Table II—Antimicrobial Activity [a]

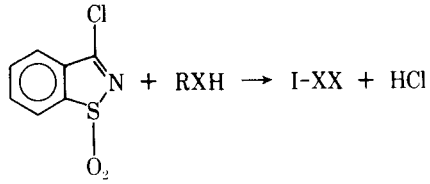
Compound	*S. aureus*	*S. typhosa*	*A. niger*
I	T	T	T
II	T	T	T
III	T	T	T
IV	T	T	T
V	T	T	T
VI	100T	T	100T
VII	100T	10T	100T
VIII	M	T	T
IX	M	10	T[b]
X	100T	T	10T
XI	+[b]	+	+[b]
XII	+	+	T
XIII	100T	+[b]	+[b]
XIV	M	T[b]	10T
XV	10T[c]	+	10T[c]
XVI	100T[c]	+	10T[c]
XVII	T[b]	T	T
XVIII	10T	T	T
XIX	M	M	M
XX	M	10T	100T

[a] The + represents growth at a dilution of 1×10^3; T, 10T, 100T, and M represent no growth at dilutions of 1×10^3, 1×10^4, 1×10^5, and 1×10^6, respectively. [b] The alcohol or thiol precursor showed equivalent response at one-hundredth the concentration. [c] The thiol precursur showed equivalent response at a 100-fold higher concentration.

mole of an alcohol or thiol, and 100 ml of toluene was stirred at reflux for 1–2 hr (Scheme I). The mixture was filtered free of by-product triethylamine hydrochloride, and the solvent was evaporated from the filtrate. The residue was recrystallized from the solvent indicated in Table I. The absence of carbonyl absorptions in the IR spectra confirmed that the compounds were not the *N*-substituted saccharin derivatives (6).

Antimicrobial Test Procedure—The derivatives were screened against *S. aureus* (ATCC 6538), *S. typhosa* (ATCC 6539), and *A. niger* (SN 111).

Stock solutions were prepared by dissolving 100 mg of the test compound in 10 ml of acetone, alcohol, or other solvent. The stock solutions



Scheme I

were diluted serially by pipetting 2 ml of the stock solutions into 18 ml of sterile agar to obtain a 1×10^3 dilution and continuing in the same manner for dilutions up to 1×10^6.

The agar was poured into petri dishes, allowed to harden, and spot inoculated with 1 drop of a cell suspension of the appropriate organism, prepared by suspending the growth from an agar slant culture in 10 ml of distilled water. The bacteria were incubated for 48 hr, and the *A. niger* was incubated for 5 days before examination for growth. The results reported are the minimum concentrations of the test compound that completely inhibited organism growth.

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Constituents of *Spartina cynosuroides:* Isolation and ^{13}C-NMR Analysis of Tricin

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Received October 25, 1977, from the *Department of Chemistry, Mississippi State University, Mississippi State, MS 39762.* Accepted for publication January 4, 1978.

Abstract □ Tricin was isolated from the aerial parts of the marsh plant *Spartina cynosuroides*, which yielded a fraction enriched in antileukemic activity. The ^{13}C-NMR spectrum of tricin is discussed.

Keyphrases □ Tricin—isolated from *Spartina cynosuroides* aerial parts, ^{13}C-NMR spectral analysis □ *Spartina cynosuroides*—tricin isolated from aerial parts, ^{13}C-NMR spectral analysis

The giant cordgrass, *Spartina cynosuroides*[1] (Graminae), is the second most abundant plant in the salt marshes of Southern and Southeastern United States. A preliminary study (1) involved the primary production and decomposition of *S. cynosuroides* and the food value of this plant to marsh and estuarine organisms. The analysis of the volatile constituents of this plant was reported (2). Apart from a superficial study (3), no report of a detailed chemical investigation of the organic constituents of *S. cynosuroides* has appeared.

DISCUSSION

The 95% ethanolic extract of the aerial parts of *S. cynosuroides* showed high activity[2] against P-388 lymphocytic leukemia in BDF_1 mice. The activity[3] was considerably enriched in the chloroform extract at pH 4 of the acid-soluble part of the crude ethanolic extract. Column chromatography of the active extract yielded a yellow compound (M^+ 330), mp 288–290° dec., which gave a triacetate derivative, mp 254–256°, and was

[1] The plant material was identified by Dr. Sidney McDaniel, Department of Botany, Mississippi State University, Mississippi State, Miss. A voucher (preserved) specimen (SM-181) is available for inspection at the Herbarium of the Department of Botany, Mississippi State University.

[2] Percent T/C 146 at a dose level of 400 mg/kg against the National Cancer Institute murine P-388 lymphocytic leukemia system.

[3] Percent T/C 172 at a dose level of 400 mg/kg.

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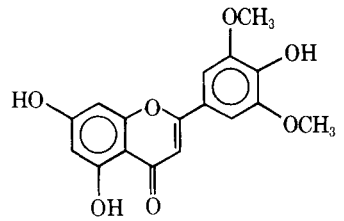

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identical by mixed melting-point, IR, UV, and NMR comparisons with an authentic[4] sample of tricin (I) (4, 5).

The ^{13}C-NMR spectrum of tricin was taken in dimethyl sulfoxide-d_6 with tetramethylsilane as the internal standard, and the chemical shifts corresponding to the various carbon atoms in the molecule are given in Table I. The chemical shifts were assigned by comparison with the data published (6) for other flavonoid compounds. The shift for C-7 and C-2 can be interchanged. The relative lowfield shifts of C-10 and C-1′ carbons are probably due to the deshielding effect caused by the interaction of the solvent molecules dimethyl sulfoxide-d_6 with the hydroxyl functions *ortho* and *para* to C-10 and C-1′, respectively.

Table I—^{13}C-NMR Chemical Shift Assignments for Tricin

Carbon	Chemical Shift, ppm	Carbon	Chemical Shift, ppm
2	164.0	9	161.3
3	103.6	10	120.8
4	181.6	1′	139.7
5	157.2	2′, 6′	104.3
6	98.7	3′, 5′	148.0
7	163.5	4′	164.0
8	94.1	OCH_3	56.3

EXPERIMENTAL

Air-dried and ground tops of *S. cynosuroides* (10.0 kg) were extracted with 95% ethanol for 24 hr, and the extract was concentrated *in vacuo*. The gummy residue (Fraction A) was treated with 5% acetic acid (2000 ml) and stirred thoroughly. The acidic solution was then filtered through a bed of diatomaceous earth[5], and the filtrate was cooled in ice. Basification of the filtrate with ammonium hydroxide to pH 4 gave a precipitate, which was thoroughly extracted with chloroform. The organic layer was then washed free from acid, dried over anhydrous sodium sulfate, and distilled *in vacuo* to give a dark residue (Fraction B, 15 g).

Tricin—Fraction B was dissolved in chloroform (100 ml) with a few drops of methanol and then chromatographed in a column (50 × 2.5 cm) of silica gel G. Fractions of 500 ml each were eluted successively with chloroform (10 liters) and chloroform–ethanol (99:1, 10 liters). Fractions eluted with chloroform–ethanol (99:1, 5 liters), upon evaporation, gave a yellowish-brown residue (0.5 g). This residue was crystallized several times from chloroform–methanol to give a yellow powder, mp 288–290° dec.

Tricin Triacetate—Tricin (0.066 g, 1.02 mmoles) was treated with acetic anhydride (1 ml) and dry pyridine (1 ml) for 16 hr at room temperature. After the usual workup, the residue was crystallized from ethyl acetate as white needles (0.045 g), mp 263–265° dec.

[4] Kindly supplied by Dr. J. B. Harborne, Department of Botany, University of Reading, Reading, England.

[5] Celite.

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Sex Differences in Plasma Half-Life of Dextrorphan in Rats Administered Dextromethorphan

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Received April 1, 1977, from the *Consumer Products Group, Warner-Lambert Company, Morris Plains, NJ 07950.* Accepted for publication December 15, 1977.

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Abstract □ Male and female rats exhibited striking differences in their ability to metabolize dextromethorphan. Upon oral administration of this drug, the plasma half-life of dextrorphan, a major biotransformation product formed by *O*-demethylation, was 40 min in the female rat and 18.5 min in the male.

Keyphrases □ Dextromethorphan—metabolism in male and female rats compared □ Dextrorphan—plasma half-life in male and female rats compared □ Metabolism—dextromethorphan in male and female rats compared □ Antitussives—dextromethorphan, metabolism in male and female rats compared

Investigations in these laboratories on the bioavailability of dextromethorphan hydrobromide, a nonnarcotic antitussive agent, revealed striking differences between male and female rats in their metabolism rates. Upon oral administration, it is rapidly metabolized, the main routes of biotransformation being *O*- and *N*-demethylation, followed by conjugation of the desmethyl metabolites to glucuronides and sulfates (1–5).

Determination of the plasma levels of dextrorphan (*d*-3-hydroxy-*N*-methylmorphinan), the *O*-demethylated metabolite, previously (6) was employed to evaluate the bioavailability of dextromethorphan hydrobromide in

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