	100.0	79.7
Total, (fat content)	(12,056)	......	(77.8)

As indicated above, the total disappearance of fats reached a high of 76.7 lb. in 1941 when there was an adequate supply and the housewives obviously stocked up for the war period everybody feared was ahead. A little later the low point of 62.6 lb. was reached during the war year of 1945, but the average since 1937 has been 68.5 lb. per capita. Of this amount about 43.8 lb. was used as food and 24.7 lb. has gone for non-food uses. For comparison the disappearance during 1952 was 65.5 lb. per capita, of which 43.9 lb. went for food and 21.6 lb. went for non-food uses. The breakdowns for both the food and the non-food uses are shown in Table III.

It is of interest to note that while the consumptions of butter and margarine were almost equal in 1952, the butter consumption just 20 years earlier was 14.5 lb. fat basis as compared to 1.3 lb. for margarine.

One other item of possible interest is the probable relation between the quantity of visible fats used for

TABLE III

Oils and Fats Consumed as Food (1952)

	Weight (mil.lb.)		Percentage		Lbs. per capita	
Spreads						
Butter (fat content)	1,080		15.9		7.0	
Margarine (fat content)	975		14.3		6.3	
		2,055		30.2		13.3
Cooking fats						
Lard	1,816		26.6		11.7	
Shortenings	1,562		23.0		10.1	
		3,378		49.6		21.8
Salad oils,etc.		1,373		20.2		8.8
Total		6,806		100.0		43.9

food and the total fat intake. If we can accept as typical a 2,500-calory diet which runs 20-25% fats, such as has generally been recommended, it indicates the consumption of about 92.5 lb. of fat per year. This would mean that the 43-44 lb. of visible fats we use in the U.S.A. is somewhat less than half the total of our food fats. Presumably the Indians and the Chinese who average a very low consumption of visible fats, as indicated earlier, get an even larger proportion of their total as non-visible fats, but we have no information on that point.

The fats used for non-food purposes have averaged about 24.7 lb. during recent years, but last year the total was 21.6 lb. The breakdown of this latter figure is shown in Table IV.

TABLE IV

Non-Food Fats Consumed (1952)

Uses	Weight (mil. lb.)	Percentage	Lbs. per capita
Soap	1,203	36.0	7.7
Drying oils	914	27.0	5.9
Other industrial uses	1,236	37.0	8.0
Total	3,353	100.0	21.6

Summarizing the above information, we conclude that the world as a whole suffers from a chronic deficiency in fats and the supply is so short that most of the visible fats are used as food, leaving only minor amounts for non-food uses such as soap, paint, etc. Any marked increase in the living standards of the more populous areas of the world will probably change the latter from exporting to importing areas and will sharply reduce the supply available to Europe and the other importing nations. The supply of visible fats can be materially increased but not enough to satisfy the needs of the people, and it is doubtful that it can increase fast enough to gain on the rapidly increasing world population.

In contrast with the world's limited fat supply and unfavorable prospects for the future the U.S.A. now has, and should continue to have, an adequate supply. We have an adequate supply because there is a demand for vegetable oils for certain food products even at premium prices. At the same time the animal fats, representing the larger share of our total production and coming as necessary by-products from the meat we eat, continue to be produced in large volume. As a result we are able to consume on a per capita basis three times the world average consumption and still have a surplus. Parenthetically it might be pointed out that this surplus has tended to accumulate in the United States rather than to move into export channels in normal fashion due to financial and other controls applied by foreign governments.

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[Received May 19, 1953]

Esters of Polyallyl Alcohols as Protective Coating Vehicles[1]

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THE allyl grouping has been studied extensively by oil chemists for the purpose of producing industrially useful allylic esters of fatty acids. A few of the approaches involve consideration of the following potentialities:

a) Esterification of monomeric drying oil fatty acids with allyl alcohol followed by polymerization of the monomeric esters.
b) Esterification of polymeric fatty acids with allyl alcohol.
c) Esterification of monomeric drying oil fatty acids with polymeric allyl alcohol.

This laboratory (16) in 1944 prepared the allyl ester of linseed fatty acids by alcoholysis of linseed oil. This ester was purified by double distillation. Attempts to polymerize the crude or purified products to give a drying oil were largely negative, using organic peroxides such as benzoyl peroxide and tertiary butyl hydroperoxide at high catalytic levels. Teeter and Cowan (15) reported the preparation of the allyl esters of polymeric soybean fatty acids by direct esterification and the corresponding ester from dilinoleic acids by alcoholysis of methyl dilinoleate. These products likewise possessed only a limited capacity for copolymerization.

Allyl alcohol is quite stable at temperatures below 100°F. undergoing neither polymerization nor other changes for long periods (14). Bradley (5) describes a procedure for preparing polyallyl alcohol by the passage of oxygen through purified allyl alcohol, maintained near the refluxing temperature. Products prepared by this process varied from 5 to 16 hydroxyl groups per molecule, depending upon the experimental conditions. Other methods of polymerizing allyl alcohol have been reported, including saponification of diallyloxalate (11), the peroxide-induced polymerization of allyl acetate (3), the use of a polymerization accelerator, *e.g.*, diallyl ether, under the influence of heat and pure oxygen (6), and the emulsion polymerization of allyl acetate (15).

Polyallyl alcohol is generally considered to contain one double bond per molecule and the structure is believed to be linear with each hydroxyl group primary. This polyhydric alcohol is soluble in water, alcohols, glycols, and only slightly soluble in hydrocarbons. It

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[1] Presented at the Fall Meeting, American Oil Chemists' Society, San Francisco, Calif., Sept. 26-28, 1950.

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