

precipitate was filtered off and washed with methanol. Yield: [4.5 g (49 %)]. (Found: C 12.8; H 3.2; S 8.6; P 8.4; Ba 37.9. Calc. for  $\text{CH}_3\text{CONHCH}_2\text{CH}_2\text{SPO}_3\text{Ba}\cdot 2\text{H}_2\text{O}$  (370.6): C 13.0; H 3.3; S 8.65; P 8.36; Ba 37.1).

1. Hansen, B. and Sörbo, B. *Acta Radiol.* **56** (1961) 141.
2. Åkerfeldt, S. *Acta Radiol.* **58** (1963) 465.
3. Åkerfeldt, S. *Acta Chem. Scand.* **17** (1963) 329.
4. Åkerfeldt, S. *Acta Chem. Scand.* **16** (1962) 1897.
5. Åkerfeldt, S. *Acta Chem. Scand.* **13** (1959) 1479.

Received January 30, 1965.

## The Identity of Cyanein and Brefeldin A

V. BETINA,<sup>a</sup> P. NEMEC<sup>a</sup> and Š. KOVÁČ<sup>b</sup>

<sup>a</sup> Department of Technical Microbiology and Biochemistry and

<sup>b</sup> Department of Organic Chemistry, Faculty of Chemistry, Slovak Technical University, Bratislava, Czechoslovakia

A. KJÆR and R. H. SHAPIRO\*

Department of Organic Chemistry, Royal Veterinary and Agricultural College, Copenhagen, Denmark

Cyanein is a crystalline antibiotic isolated from *Penicillium cyaneum*<sup>1</sup> and possessing antifungal,<sup>1,2</sup> anti-HeLa cell,<sup>3</sup> and anti-nematodal<sup>4</sup> activity. It also inhibits the growth of the root tips of *Allium cepa*<sup>5</sup> and depresses the mitotic activity in the root tips of *Vicia faba*.<sup>6</sup>

Cyanein possesses the composition  $\text{C}_{16}\text{H}_{24}\text{O}_4$  (mol.wt. by mass spectrometry: 280) and its oxygen atoms were accounted

for by the presence of a lactone grouping and two secondary alcohol functions, which were readily acetylated to give a crystalline diacetate. On catalytic hydrogenation (Pd/C) cyanein afforded a crystalline tetrahydro-derivative. The NMR-spectrum (in  $(\text{CD}_3)_2\text{SO}$ ) revealed the presence in cyanein of the grouping  $\text{CH}_2\text{CH}(\text{O}-)$ , the system  $-\text{CH}=\text{CH}-\text{CO}-\text{O}$ , as well as an isolated double bond.

At this point of the structure work, Sigg<sup>7</sup> published the structure of brefeldin A, an antibiotic produced by *Penicillium brefeldianum*,<sup>8</sup> and identical with decumbin,<sup>9</sup> previously isolated from *Penicillium decumbens* and preliminarily characterized as 'toxic to rats and to goldfish, and inhibitory to wheat germination, but not an active antibiotic under the tested conditions.'<sup>10</sup>

On critical comparison of the published data<sup>7</sup> for brefeldin A, its diacetate, tetrahydro-derivative, and the diacetate of the latter, with those of the corresponding cyanein-derivatives, we can now conclude that cyanein is, in fact, identical with brefeldin A.

1. Betina, V., Nemeč, P., Dobias, J. and Baráth, Z. *Folia Microbiol.* **7** (1962) 353.
2. Betina, V., Drobnica, Ľ., Nemeč, P. and Zemanová, M. *J. Antibiotics (Japan) Ser. A* **17** (1964) 93.
3. Betina, V., Horáková, K. and Baráth, Z. *Naturwiss.* **49** (1962) 241.
4. Bačíková, D., Betina, V. and Nemeč, P. *Naturwiss.* **51** (1964) 445.
5. Betina, V. and Nemeč, P. *Naturwiss.* **50** (1963) 696.
6. Betina, V. and Murín, A. *Cytologia (Tokyo)*. In press.
7. Sigg, H. P. *Helv. Chim. Acta* **47** (1964) 1401.
8. Härrri, E., Loeffler, W., Sigg, H. P., Stähelin, H. and Tamm, C. *Helv. Chim. Acta* **46** (1963) 1235.
9. Singleton, V. L. and Bohonos, N. *Agr. Biol. Chem.* **28** (1964) 77.
10. Singleton, V. L., Bohonos, N. and Ullstrup, A. J. *Nature* **181** (1958) 1072.

\* Postdoctoral National Science Foundation Fellow, 1964-5.

Received January 29, 1965.