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Itaconic Acid Derivatives Of Sulfanilamide and Sulfone

Malcolm J. Thompson
Xavier University of Louisiana

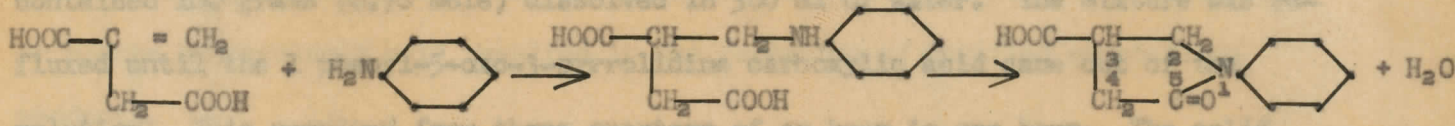
ITACONIC ACID DERIVATIVES OF SULFANILAMIDE AND SULFONE

By Malcolm J. Thompson

Part I.--Itaconic acid derivatives of Sulfanilamide involving 1(p-Chloro sulfonyl)-phenyl-5-oxo-3-carboxylic acid[1] with primary amines.

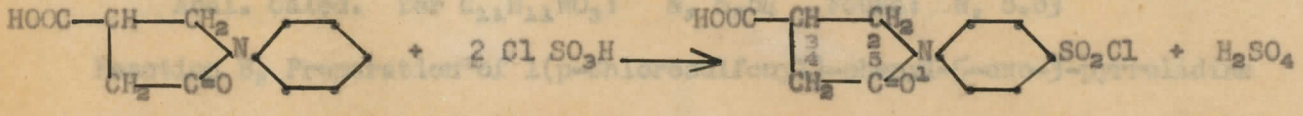
In this investigation thirty-eight itaconic acid derivatives of sulfanilamide, 1(p-Sulfamyl)-phenyl-5-oxo-3-pyrrolidine carboxylic acid were synthesized. Before this problem could be brought to a successful conclusion, two essential compounds were initially prepared. The first, 1 phenyl-5-oxo-3-pyrrolidine carboxylic acid, was formed by the interaction of aniline and itaconic acid, the second by condensation of 1 phenyl-5-oxo-3-pyrrolidine carboxylic acid with chlorosulfonic acid to give 1(p-Chlorosulfonyl)-phenyl-5-oxo-3-pyrrolidine carboxylic acid.

This interaction of aniline with methylene succinic acid (itaconic acid) to give 1 phenyl-5-oxo-3-pyrrolidine carboxylic acid had previously been studied and reported[2]. The probable mechanism for this reaction is:[1]



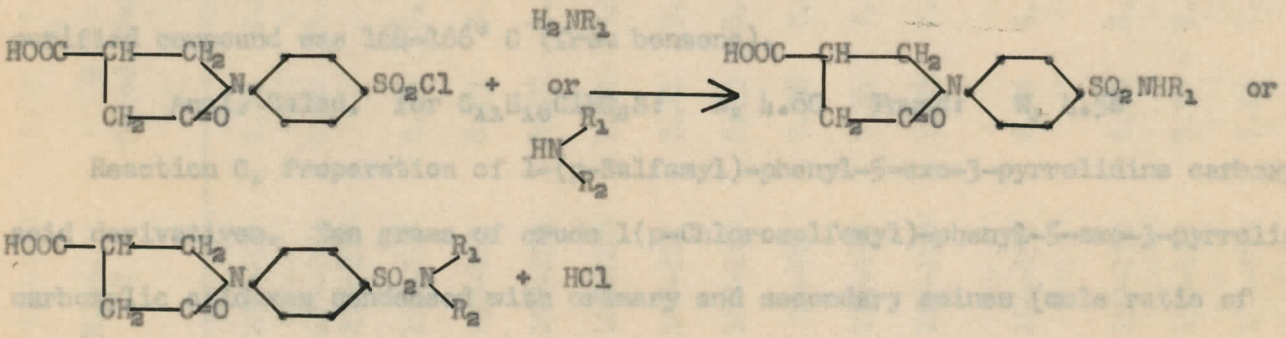
and will be referred to as carboxy pyrrolidination.

It has been shown[2e] that chlorosulfonation of 1 phenyl-5-oxo-3-pyrrolidine carboxylic acid yields chiefly 1(p-Chlorosulfonyl)-phenyl-5-oxo-3-pyrrolidine carboxylic acid at 60-65° C.



1. Nomenclature; Chemical Abstracts, 44, 1950.
2. (a) Gottlieb, Ann., 77, P. 284, 1851; (b) Michael and Palmer, Am. Chem. J., 9, P. 199, 1887; (c) Scharfenberg, Ann., 254, P. 149, 1889; (d) Anschutz and Reuter, Ann., 254, P. 129, 1889; (e) Paytash, Gathe and Sparrow, J. Am. Chem. Soc., 72, P. 1415, 1950.

During the investigation thirty-eight of the forty-five amines studied formed the desirable compounds, namely: 1-(p-Sulfamyl)-phenyl-5-oxo-3-pyrrolidine carboxylic acid derivatives. They are listed in Table I with their corresponding analytical data. There were seven derivatives that could not be confirmed either because of insufficient analytical data or unsuccessful synthesis.



Experimental

Reaction A, Preparation of 1 phenyl-5-oxo-3-pyrrolidine carboxylic acid.--Fifty grams (0.53 mole) of aniline was placed in a 500 ml Erlenmeyer flask which contained 100 grams (0.76 mole) dissolved in 300 ml of water. The mixture was refluxed until the 1 phenyl-5-oxo-3-pyrrolidine carboxylic acid came out of the solution. This required from three quarters of an hour to one hour. The solid precipitate was collected and purified by dissolving the free acid in 6 N sodium hydroxide and adding activated charcoal, finally reprecipitating the compound by making acid to litmus with dilute hydrochloric acid. The crude yield was 95-100 grams (87-92%). The purified compound melted at 190-191° C.

Anal. Calcd. for $C_{11}H_{11}NO_3$: N, 6.84 Found: N, 6.83

Reaction B, Preparation of 1(p-Chlorosulfonyl)-phenyl-5-oxo-3-pyrrolidine carboxylic acid.--Minute portions of 40 grams (0.2 mole) of purified carboxylic acid[3] was added at intervals with constant stirring to 150 grams (1.0 mole) of chlorosulfonic acid at a temperature of 60-65° C. The temperature was kept

3. The crude compound will decompose in chlorosulfonic acid.

between 65-70° C until the evolution of HCl had ceased (15-20 minutes). The syrupy liquid was cooled to room temperature, and poured slowly with stirring into large excess of crushed ice in order to precipitate the 1(p-Chlorosulfonyl)-phenyl-5-oxo-3-pyrrolidine carboxylic acid. It was filtered by suction and washed throughly with cold water. The crude yield was 45-50 grams (76-85%). Melting point of purified compound was 164-166° C (from benzene).

Anal. Calcd. for $C_{11}H_{10}ClNO_5S$: N, 4.60 Found: N, 4.58

Reaction C, Preparation of 1-(p-Sulfamyl)-phenyl-5-oxo-3-pyrrolidine carboxylic acid derivatives. Ten grams of crude 1(p-Chlorosulfonyl)-phenyl-5-oxo-3-pyrrolidine carboxylic acid was condensed with primary and secondary amines (mole ratio of 1-1.5) by bringing about the reactions in an alkaline medium (sodium bicarbonate) or acetone. At room temperature the reactions were brought about in an alkaline medium from a few hours to standing overnight; Whereas in acetone the time varied from one quarter hour to three hours. The crude compounds produced were usually gummy products, but upon successive recrystallizations from water, dilute alcohol or dilute hydrochloric acid resulted in the formation of purified crystalline products.

TABLE I [a]

Amine	1-(p-Sulfamyl phenyl)-5-oxo-3-Pyrrolidine Carboxylic Acid derivative	Yield [d] %	M. p. C	N % [b] Calcd.	N % [b] Found	Neut. Equiv. Found	Mol. Wt. [c] Cal.	Mol. Wt. [c] Found
Methylamine	R_1 Methyl	49	204-206	9.38	9.44	305	298	297
Dimethylamine	R_1 Methyl R_2 Methyl	70	220-223 237-239	8.96	8.97	307	312	-
Ethylamine	R_1 Ethyl	46	198-199	8.96	8.99	314	312	317
Diethylamine	R_1 Ethyl R_2 Ethyl	51	152-153	8.23	8.27	336	340	340
Isopropylamine	R_1 Isopropyl	81	190-191	8.55	8.55	330	326	-
3 Methoxypropylamine	R_1 3 Methoxypropyl	37	104-106	7.82	7.84	390	356	-
3 Isopropoxypropylamine	R_1 3 Isopropoxypropyl	60	105-107	7.21	7.27	382	385	381
n-Butylamine	R_1 n-Butyl	51	168-169	8.23	8.23	343	340	340
Di n-Butylamine	R_1 n-Butyl R_2 n-Butyl	48	74-76	7.06	7.04	396	396	-
Cyclohexylamine	R_1 Cyclohexyl	83	174-175	7.64	7.60	369	366	367
2,4,4,Trimethyl-2-Amino Pentane	R_1 2,4,4,Trimethyl-2-Pentyl	75	185-186	7.06	7.03	394	396	394
3,5,5,Trimethyl hexylamine	R_1 3,5,5,Trimethylhexyl	35	156-157	6.82	6.88	409	410	403
Aminoacetic Acid	R_1 Carboxymethyl	35	190-192	8.18	8.24	172	342	-
Aniline	R_1 Phenyl	67	192-193	7.77	7.78	359	360	-
Ethylaniline	R_1 Phenyl R_2 Ethyl	72	188-189	7.21	7.18	388	388	-
o-Chloroaniline	R_1 2 Chlorophenyl	57	166-168	7.09	7.09	-	395	390

m-Chloroaniline	R_1 3 Chlorophenyl	85	209-210	7.09	7.08	-	395	400
2,4-Dichloroaniline	R_1 2,4-Dichlorophenyl	75	210-211	6.52	6.52	-	429	428
2,5-Dichloroaniline	R_1 2,5-Dichlorophenyl	65	104-106	6.52	6.52	-	429	433
o-Nitroaniline	R_1 2 Nitrophenyl	30	189-191	10.37	10.18	402	405	400
m-Nitroaniline	R_1 3 Nitrophenyl	85	233-235	10.37	10.20	400	405	406
p-Nitroaniline	R_1 4 Nitrophenyl	60	220-226d	10.37	10.18	400	405	413
o-Toluidine	R_1 2 Tolyl	65	160-161	7.48	7.49	378	374	-
m-Toluidine	R_1 3 Tolyl	68	178-179	7.48	7.57	378	374	379
p-Toluidine	R_1 4 Tolyl	41	150-151	7.48	7.49	375	374	374
m-Nitro-p-Toluidine	R_1 3 Nitro 4 Tolyl	30	156-157	10.25	10.17	413	419	-
Benzylamine	R_1 Benzyl	47	194-195	7.48	7.44	379	374	366
B-Phenylethylamine	R_1 B-Phenylethyl	92	187-188	7.21	7.24	395	388	387
o-Anisidine	R_1 2 Methoxyphenyl	77	182-183	7.17	7.25	391	390	390
p-Chloroanisidine	R_1 2 Methoxy 5 Chlorophenyl	86	188-189	6.59	6.54	439	425	420
2,5 Dimethoxyaniline	R_1 2,5 Dimethoxyphenyl	90	157-158	6.61	6.63	428	420	416
2,5 Diethoxyaniline	R_1 2,5 Diethoxyaniline	49	159-160	6.24	6.26	456	448	445
B-3,4 Dimethoxyphenyl ethylamine	R_1 B-3,4 Dimethoxyphenylethyl	68	114-115	6.24	6.19	449	448	-
o-Aminodiphenyl	R_1 2 Diphenyl	50	199-200	6.41	6.39	437	437	445
p-Aminodiphenyl	R_1 4 Diphenyl	75	214-215	6.41	6.41	437	437	433
p-Phenylenediamine	R_1 1-p-(p-Sulfamyl phenyl)Phenyl 5-oxo-3-Pyrrolidyl Carboxylic Acid	80	280d	8.70	8.61	326	643	-

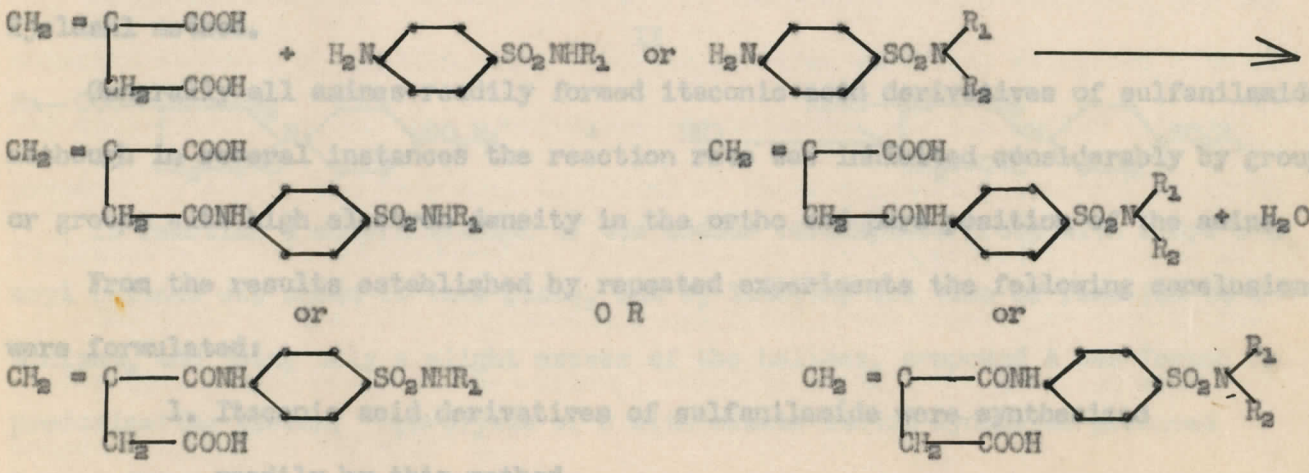
Benzidine	R_1 1-p-(p-Sulfamyl diphenyl)Phenyl 5-oxo-3-Pyrrolidyl Carboxylic Acid	80	315-320d	7.80	7.83	355	719	-
p-Aminoazobenzene	R_1 Azobenzene	75	252-254	12.06	12.20	460	464	451
1-Naphthylamine	R_1 1-Naphthyl	-	192-193	6.82	6.82	426	410	408

(a) The following derivatives could not be confirmed either because of the lack of sufficient analytical data or unsuccessful synthesis: R_1 4 Chlorophenyl, R_1 4 Methoxyphenyl, R_1 B-Naphthyl, R_1 2 Pyridyl, R_1 Primidyl, and R_1 2 Thiazolyl, R_1 2 Thiophenyl. (b) Gunning, Arnold, and Dyer, Modified Kjeldahl Method. H. C. Sherman, Methods of Organic Analysis, The Macmilliam Company, New York, New York, 1931, P. 291. Nitro and azo compounds were first reduced with Salicylic Acid and Sodium Thiosulphate. (c) Rast Camphor Method. (d) Yields based on two or more recrystallizations.

Prior to this investigation only two itaconic acid derivatives of sulfanilamide had been reported[2e] 1(p-Guanyl sulfamyl)-phenyl-5-oxo-3-pyrrolidine carboxylic acid and 1(p-Sulfamyl)-phenyl-5-oxo-3-pyrrolidine carboxylic acid. These were made by the fusion of Sulfaguanidine and Sulfanilamide with itaconic acid respectively.

Although simultaneously with this investigation further attempts were made to prepare 1(p-Sulfamyl)-phenyl-5-oxo-3-pyrrolidine carboxylic acid derivatives by fusion of itaconic acid with sulfanilamides,[4] but the general reaction did not proceed as expected. Instead the reaction favored formation of N^4 Itaconyl acid derivatives of sulfanilamide. Fifty sulfanilamide derivatives were investigated by fusion with itaconic acid. Only eleven of fifty fusion gave the desired 1(p-Sulfamyl phenyl)-5-oxo-3-pyrrolidine carboxylic acid derivatives. Forty gave N^4 Itaconyl acid sulfanilamides.

Carboxy pyrrolidination was not favored in the fusion of itaconic acid and sulfanilamides under similar circumstances as were aniline and itaconic acid. The derivatives empirical formulas, neutralization equivalents and nitrogen analyses were identically the same as 1(p-Sulfamyl)-phenyl-5-oxo-3-pyrrolidine carboxylic acid derivatives.



4. A paper by Paytash, Thompson, and Fykes, has been accepted by the J. Am. Chem. Soc. for publication.

All itaconic acid derivatives of sulfanilamide produced are classified as strong acids. Neutralization equivalents of derivatives with SO_2NHR_1 group did not correspond with their values when phenolpthalien (pH range 8.3-10) was used as the indicator, but fairly accurate results were obtained by potentiometric titration.

Further investigation showed that when phenol red was used as end point indicator accurate results were obtained. It was observed that phenol red gave an end point change at pH of 7.4; in potentiometric titration the end points were reached between a pH of 6 and 7. Compounds with the (SO_2N R_1 / R_2) group gave no indication of abnormal neutralization equivalents.

From the above observations it was concluded that (SO_2NHR_1) group was affected by 0.1 N sodium hydroxide above a pH of 8, causing activity of the hydrogen ion of the (SO_2NHR_1) group.

It was also observed that (SO_2NHR_1) group with a halogen or halogens anywhere in the ring of R enhanced the hydrogen activity of the (SO_2NHR_1) group. Similar results were produced when R contained two or more phenyl radicals.

All derivatives formed were stable to hydrochloric acid and sodium hydroxide hydrolysis. No difficulty was experienced in the determination of nitrogen by the Kjeldahl method.

Generally all amines readily formed itaconic acid derivatives of sulfanilamide although in several instances the reaction rate was inhibited considerably by group or groups with high electron density in the ortho and para position of the amine.

From the results established by repeated experiments the following conclusions were formulated:

1. Itaconic acid derivatives of sulfanilamide were synthesized readily by this method.
2. Difficulty in obtaining several derivatives immediately were ascribed to electronic and steric hindrance of the amine.

3. Thirty-eight new compounds were formed.

4. 1(p-Sulfamyl)-phenyl-5-oxo-3-pyrrolidine carboxylic acid derivatives were not favored by fusion of itaconic acid and sulfanilamide derivatives, instead N[4] Itaconyl acid sulfanilamide derivatives were the principle products.

5. Primary itaconic acid derivatives of sulfanilamide gave unusual hydrogen activity at a pH of 8.0 or higher.

Part II.--Itaconic acid derivatives of p amino phenyl sulfone. 1(p-R_1 Sulfonyl)-phenyl-5-oxo-3-pyrrolidine carboxylic acid was prepared successfully by the condensation of 1(p-Sodium sulfinate)-phenyl-5-oxo-3-pyrrolidine sodium carboxylate with various alkyl and aryl halides. The free acid was subsequently produced upon acidification.

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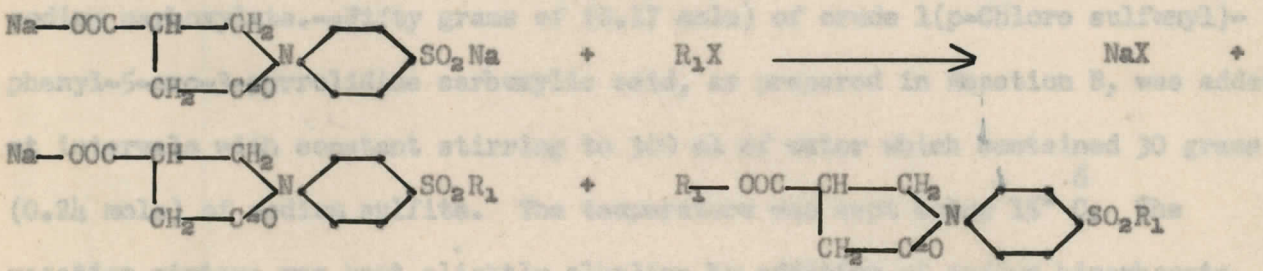

A B

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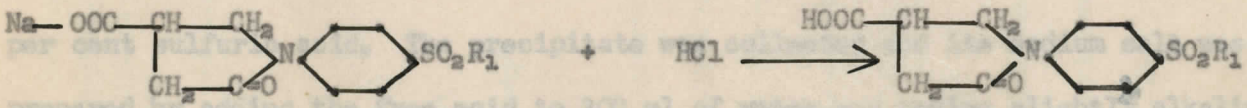
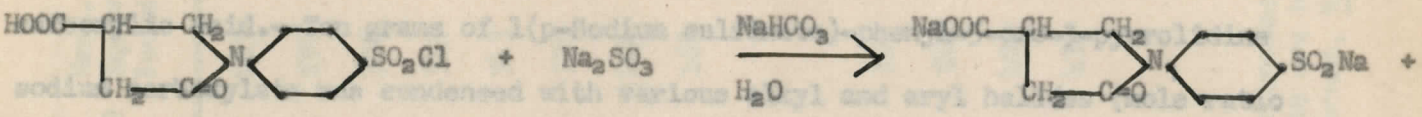


In reaction I esterification of the sodium carboxylate group with alkyl and aryl halides was shown to take place, but by limiting the time of reaction to a minimum, and using only a slight excess of the halides, compound A was formed in predominating yields. Hydrolysis of B with dilute sodium hydroxide produced compound A.

1(p-Chloro sulfonyl)-phenyl-5-oxo-3-pyrrolidine carboxylic acid with anhydrous

sodium sulfite in an aqueous solution kept alkaline with sodium bicarbonate yielded 1(p-Sodium sulfinate)-phenyl-5-oxo-3-pyrrolidine sodium carboxylate [5].



Fifteen of twenty compounds investigated gave the desired compounds 1(p-R_1 sulfonyl)-phenyl-5-oxo-3-pyrrolidine carboxylic acids. They are listed in table II with their corresponding analytical data. Five derivatives could not be confirmed either because of inadequate analytical data or unsuccessful synthesis.

Experimental

Reaction D, Preparation of 1(p-Sodium sulfinate)-phenyl-5-oxo-3-pyrrolidine sodium carboxylate.--Fifty grams of (0.17 mole) of crude 1(p-Chloro sulfonyl)-phenyl-5-oxo-3-pyrrolidine carboxylic acid, as prepared in Reaction B, was added at intervals with constant stirring to 300 ml of water which contained 30 grams (0.24 mole) of sodium sulfite. The temperature was kept below 15° C. [6] The reaction mixture was kept slightly alkaline by addition of sodium bicarbonate.

After the solution had been stirred for two hours, Norite was added and the solution filtered by suction. The filtrate was then carefully acidified with 60 per cent sulfuric acid. The precipitate was collected and its sodium salt was prepared by adding the free acid to 300 ml of water and making slightly alkaline to litmus with sodium bicarbonate. This filtrate was evaporated to dryness at 75° C.

The yield of the free acid produced was 30-35 grams (66-77 per cent of the theoretical amount based on the sulfonyl chloride used). The purified acid compound melted at 175°-180° C.

5. Gilman and Blatt; Organic Synthesis, I, 1948.
6. Formation of 1(p-Sodium sulfonate)-phenyl-5-oxo-3-pyrrolidine sodium carboxylate was favored above 15° C.

Anal. Calcd. for $C_{11}H_{11}NO_5S$: N, 5.20 Found: N, 5.19

N.E. 134.6 N.E. 135

Reaction E, Preparation of 1(p-R_1 sulfonyl)-phenyl-5-oxo-3-pyrrolidine carboxylic acid.--Ten grams of 1(p-Sodium sulfinate)-phenyl-5-oxo-3-pyrrolidine sodium carboxylate was condensed with various alkyl and aryl halides (mole ratio of 1-1) by bringing about the reactions in 75 ml. of 50% aqueous alcoholic solutions. The mixtures were allowed to reflux from four to eight hours. The mixtures remained alkaline throughout the reaction. Norite was added and solutions poured into 200-300 ml of cold water. Acidification of the filtrates with dilute hydrochloric usually produced the desired derivatives. Final recrystallization was done either from water, dilute alcohol, or hydrochloric acid.

TABLE II[a]

Halide Used	1(p-R_1 Sulfonyl)phenyl-5-oxo-3-Pyrrolidine Carboxylic Acid derivative	Yield[b] %	M. p. C	N % Calcd.	N % Found[c]	Neut. Equiv. Found[c]	Mol. Wt. Cal.	Mol. Wt. Found
Methyl Iodide	R_1 Methyl	70	209-210	4.94	4.94	283		283
Ethyl Bromide	R_1 Ethyl	62	240-242	4.70	4.64	298		297
n-Propyl Iodide	R_1 Propyl	75	205-206	~~4.60~~ 4.50	4.54	306		~~311~~
n-Butyl Bromide	R_1 Butyl	80	167-168	~~4.44~~ 4.31	4.40 4.29	313		~~315~~ 325
n-Amyl Iodide	R_1 n-Pentyl	63	159-160	4.12	4.05	343		339
Allyl Chloride	R_1 Allyl	50	196-198	4.52	4.50	308		309
Chloroacetic Acid	R_1 Carboxymethyl	49	203-205	4.25	4.27	164		~~327~~
B-Chloropropionic Acid	R_1 Carboxyethyl	55	213-215	4.10	4.06	168		341
B-Chloropropionitrile[d]	R_1 Ethyl nitrile	85	195-197	8.68	8.64			322
Chloromethyl Acetate[d]	R_1 Carbomethoxy methyl	35	138-140	4.10	4.16			341
Chloro Ethyl Acetate[d]	R_1 Carbethoxy methyl	37	216-218	3.94	3.94	350		355
Benzyl Chloride	R_1 Benzyl	85	227-229	3.90	3.88	344		359
p-Nitro Benzylchloride[d]	R_1 4,Nitro Benzyl	80	236-238	6.92	7.00	402		404
Phenacyl bromide	R_1 Benzoyl methyl	40	202-203	~~3.17~~ 3.23	3.15	430		432
1 Chloro, 2,4 dinitrobenzene	R_1 2,4, Dinitro Phenyl	55	145-147	9.63	9.60			435

(a) The following derivatives were not confirmed either because of insufficient analytical data or unsuccessful synthesis: R_1 Isopropyl, R_1 Tert-butyl, R_1 Phenyl, R_1 Carbobutoxy and R_1 Amino Phenyl. (b) Yields are based on two or more recrystallizations. (c) Gunning, Arnold, and Dyer Modified Kjeldahl Method. H. C. Sherman, Methods of

Organic Analysis. The Macmillian Company, New York, New York, 1931, P. 291. Nitro compounds were first reduced with Salicylic Acid and Sodium Thiosulphate. (d) Easily decomposed by acid or base hydrolysis.

Prior to this investigation no itaconic acid derivatives of p-amino phenyl sulfone had been reported. Although simultaneously with this investigation it was shown that similar derivatives could be produced by the fusion of itaconic acid with p-amino phenyl alkyl and aryl sulfones. Two such derivatives were prepared, 1(p-Benzyl sulfonyl)-phenyl-5-oxo-3-pyrrolidine carboxylic acid and 1(p-Methyl sulfonyl)-phenyl-5-oxo-3-pyrrolidine carboxylic acid. Although the reaction again favored N^4 Itaconyl acid derivatives as reported in Part I. Further work is still in progress on this particular problem.

All itaconic acid derivatives of p-amino phenyl sulfone are classified as strong acids. Their neutralization equivalents were in accordance with their theoretical values except in remote cases where 0.1 N sodium hydroxide decomposed the compound. For example 1(p-Ethyl nitrile sulfonyl)-phenyl-5-oxo-3-pyrrolidine carboxylic acid hydrolyzed instantaneously to 1(p-Carboxy ethyl)-phenyl-5-oxo-3-pyrrolidine carboxylic acid thus its neutralization equivalent value was nearly equalled to half of its theoretical value.

Several derivatives were susceptible to acid or alkaline hydrolysis. This instability was attributed to the original nature of the halide and not to the sulfone formed.

No difficulty was experienced in the determination of nitrogen by the Kjeldahl method.

Generally all alkyl halides readily formed itaconic acid derivatives of p-amino phenyl sulfone, although the secondary halides which were experimented with did not react. Only one tertiary alkyl halide activity was investigated and a mixture of compounds resulted. Aryl halides containing one or more nitro groups ortho or para to the halogen were sufficiently reactive to give fair yields of sulfones.

From this investigation of itaconic acid derivatives of p-amino phenyl

sulfone the following conclusions were formulated:

1. Itaconic acid derivatives of p-amino phenyl sulfone were synthesized readily with primary alkyl halides by the method employed.
2. Due to decrease reactivity of the halogens of secondary halides, they did not react.
3. Aryl halides required activating groups in the ortho or para position before they reacted.
4. Fifteen new compounds were formed.
5. 1(p-R_1 sulfonyl)-phenyl-5-oxo-3-pyrrolidine carboxylic acid derivatives were not favored by fusion of itaconic acid and p-amino phenyl sulfone derivatives, instead N^4 Itaconyl acid derivatives were the principles products.
6. The instability of several derivatives toward dilute hydrochloric acid or dilute sodium hydroxide was ascribed to the instability of the parent halide toward these compounds.

This author wishes to express his gratitude to Research Corporation for their Research Fellowship in support of this investigation, to Professor Peter L. Paytash for his assistance and suggestions, and to the following Chemical Companies for their generous supply of amines and halides:

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HOOKER ELECTRO CHEMICAL COMPANY

SHARPLES CHEMICAL COMPANY

DOW CHEMICAL COMPANY

CALCO CHEMICAL DIVISION

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for their ample supply of itaconic acid.

BIBLIOGRAPHY

Anschutz, R. and Reuter, F. Uber die Einwirkung Von Anilin auf Citraconicsaure und auf Itaconsaure. 1889. Ann., Vol. 254. P. 129.

Crowe, E. J. Chemical Abstracts. 1950. Vol. 44. P. 12851.

Gilman, H. and Blatt, A. H. Organic Synthesis. John Wiley and Sons Incorporated, New York, New York, 1948. Vol. I. P. 7.

Gottlieb, S. Beitrage zur Kenntnifs der isomeren Sauren. 1851. Ann., Vol. 77. P. 284.

Michael and Palmer. Behavior of Itaconic Acid Toward Aniline: American Chemical Journal. 1887. Vol., 9. P. 194.

Paytash, P. L., Sparrow, E. and Gathe, J. The Reaction of Itaconic Acid With Primary Amines: Journal of the American Chemical Society. 1950. Vol., 72. P. 1415.

Scharfenberg, O. Uber die Einwirkung von p-Toluidine, Phenylhydrozin und -Naphthylamin auf Itaconsaure. 1889. Ann., Vol. 254. Pp. 149-152.

Sherman, H. C. Methods of Organic Analysis. The Macmilliam Company, New York, New York, 1931. P. 291.

Malcolm J. Thompson

On February 15, 1927 in Baldwin, Louisiana, I was born to Beneva Johnson and Alfred Thompson. Nine days later the sacrament of baptism was administered to me at the Sacred Heart Church of Baldwin.

After celebrating my sixth birthday, I entered Baldwin Public School, from which I was graduated seven years later.

During my elementary education I received the formal instructions in the basic principles on my religion and received the sacraments of penance, Holy Eucharist and Confirmation.

In September of 1940 I entered the Godman Junior High School in my native city. As a result of my high scholastic standing I was tendered a scholarship to a senior high school of my selection.

Intrigued by the possibilities of realizing my ambition in a large accredited preparatory school, I elected to leave Baldwin and enrolled as a science major at Xavier University Preparatory School of New Orleans, Louisiana.

Four years of undaunted enthusiasm and hard work rewarded me with a graduation certificate in June of 1944.

Cognizant of the inadequacy of my meager knowledge in my chosen field of study, I sought the higher fields of learning by enrolling in the College of Science at Xavier University in September 1944.

During this first year of matriculating at Xavier my financial resources were such that to realize my ambition I was forced to work at night. Indeed this was not an ideal situation, but my desire for advanced formal education was greater than the hardships encountered by me during this period.

At the conclusion of my freshman year, I willingly responded to the call of my country and entered the service of the United States Army. My principle assignment in the army was performed in doing occupational duty in Japan.

This brief period I considered extremely valuable to the attitude and disposition of my future hopes and desires. I feel that the experience and education derived from this assignment rendered me more mature of mind and more determined to realize my ambition. As a result, immediately after having received my honorable discharge papers from the Armed Forces in the spring of 1947, I returned directly to Xavier University to continue my studies that I had put aside two years previously.

Re-entering Xavier University I pursued the science course, majoring in Chemistry and minoring in Mathematics. The great love developed within me for the field of my choice was rewarded with the reception of a Bachelor of Science Degree in my chosen field in May 1950.

Upon my graduation I received a Research-fellowship in chemistry and immediately started to pursue graduate study leading to a Master of Science Degree in Organic Chemistry. I was also appointed a part-time laboratory assistant in Organic and Physical Chemistry.

The research work prerequisite for a Master's Degree was done in the field of Itaconic Acid Derivatives of Sulfanilamide and p-Amino Phenyl Sulfone. An excerpt from the field in which I have specialized has been accepted for publication in the near future by the Journal of the American Chemical Society.

My graduate work will have been completed in May of 1952. It is my fond hope that I may be graciously honored as the recipient of a Master of Science Degree at the forthcoming commencement exercise to be held at Xavier University in June, 1952.