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Dedicated to Professor Alexandru T. Balaban on the occasion of his 80th anniversary

REACTIONS OF PYRYLIUM PERCHLORATES HAVING LONG ALKYL SUBSTITUENTS WITH AMINOACIDS**

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2,4,6-Trisubstituted pyrylium salts having either one or two linear α-alkyl side chains $\mathbf{1}_{1\text{-}6}$ reacts with DL-alanine **2a** or DL-tyrosine **2b** affording the corresponding pyridinium salts $\mathbf{3a}_{1\text{-}6}$ or $\mathbf{3b}_{1\text{-}4}$. An experimental procedure was presented. All new amphiphiles are fully characterized by ^{1}H- and ^{13}C-NMR, IR and elemental analysis.

INTRODUCTION

In the previous papers we described the preparation of new 2,3,4,6-tetrasubstituted pyrylium and derived pyridinium salts.[1] Synthetic membranes formed by the self-assembly of some N-substituted pyridinium perchlorates (with dodecyl, methyl, triethyltriamino or ethyleneamino groups) and with one or two long alkyl substituents (undecyl, palmitoyl or stearoyl) in the 2,6-(α) positions were presented. The effect of changes in the chemical structure of the compounds by variation of the number and length of the alkyl groups on the differential scanning calorimetry (DSC) and dynamic light scattering (DLS) analyses was also reported. [1]

Primary amines, aromatic or aliphatic, react with 2,4,6-trimethylpyrylium perchlorate in different solvents (refluxing ethyl ether, a mixture methanol with water, or in dichloromethane). A comparison between polar and non-polar solvents (water or dichloromethane) was presented. Depending on the reaction conditions and the alkyl substituents of the heterocyclic ring, the ratio between N-alkyl or N-arylpyridinium perchlorates and corresponding xylidines (major products) was reported.[2]

L-Alanine is found abundantly in blood,[3] and its excretion in urine[3,4] and it is a ubiquitous constituent of bacterial cell walls. L-Alanine plays important roles in physiology, can be used to investigate several aspects of cell wall biosynthesis and the effects of antibiotics on this process.[5] Therefore, alanine increases the electrolyte content and ion transport in rat hepatocytes in primary cultures.[6]

Tyrosine is a non-essential aminoacid that helps regulate mood and stimulates the nervous system. It can also help speed up the metabolism and treat conditions characterized by chronic fatigue. Protein tyrosine kinases and protein tyrosine phosphatases (PTPs) have a pivotal role in regulating both normal cell physiology and pathophysiology.[7] PTPs are noted as growth factor receptors or as the transforming agents of acutely transforming retroviruses.[8]

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** This is contribution no. 18 in the series "Pyrylium Salts with Long Alkyl Substituents". For some previous papers in this series see ref. [1,27-29]

More than 40 years ago, the first flavor synergism was reported between the umami-like tasting monosodium L-glutamate (MSG).[9]

Very recently, molecular-biological investigations focused on compounds which are not present in the foods, but are generated during food processing from precursors, e.g. by Maillard-type reactions from carbohydrates and amino acids; these compounds remain largely unknown. For this, a screening procedure called taste dilution analysis described by Frank *et al.*, 2001 and Ottinger *et al.*, 2001 was used. High-pressure liquid chromatography (HPLC) was applied to obtain the pure compound.[10]

Ottinger *et al.*, reported the existence of *N*-(1-carboxyethyl)-6-hydroxymethyl-pyridinium- 3-ol inner salt in heated glucose/alanine solutions . This so-called "alapyridaine", which occurs naturally in beef bouillon, has no taste on its own, but it is able to enhance the sweetness of sugars, L-alanine and the artificial sweetener aspartame. Moreover, the (+)-(*S*)-isomer was found to be the physiologically active enantiomer.[11]

Sodium lauryl sulfate (SLS) is an anionic surfactant. Because of its low surface tension of aqueous solutions, it is used as a fat emulsifier and wetting agent in many cleaning and hygiene products. It is compatible with alkanolamides and amphoterics, so that by their combination maximum optimization of foam and viscosity characteristics can be reached. The product can also be used to aid in lysing cells during DNA extraction and for unraveling proteins. Recently, the effect of SLS in patients with recurrent aphthous ulcers was investigated.[12] The SLS solubilization and the fractionation of the components of a depleted membrane from Micrococcus lysodeikticus was also described.[13]

The predominant droplet nucleation is achieved in usual miniemulsions and dispersions containing sodium lauryl sulphate. The monomer droplets can be stabilized by a surfactant to prevent them from coalescing and a co-stabilizer to retard the diffusion of monomers from small droplets to large ones (Ostwald ripening).[14]

The interphase phenomena such as the formation of supersaturation and micro-heterogeneity zones in chemical reactions or spontaneous interphase convection, as well as their role in the transfer of ions or substances, were the focus of many articles.[15] The interfacial barriers in interphase transport and the influences of surfactants are also investigated. Thus, the results showed that SLS markedly decreased the interfacial barrier.[16]

Reaction of pyrylium salts with some aminoacids (as glycine and β-alanine) was intensively studied by the groups of Balaban[17] and Dorofeenko.[18] So, N-carboxyalkyl- and N–carboxyphenylpyridinium salts were obtained. The IR, NMR spectra and pKa values of these compounds are also described.

The pyridinium salts derived from aminoacids which posses two amino groups as lysine were synthesised after protection of the α-amino group. For example 1 (5-carboxy-5-acetyl aminopentyl)-tri/tetra substituted pyridinium salts were obtained from the corresponding tri/tetrasubstituted pyrylium salts with excelent yields in mild conditions (at room temperature in CH_2Cl_2).[19]

On the other hand, the reaction of 2,4,6-triphenylpyrylium tetrafluoroborate with glycine or alanine in the presence of triethylamine and acetic acid is known to produce N-alkylpyridinium salts *via* decarboxylation.[20] In order to confirm the elimination process, the reaction of triphenylpyrydinium tetrafluoroborate with various amino acids (lysine, glutamic acid, 1-amino-cyclopropylcarboxylic acid) was investigated. The preparation and the reaction of pyridinium ylids *via* decarboxylation of pyridinium betadines were also presented.[21]

It is well known, that the N-carboxyal-kylpyridinium salts have a high antioxidative activity[22] and a powerful antimicrobial action.[23] They are used in pharmaceutical compositions for the control of the Helicobacter bacteria or the gram-negative and gram-positive bacteria (Escherichia coli and Streptococcus thermophilus),[24] as well as a mold (Neurospora crassa) and yeast (Candida utilis).[25]

Therefore, the effects of H-bonding patterns on the layer's thickness obtained by the reaction of ω-carboxy-substituted alkylpyridinium cation with inorganic anions was also reported. Structural evidence points to the formation of a layered structure.[26]

We have now found a new class of N-carboxypyridinium perchlorates with different long alkyl substituents which may possess pharmaceutical activity and could be used in pharmaceutical compositions. During the synthesis the formation of decyclization compounds is possible. The optimum reaction conditions in order to obtain mainly pyridinium salts were selected and presented.

RESULTS AND DISCUSSION

Materials and Methods

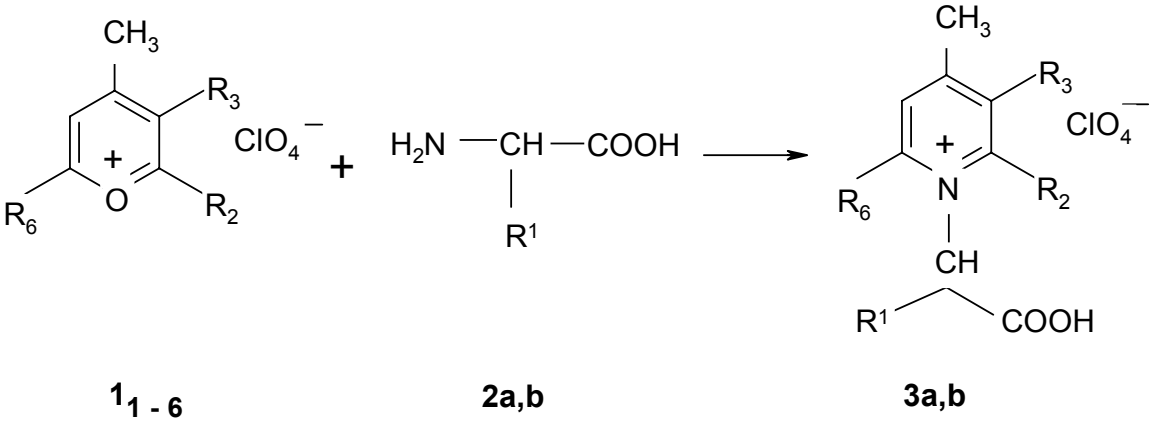
In a series of papers[1, 27-29] we have reported the synthesis of a series of pyridinium salts with long alkyl substituents in α or γ positions derived from the corresponding pyrylium salts. Two methods were employed for the conversion into pyridinium salts: either the direct reaction of pyrylium salts with amines, in boiling alcohol, or the reaction optimized by Katritzky at room temperature in methylene chloride.[30]

The present paper describes the preparation of a new class of heterocyclic compounds obtained by direct reaction of the corresponding pyrylium salts having long alkyl substituents $\mathbf{1_{1\text{-}6}}$ a with DL-alanine (**2a**) or DL-tyrosine (**2b**).

Our first attempt to synthesize these new compounds is summarized in Scheme 1.

Table 1 presents the new compounds described in this paper.

C. Toma and A. T. Balaban have previously reported[17] the reaction of 2,4,6-trimethylpyrylium perchlorate (**I**) with glycyl-glycine. Depending on the conditions, three perchlorates (N-carboxymethylcollidinium perchlorate and two double salts of corresponding betaines) were found. The reaction of **I** with β- and α-alanine was also studied, but only a crystalline perchlorate of the first could be isolated.



a: $R^1 = CH_3$

b: $R^1 =$ —CH_2—C$_6$H$_4$—OH

Scheme 1 – Synthesis of N-carboxypyridinium perchlorates.

Table 1

The new compounds synthesized

Cpd.	R_1	R_2	R_3	R_6
3a$_1$	-CH(CH$_3$)COOH	$C_{11}H_{23}$	H	CH$_3$
3a$_2$	-CH(CH$_3$)COOH	$C_{11}H_{23}$	H	$C_{11}H_{23}$
3a$_3$	-CH(CH$_3$)COOH	$C_{15}H_{31}$	H	$C_{15}H_{31}$
3a$_4$	-CH(CH$_3$)COOH	$C_{17}H_{35}$	H	$C_{17}H_{35}$
3a$_5$	-CH(CH$_3$)COOH	$C_{11}H_{23}$	CH$_3$	$C_{11}H_{23}$
3a$_6$	-CH(CH$_3$)COOH	$C_{15}H_{31}$	CH$_3$	$C_{15}H_{31}$
3b$_1$	-CH(-CH$_2$-C$_6$H$_4$-OH)COOH	$C_{11}H_{23}$	H	CH$_3$
3b$_2$	-CH(-CH$_2$-C$_6$H$_4$-OH)COOH	$C_{11}H_{23}$	H	$C_{11}H_{23}$
3b$_3$	-CH(-CH$_2$-C$_6$H$_4$-OH)COOH	$C_{15}H_{31}$	H	$C_{15}H_{31}$
3b$_4$	-CH(-CH$_2$-C$_6$H$_4$-OH)COOH	$C_{17}H_{35}$	H	$C_{17}H_{35}$

It was shown that for obtaining good yields of pyridinium salts *vs* decyclization corresponding compounds, some limitation on the basicity of amines or aminoacids[31] is important. In addition, high solubility differences between pyrylium perchlorates $\mathbf{1_{1\text{-}6}}$ and DL-alanine dictated other reaction conditions.

So, as shown in Table 2, 2,4,6-tri or 2,3,4,6-tetraalkylpyrylium perchlorates with one or two long alkyl substituents in 2,6 positions synthesised in our laboratory present a good solubility in alcohols, DMF (dimethylformamide), CH_2Cl_2 and low solubility in diethyl ether and water. All these compounds have relative low melting points (m.p.) in the range of temperatures of 60-90°C.

DL-Alanine is characterized by a medium or low solubility in usual solvents (16-18g/100mL water, sparingly soluble in alcohol, insoluble in diethyl ether). In contrast, tyrosine is very soluble in water. It is slightly soluble in alcohols, insoluble in ethyl ether and acetone. Both aminoacids have high m.p. (>290°C). P. Ji[32] and Nozaki[33] described in detail the solubility of amino acids (including alanine and tyrosine) using statistical associating fluid theory (SAFT), in order to establishment of a hydrobicity scale.

For synthesis of all pyridinium perchlorates $\mathbf{3a_{1\text{-}6}}$ from corresponding pyrylium salts $\mathbf{1_{1\text{-}6}}$ and DL-alanine **2a** the use of consacrate methods in solvents as ethanol, DMF, CH_2Cl_2, or a ethanol: water mixture gave less satisfactory results.

Under the given experimental conditions a mixture of unreacted compounds and ring-opened products as 1-amino-1,3-dien-5-one were formed. It should be noted, however, that the reaction mixture contains pyridinium salts in small yields and ring-opened products. The ring-opened products were presumably obtained *via* decyclization when using as solvent a mixture ethanol:water. (see Table 3).

Table 2

Physical and chemical properties for **2a,b** and $\mathbf{1_1}$-$\mathbf{1_6}$

Cpd.	Solubility			m.p., °C	Reference
	Ethanol	Water	Other		
DL-Alanine 2a	slightly soluble 0.0087g/100g	156 g/l at 20°C	insoluble in ethyl ether and organic solvents	296	32, 33
DL-Tyrosine 2b	1350p in EtOH 96%	soluble	insoluble in ethyl ether and acetone	314	32, 33
$\mathbf{1_1}$	soluble	insoluble	insoluble in ethyl ether soluble in DMF, CH_2Cl_2	66-67	29c
$\mathbf{1_2}$	soluble	insoluble	insoluble in ethyl ether soluble in DMF, CH_2Cl_2	64-65	29b
$\mathbf{1_3}$	soluble	insoluble	insoluble in ethyl ether soluble in DMF, CH_2Cl_2	81-82	28b
$\mathbf{1_4}$	soluble	insoluble	insoluble in ethyl ether soluble in DMF, CH_2Cl_2	83-84	28b
$\mathbf{1_5}$	soluble	insoluble	insoluble in ethyl ether soluble in DMF, CH_2Cl_2	48-49	29a
$\mathbf{1_6}$	soluble	insoluble	insoluble in ethyl ether soluble in DMF, CH_2Cl_2	62-63	1a

Table 3

Conversion of pyrylium perchlorates **1** to pyridinium perchlorates **3**

Cpd	Molar ratio 1 : 2	Solvent Mixture	Temp. °C	Time hrs	Yield %	Maj. Products[a]
$\mathbf{3a_1}$	1:5	EtOH	reflux	5-24	<5	mixture of unreacted $\mathbf{1_1}$+ **2a**, $\mathbf{3a_1}$ and ring opened products
$\mathbf{3a_1}$	1:1.2	CH_2Cl_2	25	3-4	-	mixture of unreacted $\mathbf{1_1}$+ **2a** and ring opened products
$\mathbf{3a_1}$	1:3-1:5	DMF	reflux	2-5	-	mixture of unreacted **2a** and ring opened products
$\mathbf{3a_1}$	1:3	EtOH:H_2O 3:1	reflux	5-24	<10	mixture of unreacted $\mathbf{1_1}$+ **2a**, $\mathbf{3a_1}$ and ring opened products

Table 3 (continued)

3a$_1$[b]	1:3	EtOH:H_2O:SLS 3:1:0.005	reflux	10	55	mixture of unreacted **2a**, **3a$_1$**
3a$_2$	1:5	EtOH	reflux	5-24	<3	mixture of unreacted **1$_2$**+ **2a**, **3a$_1$** and ring opened products
3a$_2$	1:1.2	CH_2Cl_2	25	3-4	-	mixture of unreacted **1$_2$**+ **2a** and ring opened products
3a$_2$	1:5	DMF	reflux	2-5	-	mixture of unreacted **2a** and ring opened products
3a$_2$[b]	1:3	EtOH:H_2O:SLS 3:1:0.005	reflux	10	50	mixture of unreacted **2a**, and **3a$_2$**
3a$_3$[b]	1:3	EtOH:H_2O:SLS 3:1:0.005	reflux	10	46	mixture of unreacted **2a**, and **3a$_3$**
3a$_4$[b]	1:3	EtOH:H_2O:SLS 3:1:0.005	reflux	10	45	mixture of unreacted **2a**, and **3a$_4$**
3a$_5$[b]	1:3	EtOH:H_2O:SLS 3:1:0.005	reflux	10	50	mixture of unreacted **2a**, and **3a$_5$**
3b$_1$[b]	1:5 – 1:10	EtOH	reflux	12	64	mixture of unreacted **2b** and **3b$_1$**
3b$_2$[b]	1:5 – 1:10	EtOH	reflux	12	59	mixture of unreacted **2b** and **3b$_2$**
3b$_3$[b]	1:5 – 1:10	EtOH	reflux	12	54	mixture of unreacted **2b** and **3b$_3$**
3b$_4$[b]	1:5 – 1:10	EtOH	reflux	12	55	mixture of unreacted **2b** and **3b$_4$**

SLS: sodium lauryl sulphate
[a] Determined by ^{1}H-NMR (400 MHz) analysis.
[b] Determined after preparative TLC

It was shown that many pyridinium salts have surfactant properties.[27,28a,b,34,35] But, **3a$_{1-6}$** could not be obtained by classical methods because of the low basicity of alanine and the major difference between the solubilities of the reactants.

We obtained these compounds **3a$_{1-6}$** with good yields by refluxing **1$_{1-6}$** and **2a** in a water-ethanol mixture but containing a small amount of SLS. When heating the reaction mixture at a gentle reflux, an opalescent solution was obtained. In these cases, the use of the anionic surfactant increased system's miscibility and favoured the mixing up of the reagents.

The action of SLS was visible when the reaction mixture was cooled, as in all cases, two or three layers were obtained. So, for **3a$_1$** which has a single α-long alkyl side chain, after cooling, the system contains: a lower layer, orange-cognac; an upper layer, white lightly opalescent and a highly opalescent interphase layer. For **3a$_{2-6}$** only the first two layers were obtained.

For all cases, these layers are redispersed when they are transferred in a funnel. The corresponding pyridinium salts **3a$_{1-6}$** were obtained after solvent evaporation, extracted with CH_2Cl_2 and separated by TLC (see the Experimental Part). The presence of the pyridinium structure in the crude reaction mixture was confirmed by their NMR and IR spectra.

Similar cases are described in microdispersion systems or in phenomena occuring at the interphase.

For the second case, because tyrosine has a good solubility in ethanol, the addition of SLS was not necessary. Corresponding pyridinium salts **3b$_{1-4}$** were obtained following the classical procedure.

After TLC separation, the purity for all new compounds was confirmed by ^{1}H, ^{13}C-NMR, IR spectra and elemental analysis (see the Experimental part).

The ^{1}H and ^{13}C-NMR chemical shifts of **3** were in agreement with the previously reported NMR data.[1,27-29] The chemical shift assignments in the one dimensional ^{1}H- and ^{13}C-NMR spectra were confirmed by 2D experiments (COSY, HMQC and HMBC).

Practically all individual signals could be resolved in the ^{13}C-NMR spectra.

Table 4 (**3a**) and Table 5 (**3b**) presented the ^{1}H and ^{13}C-NMR chemical shifts for these new compounds.

Table 4

Selected signal assignments for ^{1}H- and ^{13}C - NMR spectra of compounds **3a$_{1-4}$**

Cpd.	^{1}H and ^{13}C chemical shifts δ(ppm) in $CDCl_3$.																
	Aromatic ring					Aliphatic substituents											
	2C	3C	4C	5C	6C	$4CH_3$	$6CH_3$	$3CH_3$	$1'CH_2$	$2'CH_2$	$3'CH_2$	(n'-2) CH_2*	(n'-1) CH_2	n' CH_3	1"CH	n" CH_3	COOH
3a$_1$	-/ 156.58	7.50/ 129.91	-/ 157.99	7.71/ 131.19	-/ 156.88	2.50/ 22.29	2.78/ 21.60	-/-	3.64/ 35.35	1.62/ 32.95	1.54/ 27.05	-/ 34.41	-/ 22.86	0.88/ 14.28	4.11 63.14	1.26/ 19.54	11.01/ 176.92
3a$_2$	-/ 156.14	7.55/ 128.95	-/ 156.65	-/-	-/-	2.33/ 22.16	-/-	-/-	3.63/ 34.45	1.65/ 32.81	1.54/ 27.01	-/ 33.87	-/ 22.71	0.88/ 14.12	4.06/ 63.13	1.24/ 19.32	11.04/ 174.09
3a$_3$	-/ 156.08	7.53/ 128.91	-/ 156.55	-/-	-/-	2.36/ 22.12	-/-	-/-	3.62/ 34.43	1.63/ 32.80	1.55/ 26.97	-/ 33.83	-/ 22.66	0.88/ 14.13	4.07/ 63.09	1.25/ 19.30	11.04/ 174.02
3a$_4$	-/ 156.07	7.54/ 128.91	-/ 156.58	-/-	-/-	2.34/ 22.11	-/-	-/-	3.62/ 34.43	1.63/ 32.80	1.55/ 26.97	-/ 33.81	-/ 22.69	0.88/ 14.12	4.10 63.10	1.25/ 19.31	11.04/ 174.02
3a$_5$	-/ 156.23	7.54/ 128.90	-/ 157.88	-/ 130.97	-/ 157.67	2.35/ 22.13	-/-	2.28/ 15.35	2: 3.52 / 33.51 6: 3.41 / 33.86	1.63/ 32.80	1.56/ 27.59	-/ 34.02	-/ 22.70	0.88/ 14.12	4.12/ 63.02	1.25/ 19.76	11.04/ 174.02
3a$_6$	-/ 156.19	7.54/ 128.87	-/ 157.86	-/ 130.92	-/ 157.61	2.35/ 22.11	-/-	2.26/ 15.40	2: 3.52 / 33.49 6: 3.41 / 33.84	1.63/ 32.80	1.58/ 27.61	-/ 34.43	-/ 22.72	0.88/ 14.13	4.13/ 63.09	1.26/ 19.75	11.01/ 174.09

Table 5

Selected signal assignments for ^{1}H- and ^{13}C - NMR spectra of compounds **3b$_{1-4}$**

Cpd.	**^{1}H- and ^{13}C - NMR chemical shifts as δ (ppm) for the aromatic rings in $CDCl_3$.**								
	2C	3C	4C	5C	6C	1''C	o-CH	m-CH	pC
3b$_1$	-/ 156.17	7.76/ 128.86	-/ 159.15	7.55/ 125.64	-/ 158.93	-/ 130.96	7.28/ 122.69	7.53/ 124.03	-/ 155.28
3b$_2$	-/ 159.05	-/-	-/ 159.65	7.59/ 125.93	-/-	-/ 130.98	7.31/ 123.75	7.47/ 126.98	-/ 155.70
3b$_3$	-/ 158.97	-/-	-/ 159.77	7.61/ 126.12	-/-	-/ 131.05	7.33/ 123.89	7.49/ 127.05	-/ 156.11
3b$_4$	-/ 158.96	-/-	-/ 159.79	7.60/ 126.23	-/-	-/ 131.16	7.35/ 123.90	7.49/ 127.08	-/ 156.23

Cpd.	**^{1}H- and ^{13}C - NMR chemical shifts as δ (ppm) for the α-alkyl chains in $CDCl_3$.**										
	$4CH_3$	$6CH_3$	$1'CH_2$	$2'CH_2$	$3'CH_2$	$(n'-2)CH_2$	$(n'-1)CH_2$	$n'\ CH_3$	1''CH	$1''CH_2$	COOH
3b$_1$	2.69/ 21.86	2.88/ 21.41	3.19/ 34.81	1.82/ 33.86	1.64/ 32.77	-/ 34.55	-/ 22.44	0.88/ 14.11	4.32 64.47	3.16/ 43.86	9.76/ 180.83
3b$_2$	2.31/ 22.44	-/-	3.09/ 33.78	1.89/ 30.61	1.59/ 29.94	-/ 32.92	-/ 23.29	0.88/ 14.12	4.31/ 63.71	3.05/ 43.52	9.78/ 178.96
3b$_3$	2.35/ 22.49	-/-	3.09/ 33.79	1.90/ 30.62	1.61/ 29.98	-/ 32.97	-/ 23.33	0.88/ 14.12	4.30 62.89	3.04/ 43.21	9.79/ 179.02
3b$_4$	2.34/ 22.50	-/-	3.09/ 33.78	1.91/ 30.63	1.61/ 29.98	-/ 32.99	-/ 23.34	0.88/ 14.12	4.30/ 62.87	3.76/ 43.19	9.81/ 179.09

EXPERIMENTAL PART

The NMR spectra have been recorded on BRUKER AVANCE DRX 400 AVANCE III 400 instruments, equipped with a 5 mm inverse detection multinuclear probehead and field gradients on the z axis, operating at 400.13 MHz for ^{1}H and at 100.61 MHz for ^{13}C nuclei. The COSY45, HMQC and HMBC spectra have been recorded with standard Bruker parameters in the versions employing pulsed field gradients. All spectra have been recorded in deuterated chloroform, and the chemical shifts have been reported as δ values referenced to TMS as an internal standard. Infrared spectra were recorded on a BRUKER VERTEX 70 instrument equipped with a Golden Gate diamond ATR. Melting points were measured in open capillary tubes (for the low melting compounds) or on a hot-stage melting points apparatus (equipped with a polarizer to check for nematic properties).

Synthesis of N-carboxypyridinium salts

*Reaction of pyrylium salts **1**$_{1-6}$ with DL-alanine **2a***

The perchlorate salts **1**$_{1-6}$ (0.1-0.2 mmoles) and DL-alanine (0.3-0.6 mmoles) were suspended in a water ethanolic solution (EtOH:H_2O=3:1) contain 0.005% SLS (grav. ratio). The mixture was heated at gentle reflux for 12 hours when the colour of the opalescent dispersion turned to dark orange or cognac. After cooling three (**3a**$_1$) or two (**3a**$_{2-6}$) layers were obtained. The reaction mixture was evaporated to dryness or concentrated in vacuum. The residue was dissolved in 100 ml CH_2Cl_2 and extracted with 400 mL water (threefold, at 25^{o}C). The aqueous solution contains the surfactant and the unreacted alanine. The organic layer was dried ($MgSO_4$) and concentrated. The pyridinium salts were separated by thin layer chromatography (silica gel Merck type 60G, solvents ethyl acetate: methanol = 8:3).

These compounds **3a**$_{1-6}$ are waxy oils which crystallized in the refrigerator and have m.p. under 50^{o}C (**3a**$_1$: 47-48^{o}C, **3a**$_2$: 38-39^{o}C and under 30 ^{o}C for **3a**$_{3-6}$). The yields in **3a**$_{1-6}$ are presented in Table 3.

Elemental analyses for compounds **3a**$_{1-6}$:
3a$_1$ $C_{21}H_{36}NClO_6$ Calcd: N 3.23; Found N 3.24;
3a$_2$ $C_{31}H_{56}NClO_6$ Calcd: N 2.44; Found N 2.43;
3a$_3$ $C_{39}H_{72}NClO_6$ Calcd: N 2.04; Found N 2.07;
3a$_4$ $C_{43}H_{80}NClO_6$ Calcd: N 1.89; Found N 1.92;
3a$_5$ **C32H58NClO$_6$**..Calcd: N 2.38; Found N 2.40;
3a$_6$ $C_{40}H_{74}NClO_6$ Calcd: N 2.00; Found N 1.94.

*Reaction of pyrylium salts **1**$_{1-6}$ with DL-tyrosine **2b***

To the solution of pyrylium salts **1**$_{1-4}$ in ethanol an excess of tyrosine was added (1:5-1:10 molar ratio). The mixture was heated at gentle reflux for 6 hours when the colour of the solution turned to cognac. After cooling, the pyridinium salts were separated by thin layer chromatography (silica gel Merck type 60G, solvents hexane : ethyl acetate : methanol = 1:6:2). These compounds **3b**$_{1-4}$ are waxy oils which crystallized in the refrigerator and have m.p. 48-49^{o}C (**3b**$_1$), 37-38^{o} C (**3b**$_2$), 33^{o} C (**3b**$_3$) and 30^{o} C (**3b**$_4$).

The yields in **3b**$_{1-4}$ are presented in Table 3.
Elemental analyses for compounds **3b**$_{1-4}$:
3b$_1$ $C_{27}H_{40}NClO_7$ Calcd: N 2.66; Found N 2.24;
3b$_2$ $C_{37}H_{60}NClO_7$ Calcd: N 2.10; Found N 2.14;
3b$_3$ $C_{45}H_{76}NClO_7$ Calcd: N 1.80; Found N 1.76;
3b$_4$ $C_{49}H_{84}NClO_7$ Calcd: N 1.68; Found N 1.70.

In Table 6, IR spectra for some representative compounds are presented. The IR spectra for **3a**$_{1-6}$, and **3b**$_{1-4}$ were in full agreement with those of the 2,4,6-tri- or 2,3, 4, 6-tetrasubstituted homologues described earlier.

The UV-Vis spectra and CMC determinations will be presented elsewhere.

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Table 6

IR spectra of **3a**$_{1,2,6}$ and **3b**$_{1,2}$

Compound	ν (cm^{-1})
3a$_1$	574.12, 622.29, 717.39, 860.99,1092.83, 1200.87, 1380.75, 1460.99, 1746.06, 2025.34, 2594.07, 2853.88, 2923.61, 3521.22
3a$_2$	581.10, 622.45, 721.87, 886.74, 1063.96, 1176.94, 1376.12, 1463.15, 1737.65, 1970.35, 2336.57, 2674.99, 2852.81, 2921.19, 3396.12
3a$_6$	622.57, 721.76, 1060.45, 1114.13, 1173.06, 1374.13, 1461.42, 1735.99, 2852.80, 2921.23, 3430.05
3b$_1$	521.37, 622.84, 721.47, 833.30, 929.04, 1059.88, 1172.93, 1207.02, 1377.50, 1455.93, 1508.87, 1539.14, 1615.01, 1639.64, 1742.82, 2853.22, 2922.67, 3124.16, 3194.46, 3392.94
3b$_2$	521.33, 622.69, 721.38, 837.41, 1078.45, 1108.43, 1173.25, 1271.82, 1377.74, 1465.07, 1517.41, 1613.89, 1634.72, 1739.63, 2852.78, 2921.76, 2954.49, 3389.97

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