Tetrahedron Letters No.55, pp.4897- 4898, 1969. Pergamon Press. Printed in Great Britain.

THE INFLUENCE OF SKELETAL GEOMETRY ON THE n → π* CD OF BRIDGED-RING LACTONES AND LACTAMS

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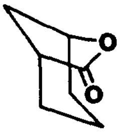
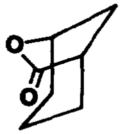
Received in the U K 17 October; accepted for publication 29 October 1969

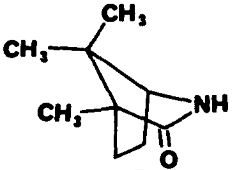
A relationship, in lactones, between the sign of the n → π* Cotton effect and the chiral sense of the lactone ring itself has been suggested recently (1-4). Four publications list the ORD (5-7) or CD (8) of thirty-nine compounds in which the lactone group bridges a six-carbon ring. Among these, through ring-fusion and through single substituents, there are fifteen different patterns of direct substitution on the bridged-ring, but the relationship indicated by I and II is found to hold *without exception*. On present evidence, therefore, the sign of the n → π* Cotton effect depends solely on the enantiomeric nature of the bridged-ring system and not at all on molecular asymmetry peripheral to this.



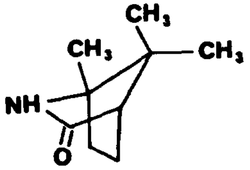
I -ve



II +ve

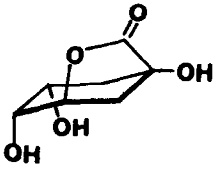


III -ve

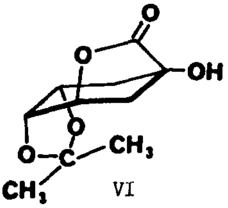


IV +ve

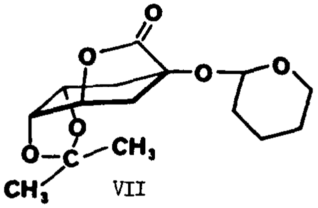
Ring geometry may be equally important in lactams (1). In the isomeric camphorolactams, III and IV, Basch et. al. (9) remarked that the quadrant rule for the sign of the amide n → π* CD (10) would predict a positive Cotton effect for III. A negative one is, in fact, observed, as in lactones of type I. Goodman et. al. (11) found that, in each of three different solvents, the CD curves from III and IV were mirror images. Since the geometric relationships between the bridgehead methyl group and the lactam chromophore are quite different in the two compounds, it is evident that the enantiomeric bridged-ring skeletons determine the sign of the CD.



V



VI



VII

The mirror image relationships of the CD curves suggest that the *degree* of dissymmetry in the $n \rightarrow \pi^*$ transition is also determined by the ring-geometry. The same conclusion was reached with respect to γ-lactones of aldonic acids (3) on the grounds of observed constancy in the dissymmetry factor (12). As shown in the Table, this factor, $|\frac{\Delta\varepsilon}{\varepsilon}|$, is also constant in quinide, V, acetonequinide, VI, and tetrahydropyranylactonequinide, VII, three bridged-ring lactones of skeletal type I. The ORD amplitudes of V and VI differ (7) by over 50%.

	In Water			In Methanol		
Compound	ε_{max}	$\Delta\varepsilon_{max}$	$\lvert\frac{\Delta\varepsilon}{\varepsilon}\rvert$	ε_{max}	$\Delta\varepsilon_{max}$	$\lvert\frac{\Delta\varepsilon}{\varepsilon}\rvert$
V	$114_{216m\mu}$	$-2.94_{217m\mu}$	0.026	$105_{220m\mu}$	$-2.93_{220m\mu}$	0.028
VI	$89_{216m\mu}$	$-2.22_{217m\mu}$	0.025	$98_{219m\mu}$	$-2.46_{220m\mu}$	0.025
VII		insoluble		$112_{221m\mu}$	$-2.76_{223m\mu}$	0.025

The transition probability, measured by ε, varies between the three compounds and also varies in the same compound with change in solvent. However, the CD varies correspondingly, so that $|\frac{\Delta\varepsilon}{\varepsilon}|$ remains constant. A constant source of dissymmetry in the transition is implied; common to all three molecules and unaffected by the differences in substitution or solvation. This can only be all or part of the common skeletal structure.

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