ABSORPTION SPECTRA OF PHENOTHIAZINES

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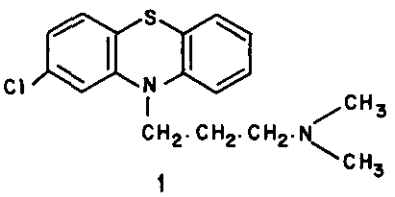
Abstract —— The ultra-violet absorption spectra of phenothiazine derivatives are reviewed.

Although the literature is replete with the studies of phenothiazine, very few references dealing with the ultraviolet absorption spectra of nuclear phenothiazines are to be found in literature. The application of this fundamental technique in structure elucidation, characterisation and identification of this class of compounds is still at its infancy.

Correlations between UV spectra and the structure of phenothiazine derivatives were investigated by Cauqil and Casadevall[1], Pinyazhko and Turkevich[2], Warren et.al.[3] and others[4-7]. There are important differences between the spectra of 2- and 3-substituted derivatives. An alkyl or aminoalkyl in position 10 affects, but not much the spectra of both phenothiazine and phenothiazine 5-oxides, while N-acylation affects the spectral parameters to a greater extent. All of these spectral changes consist of shifts and variations of the intensity of the two absorption maxima characteristic of phenothiazine and its derivatives (253 nm and 320 nm for unsubstituted phenothiazines).

Phenothiazine derivatives react with concentrated sulphuric acid either alone or in conjunction with other oxidants such as ferric salts to give products with absorption patterns different from those of the original compounds in both the visible and ultraviolet regions of the spectrum. This oxidation method was used in the identification and estimation of many phenothiazine drugs by spectrophotometer[8-16]. Street[14] recorded the absorption maxima of a number of phenothiazine derivatives in the ultraviolet regions of the spectrum before and after treatment with sulphuric acid and based a quantitative array as well as method of qualitative identification on the intensity and position of the peaks in the region 270 to 300 nm.

Becket et al.[17] have reported on the different absorption maxima in the visible region of the spectrum for the various derivatives in concentrated sulphuric acid solution and used the extinction values for a semiquantitative array in studies of the metabolism of chloropromazine(1). For the identification of promazine glycuronide of unknown structure, spectral studies of various hydroxy phenothiazines after the treatment with sulphuric acid indicated that sufficient differences exist to enable the position of ring hydroxylation of promazine metabolites to be determined.



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In the case of halogenated phenothiazines, systematic determinations were carried out by Rupprecht[18] and the dependence of the position of the absorption maxima upon the amount and nature of the halogen atom were deduced from the UV data.

Spectroscopic studies on C-substituted S^+ species obtained by oxidation with sulphuric acid revealed that 3,7-dimethylphenothiazine is oxidised by strong electron acceptor to the corresponding S^+ species[19,20].

Skorodumov et al.[21] have used the technique in the identification of the methyl ester of 10-methyl-3-phenothiazinecarbamic acid and its sulphoxide by obtaining characteristic distinct UV spectra.

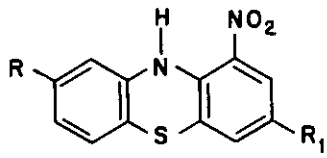
The ultraviolet spectra of the phenothiazines are characteristic both in wave length and in intensity. Two peaks were observed, the first and most intense in the region 250-265 nm and the second in the range 300-325 nm. The exact location of the peaks in both regions is dependent upon the nature of the substituent in the 2-position. Halogen substituents such as chloro, bromo or trifluoromethyl at 3- and 7-position appear to exert a slight influence in the form of small bathochromic shifts of 2-4 nm on the more intense peak in the 250-265 nm region. The trifluoromethyl effects a slightly stronger shift than the chloro analog. It has been further observed that the alkyl side chain containing an amino group causes slight shifts in the peak locations and the amount of shift is related to the length of the side chain, which is to say the proximity of the amine group to phenothiazine nucleus. The amino group has been found to exert a slight influence even when located at the end of a 4-carbon chain[23].

Phenothiazines with a carbonyl group in the 2-position are exceptions to the general rule regarding the location of the three ultraviolet peaks. Such compound exhibits strong absorption peaks in the range 240-245 nm and 275-285 nm.

The nitro group in the p-position in relation to NH group causes a strong bathochromic effect with an increase of the intensity of the long wave band, which could be explained with intramolecular transference from NH to NO_2 group[36].

In alkaline medium nitro derivatives show a strong bathochromic shift of the longwave maxima as a result of the ionization with a splitting of the proton and a transference of the charge with the formation of p-quinoid structures.

Chaudhary[53] while studying the characteristics of nitrophenothiazine has observed that nitrophenothiazines exhibited moderately strong maxima in the region 242-258 nm with a broad shoulder in the region 298-324 nm. An interesting feature is that in the compounds containing 2-nitro groups at 1- and 3-position, this shoulder appeared at 298-302 nm and the phenothiazines



2) R = OCH_3; R_1 = NO_2
3) R = OC_2H_5; R_1 = NO_2
4) R = CH_3; R_1 = NO_2
5) R = OC_2H_5; R_1 = Cl
6) R = CH_3; R_1 = Cl
7) R = NO_2; R_1 = Cl
8) R = OCH_3; R_1 = H
9) R = OC_2H_5; R_1 = H
10) R = CH_3; R_1 = H

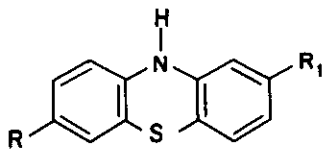
containing a nitro group at 1-position and a chlorine atom at 3-position, it is shifted to 304-314 nm. The phenothiazines having only one nitro group at 1-position exhibited this shoulder at 321-324 nm in addition to the usual strong maxima in the range of 251-253 nm. The appearance of the broad shoulder having their origin in the n $-\pi^*$ transition of single chromophoric group such as nitro group, in the case of compounds (2-4) at 298-301 nm may be attributed to the presence of two withdrawing groups at m-positions, whereas in compounds (5-7), it appeared at 304-313 nm. This is due to the combination of one electron donating and one electron withdrawing groups. Compounds (8-10) showed this band at 321-324 nm, a bathochromic shift of 1-4 nm in the R-Band value, which has been attributed to the presence of a single chromophoric nitro group.

The hypsochromic shift in the R-Band value is less for the combination of one o- and p-directing group with a m-directing group (5-7) than for both the m-directing substituents (2-4).

In case of 2,7-disubstituted phenothiazines, it has been observed that the substituents

at 7-position play an important role in the structure elucidation by UV. Phenothiazines having a methyl or methoxy at 7-position have an intense maximum at 257 nm, an additional peak at 215-221 nm and a shoulder between 325-327 nm range, whereas phenothiazines having a nitro group at 7-position have a main absorption band at 247-254 nm, which is slightly at lower wave length and the other peak at 227-229 nm and a shoulder at 304-310 nm.

A bathochromic shift of 2 nm in the more intense peak in 250-256 nm region was observed in all phenothiazines having halogen, alkyl or alkoxyl group at 7-position. In the visible region, 1,8-disubstituted phenothiazines (8 - 10) gave a maximum at 488 nm, while 2,7-disubstituted phenothiazines (12, 14,15) absorb in the 444-450 nm region. 1,3,8-Trisubstituted phenothiazines (3,5,7) exhibited maxima at 410-430 nm. (Table 2)



11) $R = OCH_3$; $R = NO_2$

12) $R_1 = OC_2H_5$; $R = NO_2$

13) $R_1 = CH_3$; $R = NO_2$

14) $R_1 = CH_3$; $R = OCH_3$

15) $R_1 = R = CH_3$

When both the 3- and 7-positions are occupied by alkoxy groups (methoxy or ethoxy) the bathochromic effect is noticeably stronger (11 nm) as compared with that arising from halogen substitution.

Hypsochromic shifts in the second maxima (305-326 nm) are exerted in these 3,7-disubstituted phenothiazines. Such shifts are stronger in haloalkoxy or dihalophenothiazines (15-20 nm) than in dialkoxyphenothiazines (10-12 nm).

In case of 3-sulphonylphenothiazines molecular extinction (268 nm band) was found constant. The 2-methylsulphonylphenothiazine absorption was stronger ($\log_e$ 4.64). The shift in absorption of 12 nm (from 268-280 nm) resulting from the addition of a second benzenesulphonyl group to the 7-position of 3-phenylsulphonylphenothiazine compares closely with the shift of 14 nm (254-268 nm) resulting from the addition of a single benzenesulphonyl group to the 7-position of phenothiazine[6].

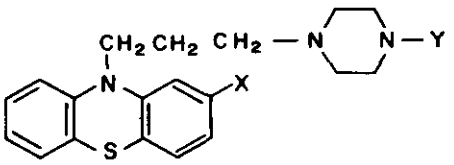
N-Alkylphenothiazines were shown to have a small bathochromic effect in the shortwave band of the spectrum (1-3 nm) and a large hypsochromic effect in the longwave band (10-15 nm). This hypsochromic effect has been attributed to the conjugation degree of the electronic pair of nitro-

gen as a result of the space preferred configuration "H extra" in contrast to the configuration of "H intra" for the NH bond[36].

Blazek et al.[28] have studied the effect of the substituents at 10,3,1-positions of the phenothiazine derivatives and have concluded that substitution in the 10-position caused mostly a hypsochromic shift of absorption maxima, whereas substitution in 10- and 3-positions or 10,3- and 1-position did not change the absorption maxima. In some compounds, a bathochromic and hypsochromic effect in the individual phenothiazine derivatives substituted in 10-position is caused by extending and branching the aliphatic chain of substituted alkylamine and by the presence of a saturated heterocycle. Groups like O-alkyl, CH_3, halogens, CN, SO_2NR_2, S-alkyl at 3-position in compounds (18) having propylamine or propylpiperazine (17) at 10-position brought about a similar bathochromic shift and hypsochromic effect of the absorption maxima and minima.

Substitution in the 1-position increased the bathochromic shift and hypsochromic effect of the basic substitutions in 10- and 3-positions. Using 0.1 M HCl as solvent, a small bathochromic shift and hypsochromic effect were observed.

Mendybayer[53] observed that in case of 10-piperazinylphenothiazine(16) the integral intensity of bands and power of the oscillator can serve as valuable indications for the identification of separate phenothiazine derivative. The absorption maxima of these derivatives (16) are characterised by their being in three regions up to 235, 259-263 and from 294-311 nm.



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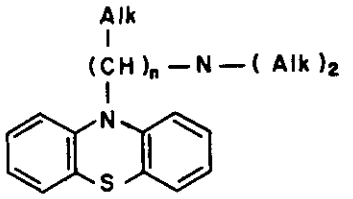
Similarly, 10-dialkylaminoalkylphenothiazine (17) having absorption bands at 208, 248-253 and 248-313 nm showed considerable widening of the second absorption band, narrowing of the third band and increase in the integral of the 2nd band[22].



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The UV absorption spectra have also been used in determining the presence of chlorpromazine (1) in human tissues. The method involved the oxidation of the extract with hydrogen peroxide into sulphoxide. This gave a characteristic absorption spectra at 300 and 340 nm[54].

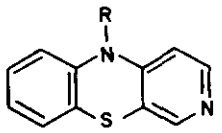
In general, the more characteristic drugs showed a very strong central absorption band near 255 nm in aqueous acid solution. A dilute aqueous base produces a maximum shift of few nanometers and a slight increase in absorptivity. An upper weaker band near 300 nm is invariably present. Phenothiazines isolated from biological specimens contain sulphoxide metabolites which have 4 or 5 maxima between 230 and 350 nm[45].

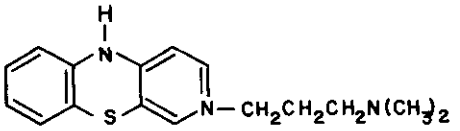
It was shown that the introduction of an oxygen atom bring substantial changes into the character of the spectra. The free electronic pair decreases its participation in the conjugation of the system as a result of the strong polarisation of the S $\longrightarrow$ O bond which leads to a breaking of the electronic structures[36].

In nitrophenothiazine oxides and sulphones a similar bathochromic shift of the longwave maxima in alkaline medium was observed but in a considerably lower degree than their unoxidated analogs[36].

In sulphoxides, the presence of groups like Cl, CF_3, SCH_3 and $SO_2N(CH_3)_2$ produces correlating bathochromic shifts with the exception of the 267 nm absorption and also appear as the most deviating of all the correlations found. The CN group fits well as a bathochromic but shows up off-line hypsochromic substituent for the 307 nm band. Acceptable correlations exist for the $-OCH_3$ as a hypsochromic for the 232 and 294 bands and as a bathochromic substituent for the 274 nm shoulder, but not, however, for the strongly bathochromic 249 nm absorption[46].

The structures of 3-azaphenothiazine (19) and its 3- and 10-alkylated derivatives (20, 21) were supported by their UV spectra. 3-Azaphenothiazine in 50% ethanol gave an intense





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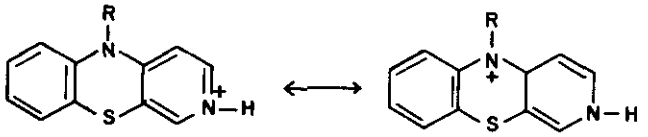
19, R = H

21, R = CH_2-CH_2-CH_2-$N(CH_3)_2$

23, R = CH_2-CH_2-CH_2-$\overset{+}{N}H(CH_3)_2$

maximum at 258 nm, which is replaced in acid solution by two maxima at 267 nm, and 274 nm.



22, R = H

This bathochromic displacement is a consequence of increased resonance of the cation (22)[62].

3-Azaphenothiazine as a weak base has its salts partially dissociated in dilute solution, and its UV spectrum is a composite of the spectrum of the cation 22 and the free base 19.

The UV spectrum of 10-(3-dimethylaminopropyl)-3-azaphenothiazine dihydrochloride (21) in 50% ethanol is similar to that of 3-azaphenothiazine hydrochloride. In acid and alkaline solution, the spectrum is again the composite of the cation (23) and of the free base (21).

In case of 3-(3-dimethylaminopropyl)-3-azaphenothiazinium chloride hydrochloride (21) the UV spectrum remains unchanged in 50% enthanol and in acid solution, but gives a new shoulder at 285 nm in alkaline solution. This is because of the strongly basic nature of the compound, an alkaline solution is required to alter the spectra of the "quaternary salt" by removing a proton from the onium ions to form the corresponding anhydronium base[63].

This interpretation is supported by the fact that when the crystalline anhydronium bases are dissolved in chloroform, the UV spectrum of the solutions have the characteristic shoulder at 284-285 nm, whereas in 50% ethanol the spectra of the quaternary salts are obtained[62].

Spectrofluorometric measurements have been used for the identification of phenothiazine derivatives qualitatively. However, no consistent relationship could be established between fluorescence spectra and the type of substitution of the phenothiazines in the case of the unoxidised solutions. Oxidation of phenothiazines was found to produce a large increase in the amount of fluorescence measured. It could not be determined whether the compounds oxidised were the sulphones or sulphoxides. Changes in pH affected phenothiazine fluorescence both qualitatively and quantitatively.

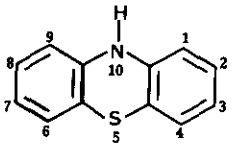
The wavelength at which the maximum activation and fluorescence readings were observed are given in Table 3.

Recently diffferential fluorescence technique has been used for analysis of some phenothiazine drugs in establishing their composite purity[64].

SOLVENTS

a. Methanol	h. Ethane Nitrile
b. Heptane-isoamyl alcohol	k. Chloroform
c. Acetic Acid	l. Dioxan
d. Ethanol (95%)	m. Potassium Hydroxide
e. Hydrochloric Acid (0.1 N)	n. Water
f. Sodium Hydroxide (0.1 N)	o. Ethanol (50%)
g. Sulphuric Acid (0.1 N)	

TABLE 1

Compound	Solv.	Absorption Maxima Max. nm./$\log_e$	Absorption Minima max. nm./$\log_e$	Ref.
A. Nuclear Substituted Phenothiazines				
				
	a	253, 320 (4.64, 3.64)	280 (3.01)	28
Phenothiazine	a	254, 317 (4.476, 3.683)	220, 282	22,23,24
2-Chlorophenothiazine	d	258, 322 (4.78, 3.84)		25,26,27,29
2-Trifluoromethylphenothiazine	d	262, 324 (4.62, 3.61)		29
2-Dimethylsulphonamidophenothiazine	d	267, 330 (4.53, 3.53)		29
2-Methoxyphenothiazine	d,g	219, 277, 343,428,554		17
2-Methylsulphonylphenothiazine	d	238, 268 (4.12, 4.64)		6
3-Methylsulphonylphenothiazine	d	235, 268 (4.06, 4.59)		6
3-Phenylsulphonylphenothiazine	d	235, 268 (4.35, 4.58)		6
3-p-Tolylsulphonylphenothiazine	d	236, 268 (4.39, 4.58)		6
2-Aminophenothiazine	d	256, 320	234, 288	27
3-Hydroxyphenothiazine	d,g	221,276,342,369,443,549		16
3-Aminophenothiazine	d	224, 282	260	27
7-Methoxyphenothiazine	d	255, 310	285	35
7-Ethoxyphenothiazine	d	255, 309	289	35
2-Dimethylsulphonamidophenothiazine	d	267, 330 (4.53, 3.53)		29
7-Nitrophenothiazine	d	245, 310	265	35
2-Chloro-8-acetylphenothiazine	a	268, 340	265	59
2-Acetyl-7-hydroxyphenothiazine	a	246.7, 282		32
2-Acetyl-7-acetoxyphenothiazine	a	245.5, 279.5		32
2-Acetyl-7-methoxyphenothiazine	a	247.2, 279.5		32
3,7-Diphenylsulphonylphenothiazine	d	226., 280 (4.60, 4.79)		6

Compound	Solv.	Absorption Maxima max. nm./$\log_e$	Absorption Minima max. nm./$\log_e$	Ref.
8- Methoxy-1-nitrophenothiazine	a	219, 253, 323 (4.21, 4.04, 3.69)		33
8-Ethoxy-1-nitrophenothiazine	a	219, 253, 321^{sh} (4.19, 4.07, 3.64)		33
8-Methyl-1-nitrophenothiazine	a	213, 251, 324^{sh} (4.41, 3.21, 3.65)		33
2-Methoxy-7-nitrophenothiazine	a	228, 245, 304^{sh} (4.26, 4.74, 3.60)		33
2-Ethoxy-7-nitrophenothiazine	a	229, 252, 305^{sh} (4.29, 4.19, 3.55)		33
2-Methyl-7-nitrophenothiazine	a	227, 247, 310^{sh} (4.32, 4.45, 3.66)		33
2-Methyl-7-methoxyphenothiazine	a	221, 257, 327 (4.24, 4.15, 3.65)		33
2,7-Dimethylphenothiazine	a	215, 257, 325^{sh} (4.42, 4.15, 3.69)		33
3,7-Diethoxyphenothiazine	d	264, 316	239, 300	34
3-Chloro-7-ethoxyphenothiazine	d	256, 309	280	35
3-Ethoxy-7-methoxyphenothiazine	d	264, 314	240, 302	34
3-Bromo-7-ethoxyphenothiazine	d	255, 310	284	34
3-Bromo-7-ethoxyphenothiazine	d	258, 305	278	34
3-Bromo-7-chlorophenothiazine	d	257, 310	225, 278	35
3-Methoxy-7-chlorophenothiazine	d	255, 310	285	35
3,7-Dinitrophenothiazine	d	245, 305	270	35
	d,m	233, 311, 486		36
	d,m	240, 358, 472, 700	264	36
3-Nitro-7-chlorophenothiazine	d	250, 285	264	35
	d	248, 308, 462		36
	d,m	245, 356, 670		36
3,7- Dibromophenothiazine	a	256, 321		36
3,7-Dichlorophenothiazine	a	264, 322		36
1,3-Dinitro-3-methoxyphenothiazine	a	288, 256, 298^{sh} (4.28, 4.35, 3.72)		33
1,3-Dinitro-8-ethoxyphenothiazine	a	230, 250, 301^{sh} (4.31, 4.29, 3.51)		33
1,3-Dinitro-8-methylphenothiazine	a	220, 242, 301^{sh} (4.32, 4.38, 3.58		33
3-Chloro-8-ethoxy-1-nitrophenothiazine	a	226, 258, 305^{sh} (4.32, 4.15, 3.66)		33
3-Chloro-8-methyl-1-nitrophenothiazine	a	230, 254, 304^{sh} (4.28, 4.24, 3.61)		33
3-Chloro-1,8-dinitrophenothiazine	a	223, 247, 314^{sh} (4.26, 4.45, 3.65)		33

Compound	Solv.	Absorption Maxima max. nm./$\log_e$	Absorption Minima max. nm./$\log_e$	Ref.
2-Acetyl-10-methylphenothiazine	d	244, 282 (4.37, 4.33)		1
2-Acetyl-10-ethylphenothiazine	d	244.5, 282.5 (4.35, 4.33)		1
3,10-Dimethyl-7-formylphenothiazine	d	240.5, 272, 289, 390 (4.31, 4.22, 4.29, 3.85)		1
3,10-Dimethyl-7-acetylphenothiazine	d	238.5, 270, 285, 380 (4.30, 4.31, 426, 3.59)		1
2,8-Diacetyl-10-methylphenothiazine	d	281, 362 (4.55, 3.72)		1
3,7-Diacetyl-10-methylphenothiazine	d	286, 395 (4.61, 3.92)		1
2,7-Diacetyl-10-methylphenothiazine	d	235, 271, 303, 354 (4.28, 4.43, 4.36, 407)		1
3,7-Diacetyl-1-ethylphenothiazine	d	289, 400 (4.59, 3.90)		1
3,7-Diacetyl-10-phenothiazine	d	243, 291, 409 (4.38, 4.60, 3.79)		1
2,7-Diacetyl-3,10-dimethylphenothiazine	d	236, 272, 302, 353 (4.25, 4.39, 4.26, 4.02)		1
2,7-Diacetyl-3-methyl-10-ethyl-phenothiazine	d	237.5, 274, 304, 357 (4.28, 4.41, 4.27,4.03)		1
2,7-Diacetyl-3-ethy-10-methyl-phenothiazine	d	236, 272, 302, 353 (4.26, 4.43, 4.25, 4.03)		1
10-Methylphenothiazine	a	306, 254		27,2,21
	d	227, 256 (4.40, 3.88)		6
	h	250, 302		2
	k	250, 311.2		43
10-Ethylphenothiazine	d	259, 228	248	27
	a	254, 308	248	36
10-Phenylphenothiazine	d	236, 273 (4.28, 3.83)		6
10-p-Tolylphenothiazine	d	236, 273 (4.8, 3.83)		6
10-(2-Methylpropenyl)phenothiazine	a	254, 313		36
10-(1-Propynyl)phenothiazine	a	253, 307		36
10-Acetylphenothiazine	a	228, 257		36
3-Amino-10-acetylphenothiazine	a	226, 296	278	49
3-Formyl-10-methylphenothiazine	k	287.7, 384		43

Compound	Solv.	Absorption Maxima max. nm / $\log_e$	Absorption Minima max. nm / $\log_e$	Ref.
3-Formyl-10-methylphenothiazine azlactone	k	298, 343, 475		43
3-Chloro-10-methylphenothiazine azlactone	h	253, 306		43
3-Chloro-10-phenylphenothiazine azlactone	h	255, 320		43
10-Methyl-3-nitrophenothiazine azlactone	k	240.5, 282.5,299,422		35
3- Nitro-10-methylphenothiazine	d	280, 298, 368	230, 286	27
3-Amino-10-ethylphenothiazine	d	226, 296	278	27
3-Hydroxy-10-methylphenothiazine	a	230, 296, 362	280, 298	27
3,7-Dinitro-10-ethylphenothiazine	a	230, 302, 435		36
3-Amino-7-chloro-10-ethylphenothiazine	a	234, 259		36
10-Acetyl-3,7-dibromophenothiazine	a	234, 259		36
7,9-Dichloro-3-nitro-10-ethylphenothiazine	a	248, 280, 409		36
3-Amino-7,9-dichloro-10-ethylphenothiazine	a	248, 280, 409		36
3-Acetoxy-10-acetyl-4-diacetyl-aminophenothiazine	l	234, 258, 295		37
10-(3-Methylaminopropyl)phenothiazine hydrochloride	d	248, 300		25
10-(Amino-2-methylpropyl)phenothiazine hydrochloride	d	252, 305		25
2-Chloro-10-(methylaminopropyl)phenothiazine maleate	d	250, 305		25
2-Chloro-10-(3-ethylaminopropyl)phenothiazine hydrochloride	d	250, 305		25
2-Chloro-10-(3-dimethylamino-1-methylpropyl)phenothiazine hydrochloride	d	255, 310		25
2-Chloro-10-(3-dimethylamino-2-methylpropyl) phenothiazine hydrochloride	d	260, 320		25
2-Chloro-10-(3-dimethylamino-2-ethylpropyl)phenothiazine hydrochloride	d	252, 310		25
2-Methoxy-10-(3-dimethylamino-2-methyl propyl)phenothiazine hydrochloride	d	252, 308		25
phenothiazine-p-ethylbenzenesulphonylimine	a	256.5, 306		55
Phenothiazine-benzenesulphonylimine	a	244, 302.5		55
Phenothiazine-p-methylbenzene sulphonylimine	a	254, 306		55
10-(3-Dimethylaminopropyl)phenothiazine hydrochloride	a	254, 304 (4.40, 3.60)	222, 278	28, 23

Compound	Solv.	Absorption Maxima Max. nm./$\log_e$	Absorption Minima Max. nm./$\log_e$	Ref.
2-Nitrophenothiazone-7	k	320.5, 480.8		31
4-Nitrophenothiazone-3	k	262.5, 273, 375, 395, 484		31
4-Nitro-7-bromophenothiazone-3	k	260.7, 269.5, 406, 484		31
4-Nitro-7-chlorophenothiazone-3	k	260.7, 268.5, 401, 482		31
4-Nitro-1,7,9-tribromophenothiazone-3	k	257, 286.5, 347, 433, 492		31
4-Nitro-1,7,9-trichlorophenothiazone-3	k	248, 274.2, 347, 425.5, 488		31
4-Nitro-1,2,7,8,9-pentabromopheno-thiazone-3	k	254, 283, 298.5, 344, 446, 502		31
4-Aminophenothiazone-3	l	305.5, 350.5, 587		58
4-Acetylaminophenothiazone-3	l	239, 284.5, 360, 515		58
4-Benzylidenaminophenothiazone-3	l	252, 293, 331, 557		58
3-Acetoxy-4-diacetylamino-10-acetyl-phenothiazone-3	l	234, 258, 295		58
4-Amino-7-chlorophenothiazone-3	l	308, 357, 585		58
4-Amino-7-bromophenothiazone-3	l	310, 358.5, 590		58
2-Chloro-4-nitrophenothiazone-3	l	278.5, 385, 409, 487		58
2-Bromo-4-nitrophenothiazone-3	l	281.5, 390, 402, 488		58
4-Amino-2-chlorophenothiazone-3	l	305, 368, 605		58
2-Acetylphenothiazone-3	l	254, 280, 410		58
4-Amino-2-bromophenothiazone-3	l	306.5, 370, 610		58
2,8-Diacetylphenothiazone-3	k	237, 280.1, 367.6, 502.5		32
2,8-Diacetyl-3-hydroxyphenothiazone-3	k	253.2, 282.5		32
2-Morpholino-3-phenothiazone	m	471 (4.53)		57
7-Morpholino-3-phenothiazone	m	542 (5.26)		57
2-Piperidino-3-phenothiazone	m	475 (4.15)		57
7-Piperidino-3-phenothiazone	m	556 (4.78)		57
2-Cyclohexamethyleneamino-3-phenothiazone	m	454 (3.82)		57
7-Cyclohexamethyleneamino-3-phenothiazine	m	566 (4.76)		57
2-Methylamino-3-phenothiazone	m	480 (3.56)		57
2-Diethylamino-3-phenothiazone	m	482 (4.20)		57

Compound	Solv.	Absorption Maxima max. nm./$\log_e$	Absorption Minima max. nm./$\log_e$	Ref.
7-Diethylamino-3-phenothiazone	m	530 (4.65)		57
2-Adamantylamino-3-phenothiazone	m	472 (3.91)		57
2-Methylamino-3-phenothiazone	m	453 (4.1)		57
7-Methylanilino-3-phenothiazone	m	485 (3.98)		57
2,7-Dianilino-3-phenothiazone	m	567 (4.54)		57
2-(p-Nitroanilino)-3-phenothiazine	m	477 (4.23)		57
2-Ethylanilino-3-phenothiazone	m	469 (4.49)		57
2-Anilinophenothiazone-3	a	272, 289, 476		30
2-Anilino-4-bromophenothiazone-3	a	275.3, 294.6, 478		30
2-Anilino-4-chlorophenothiazone-3	a	274.5, 294.6, 476		30
2-Anilino-4-bromophenothiazone-3	a	262, 295.5, 474		30
2-Anilino-7-bromophenothiazone-3	a	276.2, 291.5, 476		30
2-Anilino-7-chlorophenothiazone-3	a	276, 290, 476		30
Benzo[a]phenothiazine	d	250, 363		26
4-(Benzo[a]phenothiazine-4(yl)2,6-diphenylpyran perchlorate	d	248, 373		38
Pyrrolo[3,2,1,kl]phenothiazine-2-carboxyldehyde	d	248, 373		38
Pyrrolo[3,2,1,kl]phenothiazine	d	226, 253, 268, 277 299, 311		38
Imidazo[4,5,1,kl]phenothiazine	d	225, 233, 250 (4.48, 4.42, 4.25)		38
		265, 274, 290, 300, 330 (4.05, 3.99, 3.76, 3.89, 3.92)		37
1,2-Dihydroimidazo[4,5,1,kl]phenothiazine	d	232, 257, 329 (4.37, 4.31, 3.78)		39
1,2-Dihydro-3H-pyrazine [3,2,1,kl]-phenothiazine	d	244, 270, 324 (4.24, 4.28, 3.59)		37
1,3-Dihydro-2H-pyrimido-[5,6,1,kl]-phenothiazine	d	245, 269, 328 (4.01, 4.59, 3.60)		37
3-Formyl-10-methylphenothiazine	d	238, 272, 287, 385 (4.27, 4.25, 4.23, 3.83)		1
3-Acetyl-10-methylphenothiazine	d	235, 269, 285, 374 (4.24, 4.33, 4.25, 3.75)		1

Compound	Solv.	Absorption Maxima max. nm. /$\log_e$	Absorption Minima max. nm. / $\log_e$	Ref.
(Promazine)	d	254, 306 (4.53, 3.64)	222, 277 (3.95, 3.20)	47 3
	e	205, 252, 302		46
	f	252, 303		45, 47
	g	251, 301		45, 47
Promazine hydrochloride sulphoxide	e	232.5, 271.5,298,242	255.5, 282.5,314	46
1-Hydroxypromazine	d,g	270^{sh}, 281, 477,490,513		17
2-Hydroxypromazine	d,g	219,278,343,440^{sh},558		17
4-Hydroxypromazine	d,g	262^{sh},271,292,486,500		17
3-Methoxypromazine	d,g	225, 279, 342,372, 565		17
2-Methoxypromazine maleate	a	253, 307	231, 279	28, 23
	d,g	219, 278, 343, 440,565		
2-Propionyl-10-(3-dimethylaminopropyl)-phenothiazine phosphate (Propiopromazine phosphate)	e	205, 242.5, 277	220, 256.5	46
Propiopromazine sulphoxide	e	219, 252, 310, 361	228, 291, 331	46
3-Trifluoromethylpromazine	d	255, 305		35
Triftazine	a	257, 303 - 306 (3.617, 4.522)		7
	a	259, 308.5	224, 279.5	28, 23
	d	258, 308	224, 280 (4.01, 3.21)	28,10,47
	e	205, 238, 256, 306.5	223.5, 280	46
	f	259, 311		10, 47
	g	255, 306		10, 47
3-Trifluoromethylpromazine sulphoxide	d	235, 278, 302, 248		36
	e	234, 273, 301.5, 347.5	258, 285, 318.5	46
3-Trifluoromethylpromazine sulphone	d	233, 274, 303, 348		46
Acetopromazine maleate	a	243.5, 278, 370 (4.40, 4.30, 3.30)	228.5, 256, 343	28, 23
	e	205, 242.5, 278.5	225, 257.5	46
	n	242, 245, 276, 282, 377		46
Acetopromazine sulphoxide	e	207, 252.5,267,311-361	230, 292, 332	46
10-[2,3-bis(dimethylamino) propyl]-Phenothiazine fumarate (Aminopromazine fumarate)	a	254, 305	224, 278	28, 23

Compound	Solv.	Absorption Maxima max. nm./$\log_e$	Absorption Minima max. nm./$\log_e$	Ref.
	e	205, 248, 296.5	221, 272.5	46
Aminopromazine fumarate sulphoxide	e	289, 332	303.5	46
2-Chloropromazine hydrochloride	a	256.5, 309.5 (4.50, 3.60)	226, 278.5	28, 23
	b,c	253, 307	224, 280	9
	d	255, 308 (4.53, 3.67)	222, 278 (3.95, 3.22)	3,45,50
	e	207.5, 254, 307	225, 278	45, 46
	f	255, 310		45, 50
	k	21o, 242, 256, 276, 275, 307		52
2-Chloropromazine sulphoxide	b,c	242, 273, 300, 340	240, 283, 320	46
	d	240, 275, 298, 342.5 (4.52, 403, 3.88, 3.72)		3
	e	238.5, 274, 299, 342	261.5, 285.5, 314.5	46
	a	255, 310		25
2-Chloropromazine sulphone	b,c	236, 270, 298, 334	256, 284, 311, 344	46
	d	233, 271, 294, 332 (4.54, 4.6, 3.89, 3.76)		3
2,4-*Dichloropromazine hydrochloride*	a	240.5, 262, 312.5 (4.2, 4.6, 3.6)	228, 244, 284.5	28, 23
7-Hydrochloropromazine quaternary iodide	d	223, 256, 310 (4.40, 4.43, 3.83)		24
10-[3-(1-methyl-4-properazinyl) Propyl]phenothiazine dimalonate	a	255.5, 309 (4.489, 3.617)	221.5, 278.5	23
(Perazine dimalonate)	e	232.5, 271, 297.5, 341	255.5, 282, 313.5	46
Trifluoroperazine dihydrochloride	a	260.5, 312 (4.6, 3.6)	220, 283	28, 23
	d	258, 307.5 (4.50, 3.50	280 (3.08)	3, 45 45, 46
	e	204.5, 237, 255.5, 306	223, 279.5	45
	f	273, 318		45
Trifluoroperazine sulphoxide	e	216, 234, 272.5, 301,347	258, 284.5, 317.5	46
Thiethyloperazine maleate	a	216, 265, 317 (4.6, 4.8, 3.6)	239, 292	28, 23
2-Chloro-10[3-(1-methyl-4-piperizinyl)-Phenothiazine	d	258, 313, (4.57, 3.65)	227, 281 280	18, 23 3, 45

Compound	Solv.	Absorption Maxima max. nm./$\log_e$	Absorption Minima max. nm. / $\log_e$	Ref.
	d	256, 309 (4.54, 3.62)	280 (3.16)	45
Prochlorperazine	e	206, 254.5, 306.5	225, 278	45,46
	f	256, 308		45
	n	239, 255, 272, 309		52
	k	242, 260, 275, 311		52
Prochlorperazine-cobalt complex	k	242, 261, 275 317, 585, 625		52
Prochlorperazine sulphoxide	e	239, 274, 298.5, 341.5	261.5, 285, 314	46
7-Hydroxychlorperazine	d	216, 258, 316 (4.27, 4.40, 3.76)		24
8-Hydroxyprochlorperazine	d	237, 265, 316 (4.33, 4.36, 3.74)		24
7-Hydroxydesmethylprochlorperazine	d	219, 159, 318 (4.27, 4.43, 3.78)		24
7,8-Dihydroxyprochlorperazine dihydrochloride	d	213, 236, 258, 319 (4.35, 4.40, 4.27, 3.80)		24
Aethaperazine	a	254, 303-306 (4.486, 3.640)		53
Thioproperazine	a	262-263, 309-311 (3.481, 4.344)		53
2-Dimethylsulfamino-10-[3-(1-methyl 4-piperazinyl]phenothiazine dimethyl-sulphonate	d	264, 316 (4.59, 3.69)	239, 300 (4.28, 3.51)	3
(Thioproperazine dimethyl sulphonate)	a	236, 267, 317	218, 248, 291	23
	e	204.5, 234, 263.5, 311.5	216, 245.5, 293.5	46
Thioproperazine dimethyl sulphonate sulphoxide	e	218, 245.5, 273.5 304, 352	226, 270, 288, 322	46
Butyrylperazine maleate	a	244.5, 279, 362-378 (4.4, 4.3)	231.5, 258	28,23
Prochlorperazine-benzenesulphonylimine	a	255, 267.5, 272.5		55
Perfenazine hydrochloride	a	213, 257, 314		49
	d	257, 310 (4.57, 3.66)	225, 278 (4.06, 3.23)	3,45 47,48
	e	207, 254.5, 307	225, 278	45, 46
	f	255, 310		45,47,48
	e	239, 273.5, 298.5, 341.5	262, 285, 314	46

Compound	Solv.	Absorption Maxima Max. nm./$\log_e$	Absorption Minima Max. nm./$\log_e$	Ref.
Perphenazine sulphoxide	e	239, 273.5, 298.5, 341.5	262, 285, 314	46
7-Hydroxyperphenazine	d	214, 257, 315		24
		(4.29, 4.39, 3.69)		
8-Hydroxyperphenazine	d	212, 230, 263, 317		24
		(4.17, 4.29, 4.32, 3.64)		
2-Trifluoromethyl-10-[3-(1-(2-hydroxy-	a	260, 311	225.5, 282	23,28
ethyl)-4-piperazinyl)propyl]pheno-		(4.4, 3.5)	224.5, 279	3,45
thiazine hydrochloride	d	259, 309	224.5, 279	3,45
		(4.53, 3.58)	(4.00, 3.23)	47,48
Fluphenazine hydrochloride	d	204, 238, 255.5, 306	223, 279.5	45,47
	f	257, 306		48,50
				45,48,50
Fluphenazine sulphoxide	e	216, 234, 273, 301, 347.5	258, 284.5, 318	48
2-Acetyl-10-[3-(1-(2-hydroxyethyl)-	d	243, 280	230, 255	3,45,47
4-piperazinyl)-propyl]phenothiazine		(4.35, 4.44)		
dimaleate	e	206, 242, 278	228, 285	46
Acetophenazine dimaleate	f	243, 280		45,47
	g	243, 278		45,47
Acetophenazine sulphoxide	d	207, 252.5, 267, 310, 361	230.5, 291.5,332	46
7,8-Dihydroxyperphenazine	d	212, 233, 256, 319		49
		(4.32, 4.39, 4.25, 3.78)		
Carphenazine maleate	a	244, 278.5, 368	232, 257	23,28
(Proketazine)	d	243, 278	230, 256	28,45
		(4.46, 4.39)	(4.36, 4.25)	47
	f	243, 280		45,47
	g	244, 277		45,47
10[2-methyl-3(1-hydroxy-ethoxyethyl-	a	255.5, 308	223.5, 279	3,23
4-piperazinyl]propyl]phenothiazine	e	205, 252, 301	220.5, 275.5	46
(Dixyrazine)				
Dixyrazine sulphoxide	e	233, 271, 296, 340	256.5,282,312.5	46
Methdilazine hydrochloride	d	254, 304		
		(4.50, 3.61)		
2-Chloro-10[3-(1-(2-acetoxyethyl-	a	213, 257, 310	226, 279	23,28
4-piperazinyl)propyl]phenothiazine	d	257, 310	226, 280	
hydrochloride		(4.57, 3.66)	(4.12, 3.26)	
Thiopropazate hydrochloride	d	206, 254.5, 306	225, 278	46
	f	257, 310		45,47,50

Compound	Solv.	Absoprtion Maxima max. nm./$\log_e$	Absorption Minima max. nm./$\log_e$	Ref.
	g	255, 306		45,47,50
Thiopropazate sulphoxide	e	239, 273, 299, 241.5	261.5, 285, 314	46
2-Methylmercapto-10-[2-N-methyl-2-piperi-	a	208, 230, 264, 315	221, 238, 290	23, 28
dyl)]phenothiazine hydrochloride	d	263, 314	288	3, 45
(Thioridazate hydrochloride)		(4.58, 3.66)	(3.72)	
	e	206, 229, 262, 312	219, 233, 289.5	45, 46 47, 50
	f	273, 318		45, 47, 48
Thioridazine sulphoxide	e	235, 273, 303.5, 348,	288, 320.5	46
Piperacetazine hydrochloride	d	244, 280	220, 256	3
		(4.40, 4.35)	(4.23, 4.15)	
Pipamazine hydrochloride	d	257, 312	280	3
		(4.57, 3.65)	(3.22)	
Methophenazate fumarate	a	216, 257, 296	235	23, 28
Acepromethazine	n	242, 245, 272-276, 365		25
Aminazine	a	252-253, 301-304		22
		(3.633, 4.507)		
Tisercin	a	249-251, 298, 302		22
		(4.349, 3.644)		
10-(3-Dimethylamino propyl)phenothiazine	a	255, 306	221.5, 278	23, 28
Trimeprazine	d	255, 308	222, 278	3, 23
		(4.53, 3.67)	(3.45, 3.22)	
	e	295, 251.5, 300.5	220.5, 275,5	46
	f	255, 306		45,47,50
	g	251, 299		45, 47,50
Trimeprazine sulphoxide	e	233, 271.5, 297, 341	256.5, 282.5, 313	46
Levomeprazine maleate	a	253, 306	231.5, 278	23, 28
(Methotrimeprazine)	e	209, 250, 303	227, 229	45,46,47
	d	255, 310		45, 47
	f	255, 310		45, 47
	n	216, 242, 250, 268, 302		52
Levomeprazine sulphoxide	e	217, 249, 274, 294, 332	227, 291.5, 308	46
Trifluoromeprazine hydrochloride	d	238, 258, 308	223, 240, 279	28
		(4.18, 4.55, 3.60)	(4.02, 4.18, 3.21)	
2-Methylmercapto-10-(3-dimethylamino-2-methyl-propyl)phenothiazine	e	206, 229.5, 262, 310	214, 233.5, 289.5	46

Compound	Solv.	Absorption Maxima max. nm./$\log_e$	Absorption Minima max. nm./$\log_e$	Ref.
(Methiomeprazine)				
Methiomeprazine sulphoxide	e	235, 273, 202.5, 347.5	288, 319.5	46
2-Dimethylsulphamino-10-(2-dimethyl-	e	204, 265, 268, 315		46
aminopropyl)phenothiazine methane-	k	240, 265, 268, 315		52
sulphonate				
(Dimethothiazine methane sulphonate)	n	206, 239, 262, 265, 310		52
Dimethothiazine-coblat complex	k	240, 266, 268, 321, 585,625		52
Dimethothiazine sulphoxide	e	218, 245, 299, 348	225, 288, 317.5	46
2-Propionyl-10-(2-dimethylaminopropyl) phenothiazine maleate	e	205, 240.5, 273.5, 363	224, 257, 337	45,46
(Propiomazine maleate)	f	224, 280		46
Propiomazine sulphoxide	n	24, 245, 268-274, 364		42
10-(2-Propionyl-10-(2-methylamino-	a	252, 300.5	221, 275	3, 23
propyl)phenothiazine hydrochloride	e	205, 249, 298	219.5, 273.5	46
(Profenamine hydrochloride)	d	248, 297		25
	k	240, 251, 265, 298		52
Profenamine hydrochloride sulphoxide	e	234, 267.5, 291.5, 335		46
2-Chloro-10-(3-diethylaminopropyl)	e	206, 250, 256, 265, 304	229, 289.5, 324	46
phenothiazine hydrochloride				
(Chloroproethazine hydrochloride)	e	207, 255, 307	225, 278.5	46
Chloroproethazine sulphoxide	e	239, 274, 229, 342	261.5, 285.5,314.5	46
10-(2-Diethylaminoethyl)phenothiazine hydrochloride	a	252, 301.5 (4.49, 3.55)	221, 275	3,23,46
(Diethazine)	e	205.5, 250, 299	220, 373.5	52
	n	238, 252, 268, 300		52
Diethazine-coblat complex	k	240, 256, 270, 308,285,625		52
Diethazine sulphoxide	e	233.5, 268, 292.5, 336	256, 280, 308.5	46
10-(2-Dimethylaminopropyl)phenothiazine	a	252, 301.5	220.5, 275	3, 23
hydrochloride		(4.49, 3.58)		
(Promethazine hydrochloride)	d	252, 302 (4.49, 3.58)	220, 274 (3.97, 3.21)	45, 47,
	e	205, 249.5, 298.5	220, 274	46
	f	253, 304		45,47,48

Compound	Solv.	Absorption Maxima Max. nm./$\log_e$	Absorption Minima Max. nm./$\log_e$	Ref.
	g	249, 299		45,47,48
	h	240, 251, 268, 299		52
Promethazine-cobalt complex	k	242,253,272,305,585,625		52
Promethazine hydrochloride sulphoxide	e	234, 268, 293, 336.5	256.5,280.5,310	46
10-[N-Methyl-3-piperidyl)methyl-	a	254.5, 305.5	222, 276.5	3, 23
phenothiazine		(4.5, 3.6)		
(Pecazine)	e	205, 253, 303	220.5, 270.5	45,50
	f	252, 304		45,50
	g	252, 302		45,50
Pecazine sulphoxide	e	233, 272, 298, 342	256,283,314.5	46
2-Cyano-1-[3-(4-hydroxypiperidyl)]-	a	232.5, 271.5, 316	256,283,314.5	46
ethylphenothiazine		(4.31, 4.53)		
(Propericiazine)	d	272, 315, 365		25
	e	205, 232, 268.5	214.5, 247.5	46
	n	207,223,232,268,317,350		52
Propericiazine sulphoxide	e	222, 244.5, 275.5,	268, 289, 326	46
		307.5, 357		
10-Dimethylaminopropyl-2-trifluoro-	d	255, 305		49
methylphenothiazine				
(Vesprin)				
Vesprin sulphoxide	d	235, 278, 302, 348		49
Vesprin sulphone	d	233, 274, 303, 348		49
(Dimethylamino-2-ethoxy-2-ethylpheno-	e	252.5, 302.5	220.5, 276.5	51
thiazinyl-10-carboxylate				
hydrochloride				
Dimethozanate hydrochloride	e	205, 225.5, 254	217, 245.5	46
Dimethozanate sulphoxide	e	209, 246, 275, 298	283	46
10-(2-Trimethylammoniumpropyl)-	e	205, 225.5, 301	220.5, 275	46
phenothiazine methylsulphonate				
Thiazinamium methylsulphonate	n	239, 252, 268, 303		52
Thiazinamium methylsulphonate	k	240, 266, 268, 321		52
cobalt complex				
Thiazinamium sulphonate	e	233, 268.5, 293, 337	255.5,280,307.5	46
Memazine	e	226, 267.5, 295, 333	250.5,280.5,310	46
	n	227, 239, 268, 291		

Compound	Solv.	Absorption Maxima Max. nm./$\log_e$	Absorption Minima Max. nm./$\log_e$	Ref.
Memazine sulphoxide	k	242, 270, 291, 326, 333		52
Memazine sulphoxide-cobalt complex	k	242, 270, 294, 326, 333 585, 625		
Pyrathiazine	a	251, 300		45,50
	f	252, 298		45,50
	g	248, 298		45,50
10-(3-Dimethylaminopropyl)-1-aza- phenothiazine	d	249, 315		45,47,50
	f	249, 315		45,47,50
(Isothiapendyl)	g	245, 315		45,47,50
Parathiazine hydrochloride	d	250, 299	220, 274	51
Morazine (base)	e	252.5, 301.5	220.5, 276	51
Perazine (dimalonate)	e	252.5, 302	220.5, 276	51
Ridazine (base)	e	252.5, 302.5	221, 276.5	51
Mepazine hydrochloride	d	252.5, 302	220.5, 276	51
Phenazine hydrochloride	e	252.5, 302	220.5, 276	51
Acetylphenothiazine hydrochloride	e	252.5, 302	220.5, 276	51
Dizyrazine (base)	e	252.5, 302	220.5, 276	51
Methdilazine hydrochloride	e	252.5, 302.5	220.5, 276.5	51
Phrenolon	a	253-255, 294, 296 (4.499, 3.805)		53
Dinezine	a	248, 250, 294, 298 (4.466, 3.580)		22
Diprizine	a	249, 250, 294, 300 (4.453, 3.568)		22
5-(Benzylamino)5,5-dihydro-o- phenylphenothiazine	h	207, 254, 275, 304 335		57
5-(Benzylmethylamino)-5,5-dihydro- 10-phenylphenothiazine iodide	h	347, 308, 243		56
5-(Benzylmethylamino)-5,5-dihydro- 10-methylphenothiazine iodide	h	241, 302, 355		56
5,5-Dihydro-10-methyl-3-piperidinium -1-ylidene phenothiazine iodide	h	242, 267, 307, 350		56
3-Azaphenothiazine	o	238, 269, 275, 306, 380		62
10-3(Dimethylaminopropyl)-3-aza- phenothiazine	f	235, 258, 308 232, 258, 317		62

Compound	Solv.	Absorption Maxima max. nm./$\log_e$	Absorption Minima max. nm. /$\log_e$	Ref.
3-(3-Dimethylaminopropyl)3-azaphenothiazinium chloride	o	240, 271, 278, 310, 415		62
	f	260, 276, 285, 444		62
3-(3-Dimethylaminopropyl)-3-azaphenothiazine anhydronium base	k	271, 279, 310, 420		62
3-(3-N-piperidinopropyl)-3 azaphenothiazinium chloride hydrochloride	o	240, 271, 279, 310, 415		62
	f	260, 270, 276, 283, 443,		62
3-(2-N-piperidinoethyl)3-azaphenothiazinium chloride hydrochloride	o	240, 271, 279, 310, 420		62
	f	260, 270, 276, 283, 444		62
3-(2-Aminoethyl)3-azaphenothiazinium bromide hydrobromide	o	241, 272, 279, 310, 418		62
	f	260, 270, 276, 310, 418		62
3-Methyl-3-azaphenothiazinium iodide	o	240, 270, 277, 305, 410		62
	f	260, 270, 276, 283, 443		62
4-Methyl-3-azaphenothiazine anhydronium base	k	260, 270, 277, 285, 440		62
3,10-Dimethyl-3-azaphenothiazinium iodide	o	270, 276, 300, 390		62
	f	270, 278, 300, 390		62
2,4-Diamino-1,3-diazaphenothiazine	e	268, 291, 295		63
	f	255, 277, 292		63
2,10-Dimethyl-1,3-diazaphenothiazine	d	222, 245, 285 (4.28, 4.26, 4.28)		39
	o	293, 321, 360, 470 (4.33, 3.91, 3.46, 3.13)		39
3,10-Dimethyl-2,3-diazaphenothiazine	d	223, 240, 276 (4.17, 3.96, 4.28)		39
	o	284, 316, 355, 453 (4.36, 3.73, 3.32, 3.27)		39
1-Chloro-10-methyl-2,3-diazaphenothiazine	d	227, 271, 296, 382 4.15, 4.30, 3.65, 3.00		39
1-Chloro-2-methyl-2,3-diazaphenothiazine	d	278, 380, 477 (4.19, 3.58, 3.39)		39
1,4-Dioxa-1,2,3,4-tetrahydro-2,3-diazaphenothiazine	d	209, 255, 328		40
2,3-Diacetyl-1,4-dioxa-1,2,3,4-tetrahydro-2,3-diazaphenothiazine	d	207, 255, 340		40

Compound	Solv.	Absorption Maxima max. nm./$\log_e$	Absorption Minima max.nm/$\log_e$	Ref.
2,4-Dimethoxy-8-methy-1,3,9-triazaphenothiazine	a d	221, 250,283 (3.86, 3.77, 3.86)		41
4-Amino-7-methoxy-1,3,6-triazaphenothiazine	a	217, 332	262	42
4-Amino-7-chloro-1,3,6-triazaphenothiazine	a	210, 220,324 (4.15, 4.18, 3.87)	215, 261 (4.14, 3.41)	42
2,4- Diamino-8-methyl-1,3,9-triazaphenothiazine	a	224, 251, 290 (4.05, 4.07, 3.80)	215, 235, 275	42
2-Amino-4,8-dimethyl-1,3,6-triazaphenothiazine	a	242, 317 (4.12, 3.69)	316, 285	42
2-Amino-4-chloro-8-methyl-1,3,9-triazaphenothiazine	a	248, 309 (4.26, 3.93)	216, 281 (3.97, 3.69)	42
4-Amino-8-methyl-2-methylthio-1,3,9-triazaphenothiazine	a	225, 249, 300 (3.71, 3.74, 3.52)	214, 233, 283 (3.68, 3.70, 3.46)	42
2-Amino-7-chloro-4-hydroxy-1,3,6-triazaphenothiazine	a	220, 263, 366 (4.41, 4.52, 3.75)	234, 310 (3.99, 3.16)	42
2,4-Dichloro-7-methoxy-1,3,6-triazaphenothiazine	a	245, 297 (4.27, 4.06)	230, 272 (4.21, 4.01)	42
4-Amino-4-hydroxy-7-methoxy-1,3,6-triazaphenothiazine	a	210, 252, 311 (4.31, 4.01, 4.04)	243, 277 (3.68, 3.30)	42
2,4,7-trichloro-1,3,6-triazaphenothiazine	a	209, 253, 399 (4.43, 4.12, 4.21)	205, 239, 267 (4.41, 4.09, 4.08)	42
2-Amino-4-chloro-7-methoxy-1,3,6-triazaphenothiazine	a	213, 235, 320 (4.22, 4.20, 3.92)	230, 281 (4.19, 3.70)	42
Phenothiazine sulphoxide	k	228, 272, 302, 341		36
3-Nitrophenothiazine sulphoxide	d	287, 380		36
	d,e	287, 378		36
	d,m	350, 486		36
10-Methylphenothiazine sulphoxide	k	228, 268, 298, 340		36
3-Nitro-10-methylphenothiazine sulphoxide		228.5, 254 286.7, 254		36,44 36
3,7-Dinitrophenothiazine sulphoxide	d	286, 310, 380		36
3-Amino-10-methylphenothiazine	d	232, 284, 370	252, 344	36
sulphoxide	d,e	286, 310, 380		36

Compound	Solv.	Absorption Maxima max. nm./log$_e$	Absorption Minima max. nm/log$_e$	Ref.
	d,m	257, 345, 488		36
Phenothiazine sulphone	k	225, 270, 300, 331		36
10-Methylphenothiazine sulphone	k	272, 295.8, 336		36
3,7-Dichlorophenothiazine sulphoxide	d	280, 315, 346		36
7-Chloro-10-ethyl-3-nitrophenothiazine sulphone	k	255, 290, 362		36
7,9-Dichloro-10-ethyl-3-nitrophenothiazine sulphone	k	294, 344, 356		36
3-Amino-7-chloro-10-ethylphenothiazine sulphone	k	263, 289, 363		36
3-Amino-7,9-dichloro-10-ethylphenothiazine sulphone	k	228, 293.5, 364		36
	d	228, 293.5, 364		36
	d,e	226, 282, 306, 348		36
	d,m	279, 303, 365		
2,8-bis(Ethylamino)phenothiazine sulphone	d	268, 312		60
2,8-bis(Methylamino)phenothiazine sulphone	d	267, 311		60
2,8-bis(Dimethylamino)phenothiazine sulphone	d	272, 315		60
10-(2-Methylprop-2-enyl)phenothiazine sulphone	k	268, 296, 333		36
	d,e	279, 315, 346		36
	d,m	258,5, 314, 358		36
10-Propyn-2-yl-phenothiazine sulphone	k	253, 265, 292, 324		36
3-Nitrophenothiazine sulphone	d	292, 372		36
	d,e	292, 372		36
	d,m	343, 488		36
3-Amino-10-methylphenothiazine sulphone	d	226, 281, 362	248, 336	27
3-Formyl-10-methylphenothiazine sulphone	k	283, 334		43
3,7-Dichlorophenothiazine sulphone	d	279, 315, 335		36
	d,e	279, 315, 335		36
	d,m	265, 317, 362		36
10-Methylphenothiazine-3- azlactone sulphone	k	259, 311.7, 327 410, 429		43

TABLE 2

Visible Spectral Data of Nuclear Substituted Phenothiazines

Compound	Max./$\log_e$	Ref.
8-Methoxy-1-nitrophenothiazine	488 (2.16)	25
8-Ethoxy-1-nitrophenothiazine	488 (2.21)	25
8-Methyl-1-nitrophenothiazine	488 (2.25)	25
2-Ethoxy-7-nitrophenothiazine	448 (2.20)	25
2-Methyl-7-nitrophenothiazine	450 (2.18)	25
2,7-Dimethylphenothiazine	444 (2.15)	25
1,3-Dinitro-8-ethoxyphenothiazine	430 (2.11)	25
3-Chloro-8-ethoxy-1-nitrophenothiazine	422 (2.35)	25
3-Chloro-1,8-dinitrophenothiazine	410 (2.31)	25

TABLE 3

Activation and Fluorescence Maxima of Phenothiazines

Compound	Substitution Position 2	Position 5	Activation Max. nm Unoxidised	Oxidised	Fluorescence Max.nm Unoxidised	Oxidised	Ref.
Phenothiazine	Cl	S	340	360	470	440	7
Methiophenothiazine	S-CH_3	S	310	390	440	385	7
Trifluorophenothiazine	CF_3	S	300	350	440	410	7
Thiethylperazine	S-C_2H_5	S	285	360	470	445	7
Prochloroperazine	Cl	S	325	340	450	380	7
Trifluoperazine	CF_3	S	320	350	470	405	7
Trifluoperazine sulphoxide	CF_3	S=O	360	350	410	405	7

TABLE 3 (Contd.)

Activation and Fluorescence Maxima of Phenothiazines

Compound	Substitution Position 2	Position 5	Activation Max. nm Unoxidised	Oxidised	Fluorescence Max.nm Unoxidised	Oxidised	Ref.
Promazine	H	S	320	340	450	375	7
Chloropromazine	Cl	S	325	340	455	380	7
Chloropromazine Sulphoxide	Cl	S=O	350	340	385	380	7
Methoxypromazine	$O-CH_3$	S	320	340	450	380	7
Trifluopromazine	CF_3	S	330	350	475	405	7
Trifluomeprazine	CF_3	S	325	350	480	405	7
Methiomeprazine	$S-CH_3$	S	330	360	470	405	7
Fluephenazine	CH_3	S	325	350	475	405	7
Perphenazine	C	S	330	345	460	380	7
Carphenazine	$\overset{O}{\overset{\|}{C}} - C_2H_5$	S		370		475	7
Bromridazine	Br	S	290	340	450	380	7
Chloridazine	Cl	S	330	340	455	380	7
Thioridazine	$S-CH_3$	S	330	360	470	440	7
Thioridazine disulphone	$\overset{O}{\overset{\|}{S}}-CH_3$ $\overset{\|}{O}$	O S O	360	360	435	440	7

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