SYNTHESIS OF PYRIDAZINONE DERIVATIVES OF CHELATING BIOLOGICAL INTEREST

BY

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ABSTRACT

Different 1-substituted-4,5-diacetyl-1,2,4,5-tetrahydropyridazin-3,6-dione were synthesised by the reaction of diacetyl L(+)-tartaric acid anhydride with the corresponding hydrazine derivatives. The structure of the produced compounds was confirmed by microanalytical and UV,IR and ^{1}H NMR spectral data. The obtained compounds showed chelating behaviour toward certain transition metals (Cu^{++} and Fe^{+++}). The chelating characteristics were studied using spectrophotometric method. These compounds have also biological activities.

INTRODUCTION

Compounds containing a diazine system have a wide spectrum of biological activities e.g. antimalarial [5], antifungal [10] antiinflamatory [8], and selective plant growth regulator [4]. Since the mode of action of some compounds was attributed to the formation of stable chelates with the metals in the cell,such process inhibits

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so many vital enzymatic reactions [3,12] and also metal
chelates were suggested more toxic than the metal or the
chelator itself [1,4,11].

It was of interest to prepare the compounds contain-
ing a diazine system having a chelating behaviour and to
study their biological activities.

RESULTS AND DISCUSSION

In the present work we prepared anhydride diacetyl-
L(+)- tartaric acid (I) according to the reported procedure
[6]. The pyridazinone derivative (II) was synthesised by
direct condensation between compound (I) and hydrazine at
90°C for 3 hr. The reaction between compound (I) and 2,4-
dinitrophenylhydrazine in acetic acid at room temperature
or by fusion gave compound (III).

On the other hand, compound (IV) was obtained by
condensation of compound (I) and phenylhydrazine at 120°C
(see Scheme 1).

The structure of these compounds was established via
microanalytical, UV, IR and ^{1}H-NMR spectral data.

The spectroscopic studies of the compounds II, III
and IV led to the following results :-

The presence of broad absorption bands in IR spectra at
$3450 - 3300$ cm^{-1}. This ind cates that the compounds have
associated hydrogen bond as the following :-

(II)   (IV)
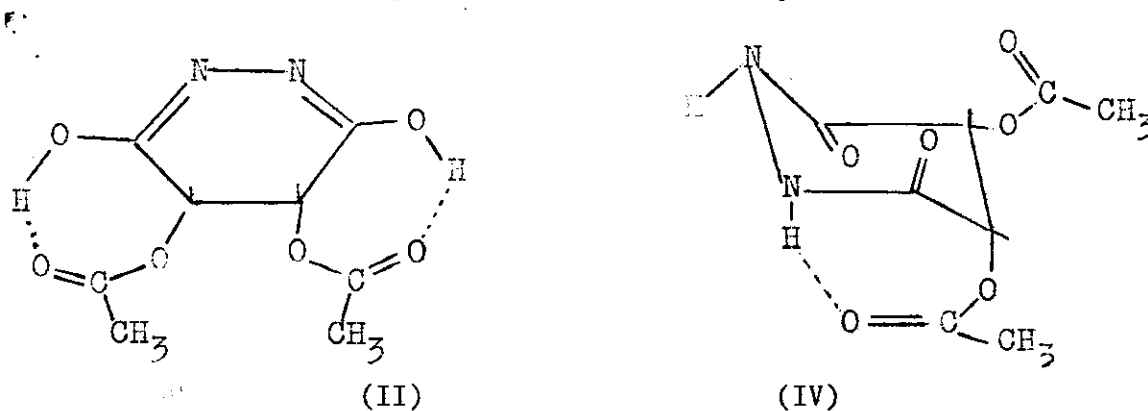
The electronic absorption spectra of the compound
II (Fig. 1) show absorption on band at 245 nm at pH 9.0
while at pH 5.0 this band disappeared.

Also in ^{1}H-NMR spectra the N-H moity appeared as two
exchangeable separate signals (at 9.3, 9.7 and 9.7,10.3 for
the compounds II and III respectively). These two signals
are due to NH and/or OH associated hydrogen bonding.This
gives an evidence that these compounds exhibit a tautomeric
structure as shown below :

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(IV)
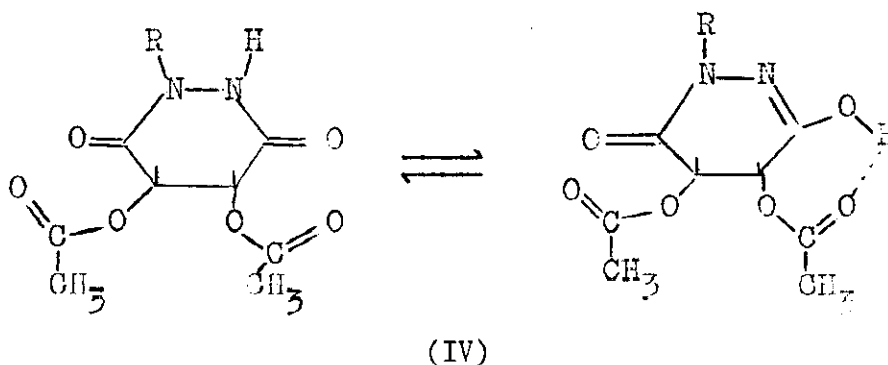
The compounds II, III and IV reacted with Cu^{++} and Fe^{+++} producing coloured complexes. The chelation chara-cters were investigated spectrophotometrically which was found to depend upon several factors as discussed below.

a- <u>Chelation of copper with compounds (II) and (III)</u>:-

The reaction of the compound II with copper sulphate in aqueous media at pH 12 yielded bluish green coloured complex. The maximum absorbance of complex at λ = 680 nm, ε = 6.5 X 10^4 lit mol^{-1} cm^{-1} . While the compounds III and IV gave deep green coloured complex, λ 595 - 600 nm, ε = 12.5 X 10^4 lit mol $^{-1}$ at pH 8.0.

b- <u>Chelation of ferric ion with the compound (II)</u>:-

The compound II was reacted with $FeCl_3$ in aqueous solution at pH 12 to give a deep red coloured complex, $\lambda_{max.}$ = 455 nm, ε 9 x 10^5 lit. $mol^{-1}cm^{-1}$. (Fig. 2).

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c- Stoichiometry of metal compounds complexes :-

The stoichiometry of metal complexes with compounds
(II) and (III) were investigated by continuous variation[9]
method (Fig. 3). From the results we found that the maxi-
mum absorption occurs when the ratio of the compound II
and metal ions are 1:1 and 3:2 for Cu^{++} and Fe^{++} respecti-
vely. While the maximum absorption of the compound III
and Cu^{++} was produced at the ratio 2:1.

d- Effect of pH :-

The complex formation was affected by variation
of pH of the solution (Fig. 4). The maximum absorbance was
obtained at pH > 8.0.

e- Effect of time and temperature on the complexes formation:-

The colour of the complexes was produced immediately
after the addition of the reagent. The maximum absorbances
were obtained within 5 min. Also the absorbances of the
complexes remained constant for long time (48 hr) at
room temperature. The variation of temperature (25-80°C)
did not affect the colour or absorbance of complexes.

f- Effect of interfering ions :-

The presence of other metals (5-30 ppm) did not
interfer with the determination of Cu^{++} or Fe^{+++}. Also
the copper- (II) complex colour was stable even in the
presence of NH_3 or amines.

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The compounds were very sensitive to Cu^{++} and suitable for the determination of 1 ppm of copper specially the compound III.

On the other hand, the biological activities of the compounds and their copper II complexes were tested against bacteria, fungi and plant by agar diffusion method. The antimicrobial, antifungal results are summarized in Table 1.

From the test on the plant it can be noticed that the compound III has toxic action on the germination of seeds and inhibits the growth of roots. The action of the compound II was very interesting . At concentration 5.0 ppm the shoot length increased while at 100 ppm the root increased in length and in number.

EXPERIMENTAL

IR spectra were recorded on a Perkin Elmer 710 B. UV./vis. spectra were recorded on a Beckman Du 24 spectrophotometer.

The ^{1}H-NMR spectra were carried out using M-390-90 MHz NMR spectrometer. Both ^{1}H-NMR spectra and microanalysis were carried out at Microanalytical Unit, Cairo University.

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1- Synthesis of 4,5-diacetyl-1,2,4,5-tetrahydropyridazin-
   3,6-dione (II)

Equimolecular amounts of diacetyl-L(+)-tartaric
acid anhydride and hydrazine hydrate were heated at 90°C
for 3 hr. The crude product was triturated several times
with acetone to a constant m.p. Yield 89% m.p. 170-172°C.
The compound is insoluble in all ordinary solvents but
soluble in the alkaline media.

Elemental analysis ($C_8H_{10}N_2O_6$)

	C %	H %	N %
found	41.2	4.5	12.5
Calcul.	41.7	4.3	12.2

IR spectrum : broad band 3600-3200 cm^{-1} (OH and/or NH),
       1710 cm^{-1} (C=O), 1660 cm^{-1} (amide), 1540 cm^{-1}
       (C=N), 1250, 1080, 1140 cm^{-1} (C-O-C).

^{1}H-NMR spectrum DMSO-D_6/pyrid. D_5
       2.15 (s,2CH_3), 5.1 and 5.3 (d,H-C-OAc), 9.3
       and 9.7 (2s, NH and/ or OH).

2- Synthesis of 1-(2,4-dinitrophenyl)-4,5-diacetyl-1,2,4,5-
   tetra-hydropyridazin-3,6-dione (III) :-

Diacetyltartaric acid anhydride (0.1 mol) was added
to the solution of 2,4-dinitrophenylhydrazine (0.1 mol) in

acetic acid (20 ml). The mixture was left at room tempera-
ture for two days. The product was poured into cold 10%
solution of Na_2CO_3 with stirring. The yellow crystalline
product was obtained. The product was recrystallized from
N,N-dimethylformamide and water. Mp. 173°C.

The same product was produced by direct fusion of
the compound (I) with dinitrophenylhydrazine.

Elemental analysis ($C_{14}H_{12}N_4O_{10}$)

	C %	H %	N %
Found	42.5	3.1	14.5
calcul.	42.4	3.0	14.1

IR spectrum : 3450 cm^{-1} (OH), 3250 cm^{-1} (NH), 1720 cm^{-1}
(ester), 1660 cm^{-1}(amide), 1560 cm^{-1}(C=N),
1250-1080 cm^{-1}.

^{1}H-NMR spectrum (DMSO-D_6) : 2.15 (s,2CH$_3$), 7.2 and 7.4(H-C-
OAc) 8.2, 8.3 and 9.1 (d,3H,$C_6H_3(NO_2)_2$) 9.7
and 10.3 (s,NH and/or OH).

3- Synthesis of 1-phenyl-4,5-diacetyl-1,2,4,5-tetrahydro-
   pyridazin-3,6-dione (IV)

Equimolecular amounts of diacetyltartaric acid
anhydride and phenylhydrazine were heated at 120°C for

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4hr. The product was poured into cold water with stirring. The yellow product was produced after recrystallization from N,N-dimethylformamide and water. Mp. 125°C.

Elemental analysis $(C_{14}H_{14}N_2O_6)$

	C %	H %	N %
found	54.3	4.8	9.8
calcul.	54.9	4.6	9.2

IR spectrum : 3450 cm^{-1}(OH), 3300 cm^{-1}(NH), 1715 cm^{-1} (ester), 1660,1540 cm^{-1}(amide),1250,1080 cm^{-1} (C-O, C-N).

Chelation with metal ions

    - (0.025 mmol) Metals $(CuSO_4.5H_2O$ and $FeCl_3)$ solution in water were prepared and standardized by complex-metric method [2].

    - A stock solution of the compounds were prepared by dissolving a certain amount of each in appropriate volume of 0.1 N-NaOH.

General procedure :-

    To a 1 ml of metals solution add a 2 ml (0.05 mmol)

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of the free ligand solution in 10 ml measuring flask and complete to mark with water. In all cases the pH of media must be adjusted at pH 12. The spectra were recorded within the wave length 200 - 800 nm.

Biological activities :-

1- Antifungal, antibacterial activities :-

Procedure :-

Standards of 6 mm sterillized paper discs were impregnated with 20 mg/ml solution of the tested compound solution. The discs were placed on the top of agar plates seeded with the organisms. The seeded plates were incubated for 24 hr at 37°C.

The results were tabulated in Table 1.

Table 1 : Antifungal, antibacterial activities of the compounds and their Cu^{2+}-complexes.

Organisms	Compounds			Cu^{2+}	Complex with Cu^{2+}		
	II	III	IV	only	II	III	IV
Fungi							
Alternaria solani	–	–	–	–	w	+	w
aspergllus nigar	w	+w	–	–	+	+	w
Fusarium oxysporum	+	+	–	~ w	+	+	–
S. cerevisia	w	+		–	+	+	+
Penicillium notatum	–	–	–	w	w	w	w

Bacteria

Bacillus subtilis	–	+	–	w	+	++	w
Escherichia coli	–		–	w	–	+	w

Whereas, – : wegative,   + : active, ++ : more active,

2- Test on the plant :
Procedure :-

    Agar solution 1.2% containing the required concentration (0.5, 5.0 and 100 ppm) of the compounds. This solution was poured while hot into 100 ml beaker and left to solidify. Each beaker was seeded with ten seeds (rice or barley) and left for 15 days.
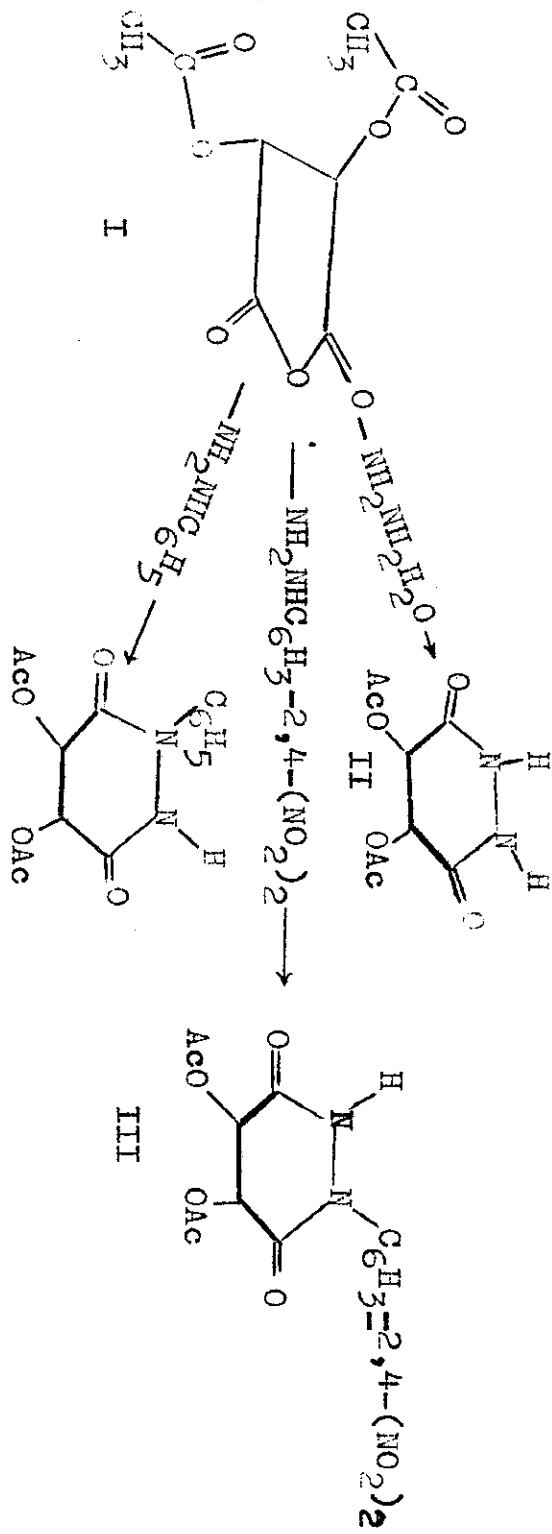
REFERENCES

1- Albert, A., Selective Toxcicity, Methuen and Co. Ltd.
        London, Barns and Noble, Inc USA, 251 (1965).

2- Asuero, A.G. and J.M.Cano. Analyst, 103 (2), 140(1978).

3- El-Sayed, L. and M.F. Iskander, J.Inorg. Nucl. Chem.,
        33, 435 (1971).

4- Ibrahim, S.A., Makhlouf M., Hammam A.H. and Hassan K.,
        First Conference of Chemistry and its Role in
        Development, 24-26 Sept., (1986).

5- Joule, J.A. and Smith.G.F., Heterocyclic Chemistry, Van
        Nos Trand Reinhold Company London, New-York,
        133 (1972).

Synthesis of Pyridazinone Derivatives

6- Lugas, H. and Perssman D., Principales and Practice
            Organic Chemistry, New York, John Willy and
            Sons, London, 275 (1949).

7- Martin, H. and Worthing C.R., Pesticide Manual, Basic
            Information on the Chemicals Used as Active
            Compounds of Pesticides, 4 th ed, British
            Crop Protection Council, 322 (1974).

8- Robert, B.D. and W.Robin, Eur. Pat. Appl. 2895, C.A.,
            92, 76333 w (1980).

9- Rose, J., Advanced Physico Chemical Experiments, Pitman,
            London, 54 (1964).

10- Rothgery, E. F. and Schoeder H.A., US, 41396 22, C.A.,
            90, 168637v (1979).

11- Rubbo, S.D., Albert A. and Gibso M.I., Brit.J. Exp.
            Pathol. 31, 425 (1950).

12- Zentmeyer, G.A., Inhibition of Metal Catalysis as a
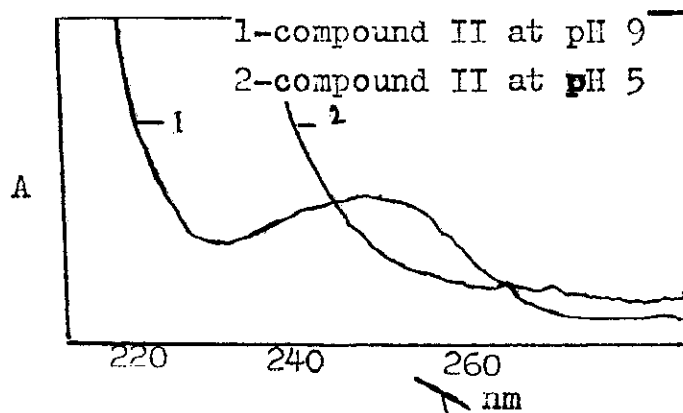   Fungistatic Mechanism, Science, 100, 294
            (1944).

Scheme 1
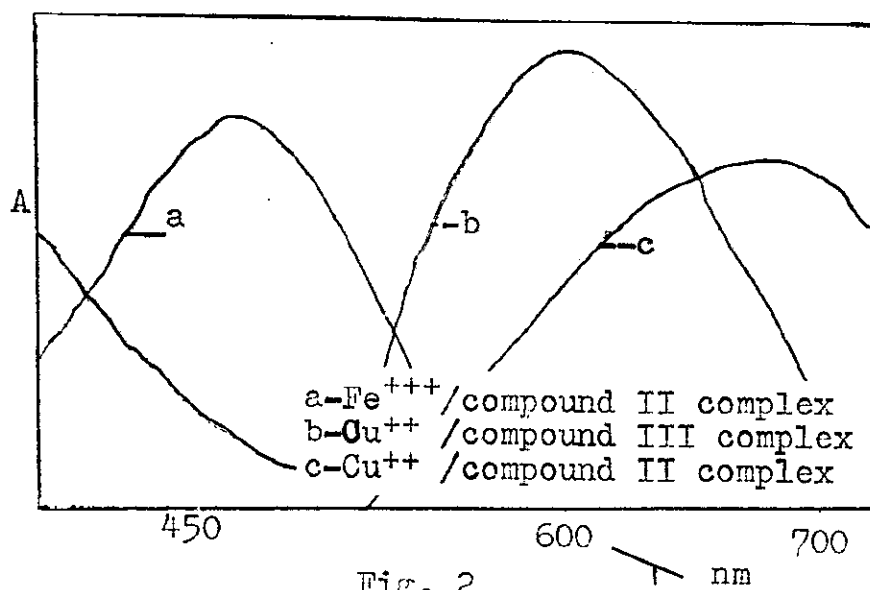
I

II

III

IV

CH_3

CH_3

C

O

O

$NH_2NH_2H_2O$

$NH_2NHC_6H_3-2,4-(NO_2)_2$

$NH_2NHC_6H_5$

AcO

OAc

C_6H_5

$C_6H_3-2,4-(NO_2)_2$

H

H

O

505

Fig. 1

Fig. 2

where   A = Absorbance

λ_{nm} = wave length in nm

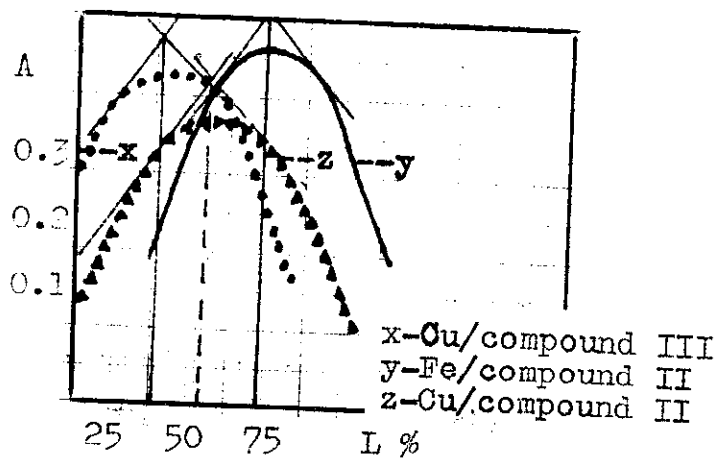x—Cu/compound III
y—Fe/compound II
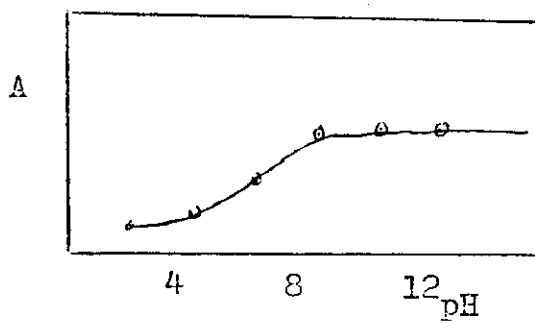z—Cu/compound II

Fig. 3

Fig. 4

تحضير مشتقات البيريدازينون ذات الأهمية المخلابية والبيولوجيه

نبوية شرف الدين ـ محمد القرش ـ حامد الغطاطرى

قسم الكيمياء الصيدلية ـ كلية الصيدله ـ جامعة طنطا ـ مصر

تم تحضير ٤ , ٥ ـ ثنائي استيل ـ ١ , ٢ , ٤ , ٥ ـ رباعى هيدروبيريدازين ـ ٣ , ٦ ـ ديون المستبدل فى الموقع ١ من تفاعل ثنائى استيل أ ثهيدريد الطرطريك مع مشتقات الهيدرازين المناظره .

وقد اثبتت التركيبات البنائيه للمركبات بواسطة التحاليل الدقيقه والقياسات الضوئية . وقد وجد أن لهذه المركبات خواص مخلابيه تجاه بعض العناصر . وتمت دراسه الخواص المخلابية بواسطة الطريقة الاسبكترو فوتومتريه . وايضا وجد أن لهذه المركبات انشطة بيولوجيه .

DETERMINATION OF THE SURFACE AREA OF CELLULOSE BY NMR-SPECTROSCOPY AND PORE SIZE DISTRIBUTION

BY

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ABSTRACT

Application of ^{1}H NMR spectroscopy, which has been shown to be an effective mean of measuring changes produced in the amount of bound water within cellulose in the wet state, has been extended to the study of alterations of the surface areas of cellulose produced by liquid ammonia treatments, under various conditions. These areas were compared with the surface areas as calculated from pore size distribution.

INTRODUCTION

Several workers [6,4,8] have shown that part of water within a moist cellulose polymer exhibits properties which are markedly different from those of the rest of the water. Filby and Maass [4] concluded from the high apparent density which could be calculated for cellulose when the volume was determined by the displacement of

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water that part of the water in the cellulose-water sys-
tem had a higher density than that of free water. To
estimate the quantity of the strongly sorbed water,Magne,
Portas, and Wakeham [5] made use of the fact that chemi-
cally sorbed water will not freeze whereas capillary
condensed or solvent water will freeze at a temperature
lower than 0°C. Most of these investigations were carried
out on cotton cellulose, and the experiments were repeated
by many workers and yet there is a distinct lack of agree-
ment upon the exact amount of bound water. Boesen has sug-
gested that 0.12 g bound water per g cellulose was the best
average value for cotton [1].

The application of NMR spectroscopy has also furthe-
red the concept of bound water [2]. The water peak in the
cellulose-water system is broader than that shown by free
water, a fact which has been interpreted in terms of some
of the water molecules being restricted in mobility owing
to their proximity to the surface of the solid material.
An attempt has been made to obtain more detailed infor-
mation on determination of the amounts of bound water
within cotton subjected to different kinds of liquid
ammonia treatments. NMR technique was also used to deter-
mine the surface areas of moist cotton cellulose. These
values have been compared with the pore surfaces calcula-
ted from the pore size distributions of the ammonia treated
samples.

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EXPERIMENTAL

Materials

The starting material used was a woven cotton fabric (Printcloth 130 g/m^2) warp 35 threads/cm, weft 322 threads /cm. crystallinity 79%.

Swelling treatments

The cotton samples were treated in a tensionless state with liquid ammonia for 5 minutes. The temperature of·the ammonia swelling medium was maintained between -35 to -33°C. Ammonia was removed by either evaporation at room temperature or by immersing in boiling distilled water, and air dried. Some samples were then further used without intermediate drying.

NMR analysis

All samples were soaked in distilled water for two days. The samples were brought from a very wet state to the required moisture content by centrifugation. Each of the samples was packed as tightly as possible in the NMR tube. The tubes were kept stoppered untill after the NMR analysis when an exact moisture content was determined by weighting the contents of the tubes before and after oven drying at 105°C for 20 hours. The instrument used was a Varian T60 NMR spectrometer. All experiments were carried out at standard measuring conditions (25°C and 65% R.H.).

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Pore size distribution

The pore size distribution and surface areas were
calculated from the pore volumes of the ammonia treated
samples. The pore volumes were determined by sorption
measurements with sugars and dextrans of graduated size
as described in previous papers [2,7].

RESULTS AND DISCUSSION

In the following, consideration is given first of
all to the method for calculating the amount of bound water
from the values of the spin-spin relaxation time of the
protons in the bound water. The mobility of a proton in
NMR spectroscopy is correlated to its relaxation time
(T_2), which can be calculated from the line width at
half-height ($\nu_{1/2}$) according to the equation 1 :

$$T_2 = \frac{1}{\nu_{1/2}} \qquad (1)$$

The amount of bound water can be calculated from the
relaxation time (T_2) according to the equation 2 [3] :

$$T_2 = \frac{T_{21}}{[H_2O]_1} \quad x \quad [H_2O]_T \qquad (2)$$

Where T_{21} is the relaxation time of protons in the bound
water and $[H_2O]_1$ is the concentration of bound water in

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the sample at a total moisture content of $[H_2O]_T$. According to equation 2, as long as $[H_2O]_1$ remains constant, a linear relationship should be found between T_2 and $[H_2O]_T$. From the slopes of the lines and by introducing $T_{21} = 3 \times 10^{-4}$ sec. for bound water, we obtained a value of the amount of bound water in the moist cotton samples. Table 1 lists the experimentally determined line with

$\nu_{1/2}$ and the calculated relaxation time for the ammonia treated cottons at different moisture content $[H_2O]_T$. Figure 1 shows the linear relationships found between T_2 and $[H_2O]_T$ for the ammonia treated cottons. The obtained slopes of the lines $T_{21}/[H_2O]_1$, and the maximum values of the bound water as well as the fiber saturation values, which are the amounts of water in the fiber that are inaccessible for the macromolecule dextran 2000 [2] are given in Table 2. We notice a marked increase in the amounts of bound water has occurred as a result of liquid ammonia treatments, but to varying degrees depending on the method of removing the ammonia. Evaporative removal of ammonia caused an increas ⟨ in the amount of bound water within cotton cellulose in the wet state of about 125%. Liquid ammonia treatment followed by removal of ammonia with boiling water caused an increase in the amount of bound water of about 129%. The strongest increase (156 %) being achieved by treatment with liquid ammonia and removal of ammonia with boiling water without intermediate drying.

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If it is assumed that the amount of bound water calcula-
ted by the NMR technique are attached to the cellulose
surface in a monomolecular layer the required surface
area for this can be calculated. Taking 3000 m^2 for the
area of a gram of water spread out as a monomolecular ·
layer [3] and multiplying the amounts of bound water by
the factor 3000, we obtain values for the surface area of
ammonia treated cottons (Table 2).

With the help of a determination of the pore size
distribution of water swollen cotton cellulose by the
exclusion method [9], it is possible to determine the
surface area of moist cotton cellulose subjected to dif-
ferent kinds of liquid ammonia treatments. In Table 3
these areas are compared with the surface areas as calcula-
ted from the amounts of bound water. The results of this
investigation show that the values of the pore surface
available for monomolecular water sorption also increased
after liquid ammonia treatments. The largest increase in
the surface area values occurred in samples treated with
liquid ammonia with removal of ammonia with boiling water
without intermediate drying. The correlation between the
surface area from NMR technique and those from the pore
size distribution is shown in Figure 2. It can be seen
that, as expected, the absolute values of surface area
obtained by the two methods differ, the agreement is

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surprisingly close considering the wide difference in approach of the two methods in surface area determination of cotton in the wet state.

REFERENCES

1- C.E.Boesen, Cellulose Chem. Technal. 4 (1970) 149.

2- K.Bredereck, A.Saafan, Angew, Makromol. Chem. 95 (1981), 13

3- J.E.Carles and M.Scallan, J.Appl.Poly.Sc:, 17 (1973) 1855.

4- E.Filby and O.Maass, Can. J.Research, 7, (1932) 162

5- F.C.Magne, H.J.Portas, and H.Wakeham, J.Am.Chem.Soc., 69 (1947) 1896.

6- F.T.Pierce, J.Textile Inst., 20, T133, (1929)

7- A.Saafan, Melliand Textilber. 65 (1984), 534

8- S.E.Smith, J.Am.Chem. Soc., 69 (1974) 646.

9- J.E., Stone, A.M.Scallan, Cellulose Chem. Technol. 2 (1968) 343.

Fig.2 Correlation between the surface areas as
calculated from NMR spectroscopy and those
calculated from pore size distribution of
ammonia - treated cottons.

1- Untreated cotton   2-NH₃-evap.
3- NH₃ - Water   4-NH₃-Water
                            without drying

Fig.1   The relationships between T_2 and $[H_2O]_T$ for the
         ammonia - treated cottons.

o Untreated cotton   ▪ NH₃ - evap.
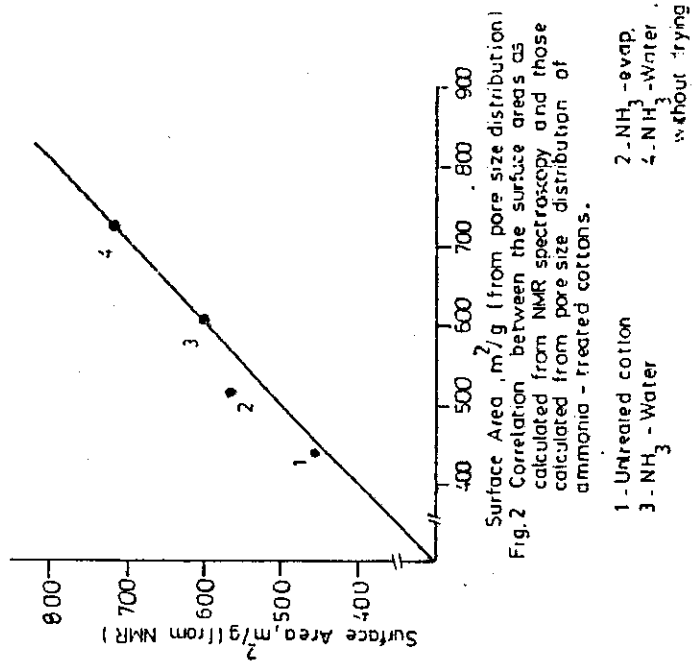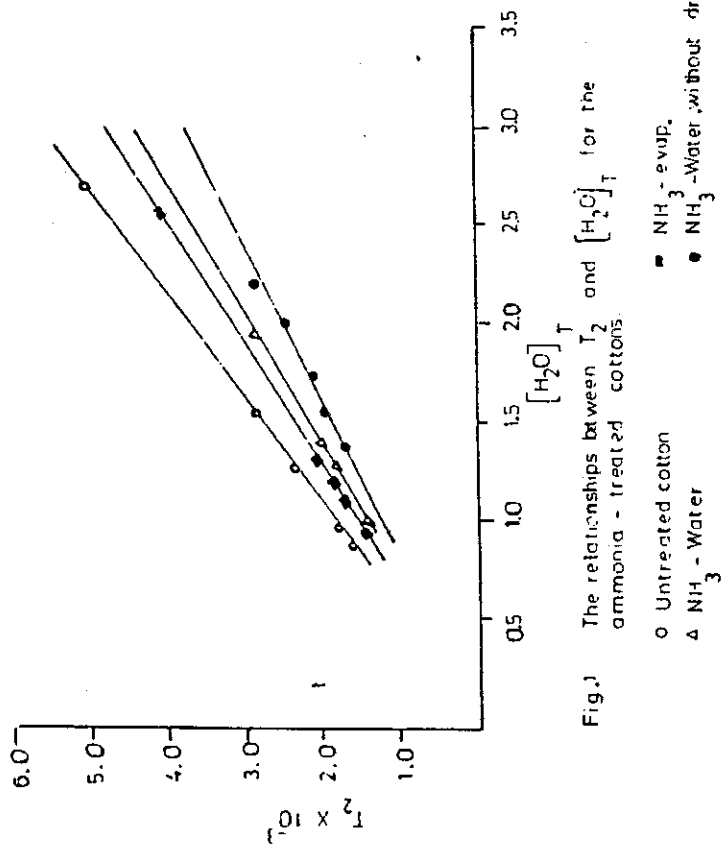△ NH₃ - Water   ● NH₃ -Water,without drying

Table 1. Line width at half-height ($\nu_{1/2}$) and the spin-spin relaxation time (T_2) at moist cottons at different moisture contents $[H_2O]_T$

Treatment	$\nu_{1/2}$	$T_2 \times 10^{-3}$	$[H_2O]_T$
Untreated	63	5.055	2.72
cotton	112	2.843	1.552
	174	1.83	1.145
	194	1.64	0.903
NH_3-evap.	79	4.03	2.53
	158	2.016	1.308
	176	1.809	1.18
	182	1.749	1.133
	212	1.502	0.977
NH_3- H_2O	109	2.94	1.92
	146	7.18	1.40
	170	1.87	1.31
	202	1.58	1.04
	115	2.769	2.203
NH_3-H_2O	150	2.12	1.72
without drying	162	1.965	1.59
	184	1.73	1.405

Table 2. Experimental Results on moist NH_3- treated cottons

Treatment	SLOPE OF Fig.1 $T_{21}/[H_2O]_1$	Amount of bound water g/g[a]	Fiber saturation value,g/g[b]	surface area m^2/g
Untreated cotton	1.945×10^{-3}	0.154	0.49	462
NH_3-evap.	1.562×10^{-3}	0.192	0.47	576
NH_3-H_2O	1.5×10^{-3}	0.2	0.5	600
NH_3-H_2O without drying	1.25×10^{-3}	0.24	0.63	720

a) Calculated from slope of Fig.1 using T_{21}= 0.3 x 10^{-3}sce.

b) The fiber saturation values of cottons were determined by the solute
exclusion technique (9). Dextran 2000 was used.

Table .3. Surface areas for pores of various size in differently ammonia-treated cotton allulose.

Specimen	Surface areas for the Pore diameter ranges						
	$< 20 \text{ Å}^{\circ}$	$= 20\text{-}50\text{Å}^{\circ}$	$= 50\text{-}100 \text{ Å}^{\circ}$	$= 100\text{-}150 \text{ Å}^{\circ}$	$= 150\text{-}300 \text{ Å}^{\circ}$	$> 300 \text{ Å}^{\circ}$	Total
Untreated cotton	340	66	17	7	4	2	436
NH_3–evap	410	7.1	19	6	2	-	508
NH_3–H_2O	0	74	18	4	2	-	598
NH_3–H_2O without drying	580	103	17	14	1	-	715

تعيين المساحة السطحية للسليلوز باستخدام طيف الرنين المغناطيسى النووى وتوزيع المسامات

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تم تطبيق طيف الرنين المغناطيسى النووى لتعيين كمية الماء الرابطه كيميائيا على سطح السليلوز وبواسطة هذه الطريقة تم حساب المساحة السطحية للسليلوز ومقارنتها بالنتائج المحسوبه من توزيع المسامات داخل السليلوز ذو الحجوم المختلفه والتى تم قياسها بواسطه محاليل مختلفة من الجلوكوز والرافينوز والديكستانات.